energy networks association

DECEMBER 2015

STOCKTAKE DATABASE **RESULTS**

ARENA

NOTES

STOCKTAKE FORMAT

This document is only an interim format for distributing the stocktake results. ARENA's ultimate aim is to have the stocktake results delivered in the form of an online portal that will allow easy searching, filtering and exploring

ASSESSMENTS OF RELEVANCE

The projects in the stocktake were included on the basis that they address or inform one or more objectives that relates to integrating renewable energy into Australian distribution networks. In this stocktake, we have assessed the degree to which each project addresses or informs each of these objectives.

The purpose of these assessments is to let users find the projects in the stocktake most relevant to them. The assessments that each project receives are not intended to judge whether the project was successfully executed or not.

NAVIGATING THE STOCKTAKE

To find a particular project by name	» Turn to the section *Projects by Title* » This alphabetically lists all the projects in the stocktake » Turn to a projects page number to find out more about that project.
To find a list of projects that match a particular objective, or **took a particular approach, or found a particular result.**	» Turn to the sections *Projects by Objective, Projects by Approach, or Projects by Result* » These alphabetically list all the projects in the stocktake, organised under headings corresponding to each Objective, Approach and Result. » Turn to a projects page number to find out more about that project.
To start browsing through the projects in the stocktake	» Turn to the section Catalog of Projects

CONTENTS

Projects: By Title

Projects: by Objective

ID	Title	Organisation	Ass	Page
1.	**Measure or quantify the benefits and costs of renewable energy**			
249	ACT District Energy	AECOM	Low	95
360	ACT large-scale wind feed-in tariff auction II	ACT Government, Environment and Planning Directorate	None	99
358	Australian Renewable Energy Mapping Infrastructure (AREMI)	Data61 (previously NICTA)	Med	132
319	BESOS Project	ETRA I+D	High	144
47	Breaking the solar gridlock	The Australian Solar Thermal Energy Association (AUSTELA)	Med	148
302	CBD Embedded Generation Project	Ausgrid	Low	161
155	Central Victoria Solar City Solar Park	Origin	High	166
260	Characterising the effect of high penetration solar intermittency on Australian electricity networks	CSIRO	Low	169
315	Distribution Transformer Low Voltage Circuit Monitoring	Energex	Med	207
299	Effect of Small Solar PV System on Peak Demand	Ausgrid	Med	225
287	E-harbours Project	Municipality of Zaanstad	Med	230
289	EPIC-HUB (Energy Positive Neighbourhoods Infrastructure Middleware based on Energy-Hub Concept)	D'Appolonia SpA	Med	243
244	Expanding the Value Proposition for Building Integrated Photovoltaics (BIPV): Thin Film Building Integrated Photovoltaic Thermal (BIPVT) Retrofitting of Buildings	BlueScope Steel Limited	Med	260
361	Facilitating Local Network Charges and Virtual Net Metering (VNM)	Institute for Sustainable Futures (ISF)	Med	263
253	FPDI: Analysis of Demand-Side Management Opportunities	Clean Energy Council	Med	272
255	FPDI: Value of Small Scale Embedded Generation and Storage	Clean Energy Council	High	284
245	Future Grid Forum	CSIRO	High	289
349	Gansu Dunhuang Photovoltaic Grid-Connected Power Generation Project	CGNPC Group	Med	294
215	Hampton Wind Farm	Ecoult	Low	308
352	Hervey Bay Hospital Solar	Queensland Health	Med	311
264	Hybrid concentrating solar thermal systems for large scale applications	CSIRO	High	321

ID	Title	Organisation	Ass	Page
259	Impact of Increasing Harmonic Levels on Distribution System Equipment	University of New South Wales	Low	330
113	Impacts of PV, AC, and Other Technologies and Tariffs on Consumer Costs	Australian PV Institute (APVI)	Med	333
261	Improving translation models for predicting the energy yield of photovoltaic power systems	CSIRO	Med	342
187	Integrating Renewable Energy - Wind Integration Studies Report	AEMO	Low	349
196	King Island Renewable Energy Integration Project (KIREIP)	Hydro Tasmania	High	367
213	Large Scale (e.g. Pumped Hydro) Energy Storage	University of Melbourne Energy Institute	Med	379
129	Least-cost carbon abatement modelling	The University of Melbourne University of New South Wales, Australian Energy Market Operator, Bureau of Meteorology, GE, Market Reform	High	382
280	Leonards Hill Wind Farm	Hepburn Community Owned	Med	385
243	Low cost building-integrated photovoltaics (BIPV) for Australian residential and commercial/industrial rooftop power generation	BlueScope Steel Limited	High	388
263	Machine learning based forecasting of distributed solar energy production	The Australian National University and NICTA	Med	398
362	Mapping Potential Network Opportunities for Renewable Energy and Demand Management	Institute for Sustainable Futures	Med	407
305	Modelling the impact of various tariff structures on distributed energy resource take-up and electricity pricing	SA Power Networks	High	421
195	Network Capacity Value Functions for Integrated Planning of Distributed Demand Side Resources	Monash University: Ross Gawler, adjunct Senior Research Fellow is pursuing this project on his own initiative and his own expense. Monash University is providing research facilities and will monitor progress	Med	427
281	Network solar policy	Citipower and Powercor	Low	431
364	Network Transformation Roadmap	Energy Networks Association	Med	434
268	Off-river pumped hydro Electricity storage	Australian National University	Low	439
324	Opower's Data Presentment Project	Opower	Med	441

ID	Title	Organisation	Ass	Page
252	Optimal deployment of renewable resources in a distribution network	Monash University	Med	444
169	Orkney Island Smart Grid	Scottish & Southern Energy Power Distribution (SSEPD)	High	448
350	Pacific Northwest Smart Grid Demonstration Project	Battelle	Med	451
265	Planning Future Energy Grids: Renewables	Queensland University of Technology	Med	463
127	Plug and Play Solar: Simplifying the Integration of Solar Energy in Hybrid Application	CSIRO	Med	466
216	PNM Prosperity	PNM New Mexico	Low	469
250	Recovery of Resources from Biomass and Residual Waste	ACT Government, Environment and Sustainable Development Directorate	Low	480
130	Redeploy able Hybrid Power	Laing O'Rourke	Med	482
278	Renewable Islands: Setting for Success	International Renewable	Low	494
355	Residential Storage Trial Australia	CitiPower and Powercor	Med	499
241	Residential Battery Storage Trial	SP AusNet	Med	502
300	SGSC: Newington Grid Battery Trial	Ausgrid	Med	524
186	SGSC: Smart Grid, Smart City Project (Overall)	Ausgrid	High	527
328	Smart City Búzios	Ampla Energia e Serviços	Med	536
321	Smart Grid and Electric Vehicle Integration Project	SGCC	Med	546
178	Smart Melit	Toyota City	Med	553
132	Solar Energy Management System (SEM) for Utilities	Ergon Energy ,GWA Group	Med	561
307	The Future Grid Research Program	The University of Sydney	High	590
188	The Impact of distributed solar generation on the wholesale electricity market	Melbourne Energy Institute (University of Melbourne)	High	593
194	The impact of the mass adoption of electric vehicles on the Australian electricity grid.	The University of Melbourne	Low	599
308	The National Feeder Taxonomy Study	CSIRO and Ausgrid	Med	609
56	Unlocking the grid: the future of the electricity distribution network	Barbara Hardy Institute - University of South Australia	Med	620
296	Virtual Power Plant	United Energy	Med	627

ID	Title	Organisation	Ass	Page
269	Virtual Power Station	CSIRO	Low	629
242	Volt VAR Strategy	CitiPower and Powercor	Med	632
217	Weipa Solar Farm	Weipa Solar Farm Pty Ltd	Med	634
276	Zhangbei National Energy Storage and Transmission Demonstration Project (China)	State Grid of China (SGCC)	Med	644

2 Support the transition to an alternative electricity pricing approach

ID	Title	Organisation	Ass	Page
116	A Distributed Energy Market: Consumer & Utility Interest, and the Regulatory Requirements	Australian PV Institute (APVI)	Med	86
360	ACT large-scale wind feed-in tariff auction II	ACT Government, Environment and Planning Directorate	Low	99
219	ADDRESS French Pilot	EDF SA	Low	101
139	Adelaide Solar City	Origin	Med	104
140	Alice Solar City	Alice Springs Town Council (ASTC)	Med	116
285	BDR Project	Opower	Med	138
319	BESOS Project	ETRA I+D	Med	144
170	Customer-Led Network Revolution	Northern Powergrid	Med	187
227	ECOGRID EU	Energinet.dk	Low	216
287	E-harbours Project	Municipality of Zaanstad	Med	230
363	Embedded Generation Project	Energy Networks Association	Med	235
289	EPIC-HUB (Energy Positive Neighbourhoods Infrastructure Middleware based on Energy-Hub Concept)	D'Appolonia SpA	Low	243
325	eTelligence Project	EWE AG	Med	252
361	Facilitating Local Network Charges and Virtual Net Metering (VNM)	Institute for Sustainable Futures (ISF)	Med	263
245	Future Grid Forum	CSIRO	Med	289
113	Impacts of PV, AC, and Other Technologies and Tariffs on Consumer Costs	Australian PV Institute (APVI)	Med	333
326	Keihanna Eco City Project	Keihanna City	Low	364
362	Mapping Potential Network Opportunities for Renewable Energy and Demand Management	Institute for Sustainable Futures	Low	407
305	Modelling the impact of various tariff structures on distributed energy resource take-up and electricity pricing	SA Power Networks	High	421

ID	Title	Organisation	Ass	Page
195	Network Capacity Value Functions for Integrated Planning of	Monash University: Ross Gawler, adjunct Senior Distributed Demand Side Resources Research Fellow is pursuing this project on his own initiative and his own expense. Monash University is providing research facilities and will monitor progress.	Med	427
364	Network Transformation Roadmap	Energy Networks Association	High	434
324	Opower's Data Presentment Project	Opower	Med	441
350	Pacific Northwest Smart Grid Demonstration Project	Battelle	Med	451
143	Perth Solar City	Western Power	Med	455
316	PRIME PLC Evaluation	Energex	Med	474
130	Redeploy able Hybrid Power	Laing O'Rourke	Low	482
174	Reforming the Energy Vision (REV)	New York Department of Public Service (NYDPS)	Med	485
355	Residential Storage Trial Australia	CitiPower and Powercor	Low	499
154	Reward Based Tariffs Trial	Ergon Energy and Energex	Med	514
186	SGSC: Smart Grid, Smart City Project (Overall)	Ausgrid	Med	527
328	Smart City Búzios	Ampla Energia e Serviços	Med	536
178	Smart Melit	Toyota City	Med	553
172	SoLa Bristol	Western Power Distribution	Med	558
225	Stockholm Royal Seaport Project	Stockholm Municipality	Low	568
303	Survey of likely take-up of a voluntary residential capacity based tariff	SA Power Networks	Med	573
306	Talking Power customer engagement process	SA Power Networks	Low	580
188	The Impact of distributed solar generation on the wholesale electricity market	Melbourne Energy Institute (University of Melbourne)	Low	593
145	Townsville Solar City	Ergon Energy	Med	617
176	Yokohama Smart City HEMS Project	Yokohama city	Low	639

3. Create new business models to cater to the shift to a network with high levels of distributed energy resources

116	A Distributed Energy Market: Consumer & Utility Interest, and the Regulatory Requirements	Australian PV Institute (APVI)	Med	86

ID	Title	Organisation	Ass	Page
251	ACT Community Solar Scheme	Environment and Sustainable Development Directorate	Med	93
249	ACT District Energy	AECOM	Low	95
257	ACT Large-scale Solar Feed-in Tariff Auction	Environment and Sustainable Development Directorate	Low	97
360	ACT large-scale wind feed-in tariff auction II	ACT Government, Environment and Planning Directorate	Low	99
247	Agua Caliente Solar Project	First Solar Inc.	High	113
285	BDR Project	Opower	Med	138
319	BESOS Project	ETRA I+D	Med	144
290	Business Model Implementation Project	Ergon Energy	Med	153
155	Central Victoria Solar City Solar Park	Origin	Med	166
286	CIVIS Project	University of Trento	Med	176
313	Commercial & Industrial Demand Management (DM)	Energex	Med	181
170	Customer-Led Network Revolution	Northern Powergrid	High	187
356	Demand Management Storage Project (DMSP)	CitiPower & Powercor Australia	Low	193
164	DERINT - Large scale virtual power plant integration	DONG Energy	High	199
315	Distribution Transformer Low Voltage Circuit Monitoring	Energex	Low	207
227	ECOGRID EU	Energinet.dk	Low	216
220	E-DeMa Project	RWE Deutschland AGE	Low	220
287	E-harbours Project	Municipality of Zaanstad	Med	230
363	Embedded Generation Project	Energy Networks Association	Low	235
289	EPIC-HUB (Energy Positive Neighbourhoods Infrastructure Middleware based on Energy-Hub Concept)	D'Appolonia SpA	Med	243
214	EPM FOA Frequency Regulation	Ecoult/East Penn Manufacturing	Med 246	
168	eStorage Project	Alstom	Med	249
325	eTelligence Project	EWE AG	Med	252
361	Facilitating Local Network Charges and Virtual Net Metering (VNM)	Institute for Sustainable Futures (ISF)	Low	263
245	Future Grid Forum	CSIRO	High	289
274	Golden Sun Demonstration Project	Ministry of Science and Technology (MOST)	Low	296

ID	Title	Organisation	Ass	Page
246	Greenough River Solar Farm	Greenough River Solar Farm (joint venture between Synergy and GE Energy Financial Services)	High	298
215	Hampton Wind Farm	Ecoult	Low	308
352	Hervey Bay Hospital Solar	Queensland Health	Med	311
222	IGREENGrid PRICE Project	Iberdrola and Gas Natural Fenosa	Med	326
175	Jeju Island Smart Renewable project	KEPKO, HYUNDAI Heavy industries, POSCO	Low	356
326	Keihanna Eco City Project	Keihanna City	Low	364
196	King Island Renewable Energy Integration Project (KIREIP)	Hydro Tasmania	High	367
323	Kitakyushu Smart Community Project	Kitakyushu City	Med	372
280	Leonards Hill Wind Farm	Hepburn Community Owned	Med	385
243	Low cost building-integrated photovoltaics (BIPV) for Australian residential and commercial/industrial rooftop power generation	BlueScope Steel Limited	High	388
263	Machine learning based forecasting of distributed solar energy production	The Australian National University and NICTA	Med	398
353	Mackay Sugar Cogeneration Plant	Mackay Sugar Ltd	High	401
362	Mapping Potential Network Opportunities for Renewable Energy and Demand Management	Institute for Sustainable Futures	Low	407
165	MeRegio (Minimum Emission Region)	ENBW	Low	413
305	Modelling the impact of various tariff structures on distributed energy resource take-up and electricity pricing	SA Power Networks	Low	421
195	Network Capacity Value Functions for Integrated Planning of	Monash University: Ross Gawler, adjunct Senior Demand Side Resources Research Fellow is pursuing this project on his own initiative and his own expense. Monash University is providing research facilities and will monitor progress.	Med	427
281	Network solar policy	Citipower and Powercor	Low	431
364	Network Transformation Roadmap	Energy Networks Association	High	434
169	Orkney Island Smart Grid	Scottish & Southern Energy Power Distribution (SSEPD)	High	448
350	Pacific Northwest Smart Grid Demonstration Project	Battelle	Med	451

ID	Title	Organisation	Ass	Page
265	Planning Future Energy Grids: Renewables	Queensland University of Technology	Med	463
316	PRIME PLC Evaluation	Energex	High	474
130	Redeploy able Hybrid Power	Laing O'Rourke	High	482
278	Renewable Islands: Setting for Success	International Renewable Energy Agency (IRENA)	Low	494
355	Residential Storage Trial Australia	CitiPower and Powercor	Low	499
317	Residential Demand Management	Energex	Med	509
186	SGSC: Smart Grid, Smart City Project (Overall)	Ausgrid	Low	527
328	Smart City Búzios	Ampla Energia e Serviços	Med	536
180	Smart Grid Gotland	Vattenfall	High	549
225	Stockholm Royal Seaport Project	Stockholm Municipality	Med	568
303	Survey of likely take-up of a voluntary residential capacity based tariff	SA Power Networks	Med	573
226	T-City Project	Deutsche Telekom (T-Systems)	Low	583
307	The Future Grid Research Program	The University of Sydney	Med	590
229	The Integrated Grid Project	The Electric Power Research Institute	Low	603
296	Virtual Power Plant	United Energy	Med	627
269	Virtual Power Station	CSIRO	Med	629
37	What Happens When We Un-Plug: Exploring the Consumer and Market Implications of Viable Off-Grid Energy Supply	Energy for the people and Alternative Technology Association (ATA)	Med	636
176	Yokohama Smart City HEMS Project	Yokohama city	Med	639

4. Inform the regulatory environment for renewable energy

ID	Title	Organisation	Ass	Page
116	A Distributed Energy Market: Consumer & Utility Interest, and the Regulatory Requirements	Australian PV Institute (APVI)	Med	86
249	ACT District Energy	AECOM	Low	95
140	Alice Solar City	Alice Springs Town Council (ASTC)	Low	116
11	Alice Springs High Penetration PV Study report	Australian PV Institute (APVI)	Low	119
358	Australian Renewable Energy Mapping Infrastructure (AREMI)	Data61 (previously NICTA)	Low	132

ID	Title	Organisation	Ass	Page
10	Carnarvon High Penetration PV Study report	Australian PV Institute (APVI)	Low	158
142	Central Victoria Solar City Household Trial	Sustainable Regional Australia (SRA)	Low	163
260	Characterising the effect of high penetration solar intermittency on Australian electricity networks	CSIRO	Med	169
297	DOE Global Energy Storage Database	Scandia National Laboratories, Department of Energy	Med	209
299	Effect of Small Solar PV System on Peak Demand	Ausgrid	High	225
287	E-harbours Project	Municipality of Zaanstad	Med	230
214	EPM FOA Frequency Regulation	Ecoult/East Penn Manufacturing	Low	246
168	eStorage Project	Alstom	Low	249
325	eTelligence Project	EWE AG	Med	252
361	Facilitating Local Network Charges and Virtual Net Metering (VNM)	Institute for Sustainable Futures (ISF)	High	263
256	FPDI: Demand Side Management Technology Testing	Clean Energy Council	Low	275
254	FPDI: Review of Policies and Incentives	Clean Energy Council	High	278
272	FPDI: Review of work undertaken to date	Clean Energy Council	High	281
255	FPDI: Value of Small Scale Embedded Generation and Storage	Clean Energy Council	Med	284
245	Future Grid Forum	CSIRO	High	289
274	Golden Sun Demonstration Project	Ministry of Science and Technology (MOST)	Low	296
113	Impacts of PV, AC, and Other Technologies and Tariffs on Consumer Costs	Australian PV Institute (APVI)	Med	333
275	Improving China's Existing Renewable Energy Legal Framework: Lessons from the International and Domestic Experience	Natural Resources Defense Council	Low	339
187	Integrating Renewable Energy - Wind Integration Studies Report	AEMO	Low	349
167	Isernia Smart Grid Project	Enel Distribuzione	Low	352
196	King Island Renewable Energy Integration Project (KIREIP)	Hydro Tasmania	Med	367
213	Large Scale (e.g. Pumped Hydro) Energy Storage	University of Melbourne Energy Institute	Low	379
9	Magnetic Island and Townsville Solar City: A Case Study of Increasing PV Penetration in Electricity Networks	Australian PV Institute (APVI)	Low	404

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195	Network Capacity Value Functions for Integrated Planning of Distributed	Monash University: Ross Gawler, adjunct Senior Demand Side Resources Research Fellow is pursuing this project on his own initiative and his own expense. Monash University is providing research facilities and will monitor progress.	Med	427
364	Network Transformation Roadmap	Energy Networks Association	High	434
252	Optimal deployment of renewable resources in a distribution network	Monash University	Med	444
265	Planning Future Energy Grids: Renewables	Queensland University of Technology	High	463
316	PRIME PLC Evaluation	Energex	Med	474
250	Recovery of Resources from Biomass and Residual Waste	ACT Government, Environment and Sustainable Development Directorate	Low	480
174	Reforming the Energy Vision (REV)	New York Department of Public Service (NYDPS)	High	485
278	Renewable Islands: Setting for Success	International Renewable Energy Agency (IRENA)	Low	494
355	Residential Storage Trial Australia	CitiPower and Powercor	Low	499
258	Residential Building Energy Efficiency	CSIRO	Low	505
154	Reward Based Tariffs Trial	Ergon Energy and Energex	Low	514
186	SGSC: Smart Grid, Smart City Project (Overall)	Ausgrid	Low	527
328	Smart City Búzios	Ampla Energia e Serviços	Med	536
321	Smart Grid and Electric Vehicle Integration Project	SGCC	Low	546
180	Smart Grid Gotland	Vattenfall	Low	549
172	SoLa Bristol	Western Power Distribution	Med	558
188	The Impact of distributed solar generation on the wholesale electricity market	Melbourne Energy Institute (University of Melbourne)	Med	593
229	The Integrated Grid Project	The Electric Power Research Institute	Low	603
291	Townsville PV/ EV/ DS impacts	Ergon Energy	Low	615

5. Engage customers to build their and the industry's understanding of distributed energy resources

ID	Title	Organisation	Ass	Page
219	ADDRESS French Pilot	EDF SA	Med	101
139	Adelaide Solar City	Origin	High	104
140	Alice Solar City	Alice Springs Town Council (ASTC)	High	116
358	Australian Renewable Energy Mapping Infrastructure (AREMI)	Data61 (previously NICTA)	Low	132
285	BDR Project	Opower	Med	138
237	Bega Library Solar Energy System	Essential Energy	Med	141
319	BESOS Project	ETRA I+D	High	144
292	Capacity Limiting	United Energy	Med	156
142	Central Victoria Solar City Household Trial	Sustainable Regional Australia(SRA)	High	163
286	CIVIS Project	University of Trento	Med	176
26	Climate-based PV Performance and Reliability	Australian PV Institute (APVI)	Med	179
313	Commercial & Industrial Demand Management (DM)	Energex	Med	181
170	Customer-Led Network Revolution	Northern Powergrid	Med	187
293	Direct Load Control of Pool Pump/AC	United Energy	Med	202
315	Distribution Transformer Low Voltage Circuit Monitoring	Energex	Med	207
227	ECOGRID EU	Energinet.dk	Med	216
220	E-DeMa Project	RWE Deutschland AGE	Med	220
287	E-harbours Project	Municipality of Zaanstad	Med	230
363	Embedded Generation Project	Energy Networks Association	Med	235
221	Enel Info+ Project	Enel Distribuzione	Med	239
289	EPIC-HUB (Energy Positive Neighbourhoods Infrastructure Middleware based on Energy-Hub Concept)	D'Appolonia SpA	Med	243
325	eTelligence Project	EWE AG	Med	252
361	Facilitating Local Network Charges and Virtual Net Metering (VNM)	Institute for Sustainable Futures (ISF)	Low	263
253	FPDI: Analysis of Demand-Side Management Opportunities	Clean Energy Council	Med	272
352	Hervey Bay Hospital Solar	Queensland Health	Low	311
264	Hybrid concentrating solar thermal systems for large scale applications	CSIRO	High	321
167	Isernia Smart Grid Project	Enel Distribuzione	Med	352
223	Kalasatama Smart Grid Project	Helsingin Energia	Med	359

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280	Leonards Hill Wind Farm	Hepburn Community Owned	Med	385
165	MeRegio (Minimum Emission Region)	ENBW	High	413
305	Modelling the impact of various tariff structures on distributed energy resource take-up and electricity pricing	SA Power Networks	Low	421
195	Network Capacity Value Functions for Integrated Planning of Distributed	Monash University: Ross Gawler, adjunct Senior Demand Side Resources Research Fellow is pursuing this project on his own initiative and his own expense. Monash University is providing research facilities and will monitor progress.	Low	427
281	Network solar policy	Citipower and Powercor	High	431
364	Network Transformation Roadmap	Energy Networks Association	High	434
324	Opower's Data Presentment Project	Opower	Med	441
143	Perth Solar City	Western Power	High	455
316	PRIME PLC Evaluation	Energex	High	474
320	Renewables-based Neighbour Comparisons Project	Opower	High	497
355	Residental Storage Trial Australia	CitiPower and Powercor	Med	499
258	Residential Building Energy Efficiency	CSIRO	Med	505
317	Residential Demand Management	Energex	Med	509
154	Reward Based Tariffs Trial	Ergon Energy and Energex	High	514
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328	Smart City Búzios	Ampla Energia e Serviços	Med	536
321	Smart Grid and Electric Vehicle Integration Project	SGCC	Med	546
180	Smart Grid Gotland	Vattenfall	Med	549
178	Smart Melit	Toyota City	High	553
172	SoLa Bristol	Western Power Distribution	Low	558
132	Solar Energy Management System (SEM) for Utilities	CSIRO Ergon Energy GWA Group	Low	561
225	Stockholm Royal Seaport Project	Stockholm Municipality	Med	568
295	Summer Energy Demand Trial	United Energy	Med	571
303	Survey of likely take-up of a voluntary residential capacity based tariff	SA Power Networks	High	573

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306	Talking Power customer engagement process	SA Power Networks	Med	580
194	The impact of the mass adoption of electric vehicles on the Australian electricity grid.	The University of Melbourne	Low	599
145	Townsville Solar City	Ergon Energy	High	617
217	Weipa Solar Farm	Weipa Solar Farm Pty Ltd	Low	634

6. Make the process of integrating renewable energy into the grid more cost-efficient

ID	Title	Organisation	Ass	Page
357	1. Solar PV Performance in Tropical Regions / 2. Technical issues in relation to high penetration of PV integrated into smart grid	James Cook University	Low	84
266	Accelerating Renewable Connections	Scottish Power Energy Networks (SP Energy Networks)	Med	90
257	ACT Large-scale Solar Feed-in Tariff Auction	Environment and Sustainable Development Directorate	Med	97
360	ACT large-scale wind feed-in tariff auction II	ACT Government, Environment and Planning Directorate	Low	99
247	Agua Caliente Solar Project	First Solar Inc.	High	113
234	Analysis of High-Penetration Levels of PV into the Distribution Grid in California (NREL/SCE High-Penetration PV Grid Integration Project)	National Renewable Energy Laboratory	Med	125
238	Analysis of Variations in Instantaneous Weather Effects across the Geographic Boundaries of an Electricity Grid, and the Development of an Improved Estimate for Maximum Solar Grid Penetration without Energy Storage	CAT Projects	Med	129
358	Australian Renewable Energy Mapping Infrastructure (AREMI)	Data61 (previously NICTA)	High	132
283	Australian Solar Energy Forecasting System (ASEFS) – Phase 1	CSIRO	Med	135
285	BDR Project	Opower	Med	138
319	BESOS Project	ETRA I+D	High	144
240	Broken Hill Solar Plant	AGL Energy	Low	151
302	CBD Embedded Generation Project	Ausgrid	Med	161
260	Characterising the effect of high penetration solar intermittency on Australian electricity networks	CSIRO	Low	169
271	Customer PV Voltage Control Project	Ergon Energy	High	185
170	Customer-Led Network Revolution	Northern Powergrid	Med	187

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196	King Island Renewable Energy Integration Project (KIREIP)	Hydro Tasmania	High	367
323	Kitakyushu Smart Community Project	Kitakyushu City	Low	372
213	Large Scale (e.g. Pumped Hydro) Energy Storage	University of Melbourne Energy Institute	Med	379
129	Least-cost carbon abatement modelling	The University of Melbourne University of New South Wales, Australian Energy Market Operator, Bureau of Meteorology, GE, Market Reform	High	382
243	Low cost building-integrated photovoltaics (BIPV) for Australian residential and commercial/industrial rooftop power generation	BlueScope Steel Limited	Low	388
236	LV Network Modelling	SP AusNet	Med	395
263	Machine learning based forecasting of distributed solar energy production	The Australian National University and NICTA	High	398
353	Mackay Sugar Cogeneration Plant	Mackay Sugar Ltd	High	401
362	Mapping Potential Network Opportunities for Renewable Energy and Demand Management	Institute for Sustainable Futures	Med	407
232	Maximum Photovoltaic Penetration Levels on Typical Distribution Feeders	National Renewable Energy Laboratory partners	Med	411
165	MeRegio (Minimum Emission Region)	ENBW	Med	413
304	Modelling the impact of distributed energy resources on the LV network	SA Power Networks	Low	418
162	NETFLEX – Network-enhanced flexibility	Elia System Operator S.A.	Low	424
195	Network Capacity Value Functions for Integrated Planning of Distributed	Monash University: Ross Gawler, adjunct Senior Demand Side Resources Research Fellow is pursuing this project on his own initiative and his own expense. Monash University is providing research facilities and will monitor progress.	Med	427
364	Network Transformation Roadmap	Energy Networks Association	Med	434
239	Nyngan Solar Plant	AGL Energy	Med	437
268	Off-river pumped hydro Electricity storage	Australian National University	Med	439
324	Opower's Data Presentment Project	Opower	Med	441

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252	Optimal deployment of renewable resources in a distribution network	Monash University	High	444
169	Orkney Island Smart Grid	Scottish & Southern Energy Power Distribution (SSEPD)	High	448
143	Perth Solar City	Western Power	Med	455
127	Plug and Play Solar: Simplifying the Integration of Solar Energy in Hybrid Applications	CSIRO	High	466
216	PNM Prosperity	PNM New Mexico	Med	469
316	PRIME PLC Evaluation	Energex	High	474
174	Reforming the Energy Vision (REV)	New York Department of Public Service (NYDPS)	Med	485
359	Regulating Distribution Transformer	Energex	Low	488
355	Residential Storage Trial Australia	CitiPower and Powercor	Low	499
136	SGSC: Distributed Generation and Storage	Ausgrid	Med	521
186	SGSC: Smart Grid, Smart City Project (Overall)	Ausgrid	Med	527
328	Smart City Búzios	Ampla Energia e Serviços	Med	536
166	Smart Country	RWE Deutschland AG	Med	540
180	Smart Grid Gotland	Vattenfall	Med	549
132	Solar Energy Management System (SEM) for Utilities	CSIRO Ergon Energy GWA Group	Med	561
161	SYSERWIND – System Services Provided by wind farms	Iberdrola	Med	577
262	The ANU Solar Radiation and Cloud Measurement Network	The Australian National University	Low	588
307	The Future Grid Research Program	The University of Sydney	Med	590
229	The Integrated Grid Project	The Electric Power Research Institute	Low	603
145	Townsville Solar City	Ergon Energy	Low	617
56	Unlocking the grid: the future of the electricity distribution network	Barbara Hardy Institute - University of South Australia	Low	620
242	Volt VAR Strategy	CitiPower and Powercor	Low	632
177	YSCP CEMS Project	Toshiba Japan	Med	642
276	Zhangbei National Energy Storage and Transmission Demonstration Project (China)	State Grid of China (SGCC)	Med	644

ID	Title	Organisation	Ass	Page

7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network

251	ACT Community Solar Scheme	Environment and Sustainable Development Directorate	Low	93
249	ACT District Energy	AECOM	Low	95
257	ACT Large-scale Solar Feed-in Tariff Auction	Environment and Sustainable Development Directorate	Low	97
235	An advanced platform for development and evaluation of grid interconnection systems using hardware-in-the-loop	National Renewable Energy Laboratory	Med	122
238	Analysis of Variations in Instantaneous Weather Effects across the Geographic Boundaries of an Electricity Grid, and the Development of an Improved Estimate for Maximum Solar Grid Penetration without Energy Storage	CAT Projects	Med	129
47	Breaking the solar gridlock	The Australian Solar Thermal Energy Association (AUSTELA)	Low	148
290	Business Model Implementation Project	Ergon Energy	High	153
302	CBD Embedded Generation Project	Ausgrid	High	161
170	Customer-Led Network Revolution	Northern Powergrid	Low	187
356	Demand Management Storage Project (DMSP)	CitiPower & Powercor Australia	Low	193
318	E.ON Smart Grid Control Centre	Ventyx	Med	213
287	E-harbours Project	Municipality of Zaanstad	Med	230
325	eTelligence Project	EWE AG	Med	252
361	Facilitating Local Network Charges and Virtual Net Metering (VNM)	Institute for Sustainable Futures (ISF)	Med	263
163	FLEXGRID – Improving the flexibility of the grid	Red Eléctrica de España	Low	268
245	Future Grid Forum	CSIRO	High	289
275	Improving China's Existing Renewable Energy Legal Framework: Lessons from the International and Domestic Experience	Natural Resources Defense Council	Low	339
187	Integrating Renewable Energy - Wind Integration Studies Report	AEMO	Med	349
196	King Island Renewable Energy Integration Project (KIREIP)	Hydro Tasmania	High	367
301	Large Embedded Generation Project	Ausgrid	Low	375
280	Leonards Hill Wind Farm	Hepburn Community Owned	Med	385

ID	Title	Organisation	Ass	Page
314	Low Voltage Network Management: LV Monitoring and the Trial of LV Statcoms	Energex	Med	391
236	LV Network Modelling	SP AusNet	Med	395
362	Mapping Potential Network Opportunities for Renewable Energy and Demand Management	Institute for Sustainable Futures	Low	407
165	MeRegio (Minimum Emission Region)	ENBW	Low	413
162	NETFLEX – Network-enhanced flexibility	Elia System Operator S.A.	Low	424
195	Network Capacity Value Functions for Integrated Planning of Distributed	Monash University: Ross Gawler, adjunct Senior Demand Side Resources Research Fellow is pursuing this project on his own initiative and his own expense. Monash University is providing research facilities and will monitor progress.	High	427
281	Network solar policy	Citipower and Powercor	Low	431
364	Network Transformation Roadmap	Energy Networks Association	High	434
252	Optimal deployment of renewable resources in a distribution network	Monash University	Med	444
350	Pacific Northwest Smart Grid Demonstration Project	Battelle	Med	451
174	Reforming the Energy Vision (REV)	New York Department of Public Service (NYDPS)	Med	485
278	Renewable Islands: Setting for Success	International Renewable Energy Agency (IRENA)	Low	494
355	Residential Storage Trial Australia	CitiPower and Powercor	Low	499
241	Residential Battery Storage Trial	SP AusNet	Low	502
186	SGSC: Smart Grid, Smart City Project (Overall)	Ausgrid	High	527
328	Smart City Búzios	Ampla Energia e Serviços	Med	536
262	The ANU Solar Radiation and Cloud Measurement Network	The Australian National University	Low	588
298	UQ 1.22 MW Solar PV Array	University of Queensland	Med	623
242	Volt VAR Strategy	CitiPower and Powercor	Low	632

8 Establish control over, or otherwise influence, intermittent generation sources

ID	Title	Organisation	Ass	Page
266	Accelerating Renewable Connections	Scottish Power Energy Networks (SP Energy Networks)	Med	90
322	ADINE Project	Technology Centre Hermia Ltd	Med	107
247	Agua Caliente Solar Project	First Solar Inc.	Med	113
358	Australian Renewable Energy Mapping Infrastructure (AREMI)	Data61 (previously NICTA)	Low	132
283	Australian Solar Energy Forecasting System (ASEFS) – Phase 1	CSIRO	Med	135
319	BESOS Project	ETRA I+D	Med	144
240	Broken Hill Solar Plant	AGL Energy	Med	151
277	China Southern Grid's Shenzhen Baoqing Battery Energy Storage Station	China Southern Power Grid	Med	173
170	Customer-Led Network Revolution	Northern Powergrid	High	187
356	Demand Management Storage Project (DMSP)	CitiPower & Powercor Australia	Med	193
164	DERINT - Large scale virtual power plant integration	DONG Energy	High	199
329	Distribution Scale Energy Storage	Isentropic Ltd	Med	204
318	E.ON Smart Grid Control Center	Ventyx	Med	213
287	E-harbours Project	Municipality of Zaanstad	Med	230
363	Embedded Generation Project	Energy Networks Association	Low	235
146	Emerging challenges in wind energy forecasting for Australia	Centre for Energy and Environmental Markets (CEEM) School of Photovoltaic and Renewable Energy Engineering, University of New South Wales, School of Physics, University of New South Wales	Med	237
289	EPIC-HUB (Energy Positive Neighbourhoods Infrastructure Middleware based on Energy-Hub Concept)	D'Appolonia SpA	Med	243
168	eStorage Project	Alstom	Low	249
325	eTelligence Project	EWE AG	Med	252
361	Facilitating Local Network Charges and Virtual Net Metering (VNM)	Institute for Sustainable Futures (ISF)	Low	263
245	Future Grid Forum	CSIRO	Med	289

ID	Title	Organisation	Ass	Page
246	Greenough River Solar Farm	Greenough River Solar Farm (joint venture between Synergy and GE Energy Financial Services)	Med	298
185	Grid Interactive Inverter program	Essential Energy	Med	301
222	IGREENGrid PRICE Project	Iberdrola and Gas Natural Fenosa	Med	326
259	Impact of Increasing Harmonic Levels on Distribution System Equipment	University of New South Wales	Low	330
187	Integrating Renewable Energy - Wind Integration Studies Report	AEMO	Low	349
175	Jeju Island Smart Renewable project	KEPKO, HYUNDAI Heavy industries, POSCO	Med	356
326	Keihanna Eco City Project	Keihanna City	Low	364
196	King Island Renewable Energy Integration Project (KIREIP)	Hydro Tasmania	High	367
323	Kitakyushu Smart Community Project	Kitakyushu City	Med	372
280	Leonards Hill Wind Farm	Hepburn Community Owned	Low	385
263	Machine learning based forecasting of distributed solar energy production	The Australian National University and NICTA	Low	398
195	Network Capacity Value Functions for Integrated Planning of Distributed	Monash University: Ross Gawler, adjunct Senior Demand Side Resources Research Fellow is pursuing this project on his own initiative and his own expense. Monash University is providing research facilities and will monitor progress.	Low	427
281	Network solar policy	Citipower and Powercor	Med	431
364	Network Transformation Roadmap	Energy Networks Association	Med	434
239	Nyngan Solar Plant	AGL Energy	Low	437
169	Orkney Island Smart Grid	Scottish & Southern Energy Power Distribution (SSEPD)	Med	448
350	Pacific Northwest Smart Grid Demonstration Project	Battelle	Med	451
265	Planning Future Energy Grids: Renewables	Queensland University of Technology	Med	463
127	Plug and Play Solar: Simplifying the Integration of Solar Energy in Hybrid Applications	CSIRO	Med	466
216	PNM Prosperity	PNM New Mexico	Med	469

ID	Title	Organisation	Ass	Page
316	PRIME PLC Evaluation	Energex	High	474
130	Redeploy able Hybrid Power	Laing O'Rourke	Med	482
355	residential Storage Trial Australia	CitiPower and Powercor	Med	499
241	Residential Battery Storage Trial	SP AusNet	Low	502
136	SGSC: Distributed Generation and Storage	Ausgrid	Med	521
186	SGSC: Smart Grid, Smart City Project (Overall)	Ausgrid	Med	527
179	Shanghai World Expo	State Grid Corporation of China (SGCC)	Med	533
180	Smart Grid Gotland	Vattenfall	Med	549
172	SoLa Bristol	Western Power Distribution	Med	558
132	Solar Energy Management System (SEM) for Utilities	CSIRO Ergon Energy GWA Group	Low	561
225	Stockholm Royal Seaport Project	Stockholm Municipality	Med	568
161	SYSERWIND – System Services Provided by wind farms	Iberdrola	High	577
307	The Future Grid Research Program	The University of Sydney	Low	590
194	The impact of the mass adoption of electric vehicles on the Australian electricity grid.	The University of Melbourne	Low	599
308	The National Feeder Taxonomy Study	CSIRO and Ausgrid	Med	609
269	Virtual Power Station	CSIRO	High	629

9. Strengthen the network to manage higher renewable energy penetration

ID	Title	Organisation	Ass	Page
357	1. Solar PV Performance in Tropical Regions / 2. Technical issues in relation to high penetration of PV integrated into smart grid	James Cook University	Low	84
249	ACT District Energy	AECOM	Low	95
322	ADINE Project	Technology Centre Hermia Ltd	Med	107
247	Agua Caliente Solar Project	First Solar Inc.	High	113
11	Alice Springs High Penetration PV Study report	Australian PV Institute (APVI)	Med	119
234	Analysis of High-Penetration Levels of PV into the Distribution Grid in California (NREL/SCE High-Penetration PV Grid Integration Project)	National Renewable Energy Laboratory	Med	125
10	Carnarvon High Penetration PV Study report	Australian PV Institute (APVI)	Med	158

ID	Title	Organisation	Ass	Page
260	Characterising the effect of high penetration solar intermittency on Australian electricity networks	CSIRO	Low	169
277	China Southern Grid's Shenzhen Baoqing Battery Energy Storage Station	China Southern Power Grid	Med	173
271	Customer PV Voltage Control Project	Ergon Energy	Med	185
170	Customer-Led Network Revolution	Northern Powergrid	Med	187
356	Demand Management Storage Project (DMSP)	CitiPower & Powercor Australia	Med	193
329	Distribution Scale Energy Storage	Isentropic Ltd	Med	204
287	E-harbours Project	Municipality of Zaanstad	Low	230
214	EPM FOA Frequency Regulation	Ecoult/East Penn Manufacturing	Med	246
168	eStorage Project	Alstom	Low	249
325	eTelligence Project	EWE AG	Med	252
245	Future Grid Forum	CSIRO	Med	289
185	Grid Interactive Inverter program	Essential Energy	Med	301
215	Hampton Wind Farm	Ecoult	Low	308
230	High Penetration Photovoltaic Case Study Report	National Renewable Energy Laboratory	Med	314
222	IGREENGrid PRICE Project	Iberdrola and Gas Natural Fenosa	Med	326
259	Impact of Increasing Harmonic Levels on Distribution System Equipment	University of New South Wales	Med	330
187	Integrating Renewable Energy - Wind Integration Studies Report	AEMO	Med	349
167	Isernia Smart Grid Project	Enel Distribuzione	High	352
196	King Island Renewable Energy Integration Project (KIREIP)	Hydro Tasmania	High	367
323	Kitakyushu Smart Community Project	Kitakyushu City	High	372
213	Large Scale (e.g. Pumped Hydro) Energy Storage	University of Melbourne Energy Institute	Low	379
280	Leonards Hill Wind Farm	Hepburn Community Owned	Med	385
243	Low cost building-integrated photovoltaics (BIPV) for Australian residential and commercial/industrial rooftop power generation	BlueScope Steel Limited	High	388
314	Low Voltage Network Management: LV Monitoring and the Trial of LV Statcoms	Energex	Med	391

ID	Title	Organisation	Ass	Page
294	Low-Voltage Regulator Trial	United Energy	Med	393
236	LV Network Modelling	SP AusNet	Med	395
263	Machine learning based forecasting of distributed solar energy production	The Australian National University and NICTA	Low	398
9	Magnetic Island and Townsville Solar City: A Case Study of Increasing PV Penetration in Electricity Networks	Australian PV Institute (APVI)	Med	404
304	Modelling the impact of distributed energy resources on the LV network	SA Power Networks	Med	418
162	NETFLEX – Network-enhanced flexibility	Elia System Operator S.A.	Low	424
281	Network solar policy	Citipower and Powercor	Low	431
364	Network Transformation Roadmap	Energy Networks Association	Med	434
252	Optimal deployment of renewable resources in a distribution network	Monash University	Med	444
231	Photovoltaic Systems Interconnected onto Secondary Network Distribution Systems – Success Stories	National Renewable Energy Laboratory	Med	458
265	Planning Future Energy Grids: Renewables	Queensland University of Technology	Med	463
355	residential Storage Trial Australia	CitiPower and Powercor	Med	499
241	Residential Battery Storage Trial	SP AusNet	Low	502
279	Residential Utility Support System (RUSS)	Ergon Energy	Med	512
158	SGSC: Active Volt-Var Control Project	Ausgrid (Lead Organisation) and consortium partners	Med	518
300	SGSC: Newington Grid Battery Trial	Ausgrid	Med	524
186	SGSC: Smart Grid, Smart City Project (Overall)	Ausgrid	High	527
159	SGSC: Substation and Feeder Monitoring	Ausgrid and consortium partners	Med	531
179	Shanghai World Expo	State Grid Corporation of China (SGCC)	Med	533
328	Smart City Búzios	Ampla Energia e Serviços	Med	536
161	SYSERWIND – System Services Provided by wind farms	Iberdrola	Med	577

ID	Title	Organisation	Ass	Page
307	The Future Grid Research Program	The University of Sydney	Low	590
284	The Impact of High Penetration of Solar Photovoltaic Systems on Low Voltage Feeder Power Quality	University of Wollongong	Med	596
194	The impact of the mass adoption of electric vehicles on the Australian electricity grid.	The University of Melbourne	Med	599
308	The National Feeder Taxonomy Study	CSIRO and Ausgrid	Med	609
282	TK NOAC scheme fault level mitigation	CitiPower Pty	Med	613
56	Unlocking the grid: the future of the electricity distribution network	Barbara Hardy Institute - University of South Australia	Med	620
269	Virtual Power Station	CSIRO	Med	629
242	Volt VAR Strategy	CitiPower and Powercor	Med	632

10. Smooth out intermittent generation output

ID	Title	Organisation	Ass	Page
322	ADINE Project	Technology Centre Hermia Ltd	Med	107
237	Bega Library Solar Energy System	Essential Energy	Low	141
155	Central Victoria Solar City Solar Park	Origin	Med	166
260	Characterising the effect of high penetration solar intermittency on Australian electricity networks	CSIRO	High	169
277	China Southern Grid's Shenzhen Baoqing Battery Energy Storage Station	China Southern Power Grid	Med	173
356	Demand Management Storage Project (DMSP)	CitiPower & Powercor Australia	Med	193
329	Distribution Scale Energy Storage	Isentropic Ltd	Med	204
273	Education Queensland	Ergon Energy	Med	223
287	E-harbours Project	Municipality of Zaanstad	Med	230
214	EPM FOA Frequency Regulation	Ecoult/East Penn Manufacturing	Med	246
168	eStorage Project	Alstom	Low	249
325	eTelligence Project	EWE AG	Med	252
6	Evaluating the benefits of implementing existing storage technologies with residential PV rooftop systems	University of New South Wales, School of Photovoltaics and Renewable Energy	Med	258
163	FLEXGRID – Improving the flexibility of the grid	Red Eléctrica de España	Low	268

ID	Title	Organisation	Ass	Page
245	Future Grid Forum	CSIRO	Med	289
246	Greenough River Solar Farm	Greenough River Solar Farm (joint venture between Synergy and GE Energy Financial Services)	Med	298
185	Grid Interactive Inverter program	Essential Energy	Low	301
215	Hampton Wind Farm	Ecoult	Med	308
267	High performance thermal energy storage systems with high temperature phase change material	University of South Australia	Med	318
187	Integrating Renewable Energy - Wind Integration Studies Report	AEMO	Low	349
175	Jeju Island Smart Renewable project industries, POSCO	KEPKO, HYUNDAI Heavy	Med	356
196	King Island Renewable Energy Integration Project (KIREIP)	Hydro Tasmania	High	367
213	Large Scale (e.g. Pumped Hydro) Energy Storage	University of Melbourne Energy Institute	Med	379
129	Least-cost carbon abatement modelling	The University of Melbourne University of New South Wales, Australian Energy Market Operator, Bureau of Meteorology, GE, Market Reform	Med	382
364	Network Transformation Roadmap	Energy Networks Association	Med	434
268	Off-river pumped hydro Electricity storage	Australian National University	Med	439
169	Orkney Island Smart Grid	Scottish & Southern Energy Power Distribution (SSEPD)	Med	448
127	Plug and Play Solar: Simplifying the Integration of Solar Energy in Hybrid Applications	CSIRO	Med	466
216	PNM Prosperity	PNM New Mexico	Med	469
316	PRIME PLC Evaluation	Energex	Med	474
351	Qingdao OES Independent Power System Demonstration Project	CNOOC Group	Med	478
130	Redeploy able Hybrid Power	Laing O'Rourke	Med	482
355	Residential Storage Trial Australia	CitiPower and Powercor	Med	499
300	SGSC: Newington Grid Battery Trial	Ausgrid	Med	524
186	SGSC: Smart Grid, Smart City Project (Overall)	Ausgrid	Med	527

ID	Title	Organisation	Ass	Page
166	Smart Country	RWE Deutschland AG	Med	540
321	Smart Grid and Electric Vehicle Integration Project	SGCC	Med	546
180	Smart Grid Gotland	Vattenfall	Med	549
172	SoLa Bristol	Western Power Distribution	Med	558
132	Solar Energy Management System (SEM) for Utilities	CSIRO Ergon Energy GWA Group	Low	561
161	SYSERWIND – System Services Provided by wind farms	Iberdrola	Med	577
307	The Future Grid Research Program	The University of Sydney	Med	590
269	Virtual Power Station	CSIRO	Med	629
276	Zhangbei National Energy Storage and Transmission Demonstration Project (China)	State Grid of China (SGCC)	Low	644

11. Alter local load profile to match a desired level

249	ACT District Energy	AECOM	Low	95
219	ADDRESS French Pilot	EDF SA	Med	101
285	BDR Project	Opower	Med	138
237	Bega Library Solar Energy System	Essential Energy	Med	141
319	BESOS Project	ETRA I+D	High	144
290	Business Model Implementation Project	Ergon Energy	Med	153
292	Capacity Limiting	United Energy	Med	156
170	Customer-Led Network Revolution	Northern Powergrid	High	187
356	Demand Management Storage Project (DMSP)	CitiPower & Powercor Australia	Med	193
293	Direct Load Control of Pool Pump/AC	United Energy	Med	202
227	ECOGRID EU	Energinet.dk	Med	216
214	EPM FOA Frequency Regulation	Ecoult/East Penn Manufacturing	Med	246
244	Expanding the Value Proposition for Building Integrated Photovoltaics (BIPV): Thin Film Building Integrated Photovoltaic Thermal (BIPVT) Retrofitting of Buildings	BlueScope Steel Limited	Med	260
245	Future Grid Forum	CSIRO	Med	289
196	King Island Renewable Energy Integration Project (KIREIP)	Hydro Tasmania	High	367

ID	Title	Organisation	Ass	Page
280	Leonards Hill Wind Farm	Hepburn Community Owned	Low	385
243	Low cost building-integrated photovoltaics (BIPV) for Australian residential and commercial/industrial rooftop power generation	BlueScope Steel Limited	High	388
314	Low Voltage Network Management: LV Monitoring and the Trial of LV Statcoms	Energex	Med	391
165	MeRegio (Minimum Emission Region)	ENBW	Med	413
304	Modelling the impact of distributed energy resources on the LV network	SA Power Networks	Med	418
364	Network Transformation Roadmap	Energy Networks Association	Med	434
265	Planning Future Energy Grids: Renewables	Queensland University of Technology	High	463
127	Plug and Play Solar: Simplifying the Integration of Solar Energy in Hybrid Applications	CSIRO	Low	466
316	PRIME PLC Evaluation	Energex	High	474
130	Redeploy able Hybrid Power	Laing O'Rourke	Med	482
355	Residential Storage Trial Australia	CitiPower and Powercor	Med	499
241	Residential Battery Storage Trial	SP AusNet	Low	502
136	SGSC: Distributed Generation and Storage	Ausgrid	Med	521
300	SGSC: Newington Grid Battery Trial	Ausgrid	Low	524
186	SGSC: Smart Grid, Smart City Project (Overall)	Ausgrid	Med	527
288	Smart End-Use Energy Storage and Integration of Energy Pilot (EnerNOC BPA Pilot)Renewable	EnerNOC	Med	543
172	SoLa Bristol	Western Power Distribution	Low	558
132	Solar Energy Management System (SEM) for Utilities	CSIRO Ergon Energy GWA Group	Med	561
295	Summer Energy Demand Trial	United Energy	Med	571
226	T-City Project	Deutsche Telekom (T-Systems)	Low	583
307	The Future Grid Research Program	The University of Sydney	Low	590
194	The impact of the mass adoption of electric vehicles on the Australian electricity grid.	The University of Melbourne	High	599
296	Virtual Power Plant	United Energy	Low	627
269	Virtual Power Station	CSIRO	Med	629

ID	Title	Organisation	Ass	Page
167	Isernia Smart Grid Project	Enel Distribuzione	High	352
175	Jeju Island Smart Renewable project industries, POSCO	KEPKO, HYUNDAI Heavy	Med	356
223	Kalasatama Smart Grid Project	Helsingin Energia	Med	359
301	Large Embedded Generation Project	Ausgrid	Med	375
312	Large LV Statcom	Ergon Energy	Med	377
236	LV Network Modelling	SP AusNet	Med	395
263	Machine learning based forecasting of distributed solar energy production	The Australian National University and NICTA	Med	398
362	Mapping Potential Network Opportunities for Renewable Energy and Demand Management	Institute for Sustainable Futures	Med	407
165	MeRegio (Minimum Emission Region)	ENBW	Med	413
195	Network Capacity Value Functions for Integrated Planning of Distributed	Monash University: Ross Gawler, adjunct Senior Demand Side Resources Research Fellow is pursuing this project on his own initiative and his own expense. Monash University is providing research facilities and will monitor progress.	High	427
281	Network solar policy	Citipower and Powercor	Low	431
364	Network Transformation Roadmap	Energy Networks Association	Med	434
268	Off-river pumped hydro Electricity storage	Australian National University	Med	439
252	Optimal deployment of renewable resources in a distribution network	Monash University	Med	444
169	Orkney Island Smart Grid	Scottish & Southern Energy Power Distribution (SSEPD)	High	448
265	Planning Future Energy Grids: Renewables	Queensland University of Technology	High	463
127	Plug and Play Solar: Simplifying the Integration of Solar Energy in Hybrid Applications	CSIRO	Low	466
310	PowerShade	Ergon Energy	Med	472
130	Redeploy able Hybrid Power	Laing O'Rourke	Med	482
359	Regulating Distribution Transformer	Energex	Med	488
355	residential Storage Trial Australia	CitiPower and Powercor	Med	499

ID	Title	Organisation	Ass	Page
136	SGSC: Distributed Generation and Storage	Ausgrid	Med	521
186	SGSC: Smart Grid, Smart City Project (Overall)	Ausgrid	Med	527
166	Smart Country	RWE Deutschland AG	Med	540
321	Smart Grid and Electric Vehicle Integration Project	SGCC	Med	546
150	Smart Voltage Regulator	Ergon Energy	Med	556
172	SoLa Bristol	Western Power Distribution	Med	558
132	Solar Energy Management System (SEM) for Utilities	CSIRO Ergon Energy GWA Group	High	561
225	Stockholm Royal Seaport Project	Stockholm Municipality	Low	568
295	Summer Energy Demand Trial	United Energy	Med	571
194	The impact of the mass adoption of electric vehicles on the Australian electricity grid	The University of Melbourne	Med	599
296	Virtual Power Plant	United Energy	Med	627
269	Virtual Power Station	CSIRO	Low	629

13. Store and organise information on customer renewable energy deployments

ID	Title	Organisation	Ass	Page
251	ACT Community Solar Scheme	Environment and Sustainable Development Directorate	Med	93
238	Analysis of Variations in Instantaneous Weather Effects across the Geographic Boundaries of an Electricity Grid, and the Development of an Improved Estimate for Maximum Solar Grid Penetration without Energy Storage	CAT Projects	High	129
358	Australian Renewable Energy Mapping Infrastructure (AREMI)	Data61 (previously NICTA)	Med	132
26	Climate-based PV Performance and Reliability	Australian PV Institute (APVI)	High	179
297	DOE Global Energy Storage Database	Scandia National Laboratories, Department of Energy	High	209
287	E-harbours Project	Municipality of Zaanstad	Med	230
221	Enel Info+ Project	Enel Distribuzione	Med	239
253	FPDI: Analysis of Demand-Side Management Opportunities	Clean Energy Council	Med	272
223	Kalasatama Smart Grid Project	Helsingin Energia	Med	359
305	Modelling the impact of various tariff structures on distributed energy resource take-up and electricity pricing	SA Power Networks	Low	421
364	Network Transformation Roadmap	Energy Networks Association	Med	434

ID	Title	Organisation	Ass	Page
316	PRIME PLC Evaluation	Energex	Med	474
130	Redeploy able Hybrid Power	Laing O'Rourke	Low	482
355	residential Storage Trial Australia	CitiPower and Powercor	Low	499
258	Residential Building Energy Efficiency	CSIRO	Med	505
136	SGSC: Distributed Generation and Storage	Ausgrid	Med	521
186	SGSC: Smart Grid, Smart City Project (Overall)	Ausgrid	Med	527
328	Smart City Búzios	Ampla Energia e Serviços	Low	536
178	Smart Melit	Toyota City	Med	553
270	Solar Resource Mapping for High Prospectively Regions	Geoscience Australia	High	564
114	Staged Development of an Interactive Australian PV Solar Mapping Resource	Australian PV Institute (APVI)	High	566
269	Virtual Power Station	CSIRO	Med	629
176	Yokohama Smart City HEMS Project	Yokohama city	Med	639

14. Improve techniques for forecasting renewable energy output

ID	Title	Organisation	Ass	Page
360	ACT large-scale wind feed-in tariff auction II	ACT Government, Environment and Planning Directorate	None	99
283	Australian Solar Energy Forecasting System (ASEFS) – Phase 1	CSIRO	High	135
319	BESOS Project	ETRA I+D	Med	144
260	Characterising the effect of high penetration solar intermittency on Australian electricity networks	CSIRO	Low	169
318	E.ON Smart Grid Control Centre	Ventyx	Med	213
299	Effect of Small Solar PV System on Peak Demand	Ausgrid	Med	225
287	E-harbours Project	Municipality of Zaanstad	Med	230
146	Emerging challenges in wind energy forecasting for Australia	Centre for Energy and Environmental Markets (CEEM) School of Photovoltaic and Renewable Energy Engineering, University of New South Wales School of Physics, University of New South Wales	Med	237

ID	Title	Organisation	Ass	Page
289	EPIC-HUB (Energy Positive Neighbourhoods Infrastructure Middleware based on Energy-Hub Concept)	D'Appolonia SpA	Med	243
244	Expanding the Value Proposition for Building Integrated Photovoltaics (BIPV): Thin Film Building Integrated Photovoltaic Thermal (BIPVT) Retrofitting of Buildings	BlueScope Steel Limited	Med	260
215	Hampton Wind Farm	Ecoult	Low	308
222	IGREENGrid PRICE Project	Iberdrola and Gas Natural Fenosa	Med	326
124	Improving accessibility of the System Advisor Model (SAM) for Australian concentrating solar power users	Australian Solar Thermal Energy Association (AUSTELA)	Med	336
261	Improving translation models for predicting the energy yield of photovoltaic power systems	CSIRO	Med	342
167	Isernia Smart Grid Project	Enel Distribuzione	High	352
224	Karnataka Project	Karnataka Power Transmission Corporation Limited (KPTCL)	Med	362
280	Leonards Hill Wind Farm	Hepburn Community Owned	Low	385
263	Machine learning based forecasting of distributed solar energy production	The Australian National University and NICTA	High	398
162	NETFLEX – Network-enhanced flexibility	Elia System Operator S.A.	Low	424
350	Pacific Northwest Smart Grid Demonstration Project	Battelle	Low	451
265	Planning Future Energy Grids: Renewables	Queensland University of Technology	High	463
316	PRIME PLC Evaluation	Energex	Low	474
186	SGSC: Smart Grid, Smart City Project (Overall)	Ausgrid	Med	527
270	Solar Resource Mapping for High Prospectively Regions	Geoscience Australia	High	564
114	Staged Development of an Interactive Australian PV Solar Mapping Resource	Australian PV Institute (APVI)	High	566
161	SYSERWIND – System Services Provided by wind farms	Iberdrola	Low	577
262	The ANU Solar Radiation and Cloud Measurement Network	The Australian National University	High	588
307	The Future Grid Research Program	The University of Sydney	Med	590
56	Unlocking the grid: the future of the electricity distribution network	Barbara Hardy Institute - University of South Australia	Med	620
138	Urban Solar Atlas City of Port Phillip	Entura Hydro Tasmania	Med	625

ID	Title	Organisation	Ass	Page
269	Virtual Power Station	CSIRO	Med	629

Projects: by Approach

Demonstration Project

Direct load control

Distributed Energy Solutions

ID	Title	Organisation	Page
237	Bega Library Solar Energy System	Essential Energy	141
142	Central Victoria Solar City Household Trial	Sustainable Regional Australia (SRA)	163
352	Hervey Bay Hospital Solar	Queensland Health	311
230	High Penetration Photovoltaic Case Study Report	National Renewable Energy Laboratory	314
264	Hybrid concentrating solar thermal systems for large scale applications	CSIRO	321
167	Isernia Smart Grid Project	Enel Distribuzione	352
326	Keihanna Eco City Project	Keihanna City	364
323	Kitakyushu Smart Community Project	Kitakyushu City	372
243	Low cost building-integrated photovoltaics (BIPV) for Australian residential and commercial/industrial rooftop power generation	BlueScope Steel Limited	388
165	MeRegio (Minimum Emission Region)	ENBW	413
324	Opower's Data Presentment Project	Opower	441
143	Perth Solar City	Western Power	455
310	PowerShade	Ergon Energy	472
179	Shanghai World Expo	State Grid Corporation of China (SGCC)	533
321	Smart Grid and Electric Vehicle Integration Project	SGCC	546
298	UQ 1.22 MW Solar PV Array	University of Queensland	623

Distribution system upgrades

230	High Penetration Photovoltaic Case Study Report	National Renewable Energy Laboratory	314

Dynamic Equipment Rating

Economic Modelling

Electrical System Modelling

ID	Title	Organisation	Page

Interviews and Surveys

116	A Distributed Energy Market: Consumer & Utility Interest, and the Regulatory Requirements	Australian PV Institute (APVI)	86
249	ACT District Energy	AECOM	95
139	Adelaide Solar City	Origin	104
142	Central Victoria Solar City Household Trial	Sustainable Regional Australia (SRA)	163
260	Characterising the effect of high penetration solar intermittency on Australian electricity networks	CSIRO	169
26	Climate-based PV Performance and Reliability	Australian PV Institute (APVI)	179
297	DOE Global Energy Storage Database	Scandia National Laboratories, Department of Energy	209
318	E.ON Smart Grid Control Center	Ventyx	213
256	FPDI: Demand Side Management Technology Testing	Clean Energy Council	275
255	FPDI: Value of Small Scale Embedded Generation and Storage	Clean Energy Council	284
245	Future Grid Forum	CSIRO	289
9	Magnetic Island and Townsville Solar City: A Case Study of Increasing PV Penetration in Electricity Networks	Australian PV Institute (APVI)	404
317	Residential Demand Management	Energex	509
303	Survey of likely take-up of a voluntary residential capacity based tariff	SA Power Networks	573
306	Talking Power customer engagement process	SA Power Networks	580
308	The National Feeder Taxonomy Study	CSIRO and Ausgrid	609
145	Townsville Solar City	Ergon Energy	617

Large Scale Renewable Plant

247	Agua Caliente Solar Project	First Solar Inc.	113
240	Broken Hill Solar Plant	AGL Energy	151
155	Central Victoria Solar City Solar Park	Origin	166
137	Doomadgee Solar Farm	Ergon Energy RFI Solar Q Energy	211
274	Golden Sun Demonstration Project	Ministry of Science and Technology (MOST)	296
246	Greenough River Solar Farm	Greenough River Solar Farm (joint venture between Synergy and GE Energy Financial Services)	298
239	Nyngan Solar Plant	AGL Energy	437

ID	Title	Organisation	Page

Literature Review

260	Characterising the effect of high penetration solar intermittency on Australian electricity networks	CSIRO	169
311	Effects of PV and CFLs on the Grid	Ergon Energy	228
361	Facilitating Local Network Charges and Virtual Net Metering (VNM)	Institute for Sustainable Futures (ISF)	263
253	FPDI: Analysis of Demand-Side Management Opportunities	Clean Energy Council	272
256	FPDI: Demand Side Management Technology Testing	Clean Energy Council	275
254	FPDI: Review of Policies and Incentives	Clean Energy Council	278
272	FPDI: Review of work undertaken to date	Clean Energy Council	281
265	Planning Future Energy Grids: Renewables	Queensland University of Technology	463
284	The Impact of High Penetration of Solar Photovoltaic Systems on Low Voltage Feeder Power Quality	University of Wollongong	596

Load Monitoring & Analysis

140	Alice Solar City	Alice Springs Town Council (ASTC)	116
170	Customer-Led Network Revolution	Northern Powergrid	187
220	E-DeMa Project	RWE Deutschland AGE	220
221	Enel Info+ Project	Enel Distribuzione	239
154	Reward Based Tariffs Trial	Ergon Energy and Energex	514
56	Unlocking the grid: the future of the electricity distribution network	Barbara Hardy Institute - University of South Australia	620
37	What Happens When We Un-Plug: Exploring the Consumer and Market Implications of Viable Off-Grid Energy Supply	Energy for the people and Alternative Technology Association (ATA)	636

ID	Title	Organisation	Page
261	Improving translation models for predicting the energy yield of photovoltaic power systems	CSIRO	342
161	SYSERWIND – System Services Provided by wind farms	Iberdrola	577

Projects: by Result

ID	Title	Organisation	Page

Adding thermal systems to building integrated PV (BIPV) increases efficiency

ID	Title	Organisation	Page
244	Expanding the Value Proposition for Building Integrated Photovoltaics (BIPV): Thin Film Building Integrated Photovoltaic Thermal (BIPVT) Retrofitting of Buildings	BlueScope Steel Limited	260

Adsorption Air Conditioning Not economical

ID	Title	Organisation	Page
309	Adsorption Solar Air Conditioning	Ergon Energy	111

Applicable to remote power grids

ID	Title	Organisation	Page
196	King Island Renewable Energy Integration Project (KIREIP)	Hydro Tasmania	367

Battery storage can reduce the demand on the Single Wire Earth Return (SWER)

ID	Title	Organisation	Page
327	Grid Utility Support System (GUSS)	Ergon Energy	305

Biogas facility can be used to provide storage

ID	Title	Organisation	Page
166	Smart Country	RWE Deutschland AG	540

Built a portable solar farm

ID	Title	Organisation	Page
130	Redeploy able Hybrid Power	Laing O'Rourke	482

Communications networks are needed to support distributed generation

ID	Title	Organisation	Page
316	PRIME PLC Evaluation	Energex	474
158	SGSC: Active Volt-Var Control Project	Ausgrid (Lead Organisation) and consortium partners	518

Confidential information

ID	Title	Organisation	Page
311	Effects of PV and CFLs on the Grid	Ergon Energy	228

ID	Title	Organisation	Page
224	Expanding the Value Proposition for Building Integrated Photovoltaics (BIPV): Thin Film Building Integrated Photovoltaic Thermal (BIPVT) Retrofitting of Buildings	BlueScope Steel Limited	362
243	Low cost building-integrated photovoltaics (BIPV) for Australian residential and commercial/industrial rooftop power generation	BlueScope Steel Limited	388

Control over PV inverter settings needed by networks

11	Alice Springs High Penetration PV Study report	Australian PV Institute (APVI)	119

Cost reflective tariffs had little impact on customer behaviour

140	Alice Solar City	Alice Springs Town Council (ASTC)	116

Critical Peak Pricing encourage consumer to reduce electricity usage

139	Adelaide Solar City	Origin	104

CSP could avoid the need for network augmentation in constrained areas

47	Breaking the solar gridlock	The Australian Solar Thermal Energy Association (AUSTELA)	148

Customer engagement achieved

313	Commercial & Industrial Demand Management (DM)	Energex	181
317	Residential Demand Management	Energex	509
328	Smart City Búzios	Ampla Energia e Serviços	536
306	Talking Power customer engagement process	SA Power Networks	580

Demand charges improve customer equity

116	A Distributed Energy Market: Consumer & Utility Interest, and the Regulatory Requirements	Australian PV Institute (APVI)	86
113	Impacts of PV, AC, and Other Technologies and Tariffs on Consumer Costs	Australian PV Institute (APVI)	333
305	Modelling the impact of various tariff structures on distributed energy resource take-up and electricity pricing	SA Power Networks	421
303	Survey of likely take-up of a voluntary residential capacity based tariff	SA Power Networks	573

ID	Title	Organisation	Page

Dispersion of distributed energy can reduce localised voltage and stability issues

11	Alice Springs High Penetration PV Study report	Australian PV Institute (APVI)	119
238	Analysis of Variations in Instantaneous Weather Effects across the Geographic Boundaries of an Electricity Grid, and the Development of an Improved Estimate for Maximum Solar Grid Penetration without Energy Storage	CAT Projects	129
252	Optimal deployment of renewable resources in a distribution network	Monash University	444

Distributed energy benefits from strong policy backing

278	Renewable Islands: Setting for Success	International Renewable Energy Agency (IRENA)	494

Distributed energy is currently disadvantaged by regulation

116	A Distributed Energy Market: Consumer & Utility Interest, and the Regulatory Requirements	Australian PV Institute (APVI)	86

Distributed energy resources need careful planning, analysis and predictive algorithms

278	Renewable Islands: Setting for Success	International Renewable Energy Agency (IRENA)	494

Distributed energy resources were not able to ride through network faults

301	Large Embedded Generation Project	Ausgrid	375

Distributed energy solutions derive value from being grid-connected

229	The Integrated Grid Project	The Electric Power Research Institute	603

ID	Title	Organisation	Page
Distributed energy solutions need access to better network information			
47	Breaking the solar gridlock	The Australian Solar Thermal Energy Association (AUSTELA)	148
Distributed energy solutions not currently integrated into network			
229	The Integrated Grid Project	The Electric Power Research Institute	603
Distributed energy solutions reduce energy consumed from the network			
142	Central Victoria Solar City Household Trial	Sustainable Regional Australia (SRA)	163
352	Hervey Bay Hospital Solar	Queensland Health	311
353	Mackay Sugar Cogeneration Plant	Mackay Sugar Ltd	401
143	Perth Solar City	Western Power	455
145	Townsville Solar City	Ergon Energy	617
Dynamic Line Rating allows high transmission capacities			
162	NETFLEX – Network-enhanced flexibility	Elia System Operator S.A.	424
Enables energy efficiency in smart cities			
319	BESOS Project	ETRA I+D	144
328	Smart City Búzios	Ampla Energia e Serviços	536
Energy storage and reactive power can help control voltage			
185	Grid Interactive Inverter program	Essential Energy	301
279	Residential Utility Support System (RUSS)	Ergon Energy	512

Existing networks are capable of handling large electric vehicle uptake

ID	Title	Organisation	Page
194	The impact of the mass adoption of electric vehicles on the Australian electricity grid.	The University of Melbourne	599

Feed-in tariff auction price lower than expected

ID	Title	Organisation	Page
257	ACT Large-scale Solar Feed-in Tariff Auction	Environment and Sustainable Development Directorate	97

Greater renewable penetration enabled by smart technologies

ID	Title	Organisation	Page
162	NETFLEX – Network-enhanced flexibility	Elia System Operator S.A.	424

Harmonics are a significant source of increased losses

ID	Title	Organisation	Page
259	Impact of Increasing Harmonic Levels on Distribution System Equipment	University of New South Wales	330

High degree of variability observed

ID	Title	Organisation	Page
279	Residential Utility Support System (RUSS)	Ergon Energy	512

Home DC network with PV successfully implemented

ID	Title	Organisation	Page
172	SoLa Bristol	Western Power Distribution	558

Identified adoption rates

ID	Title	Organisation	Page
291	Townsville PV/ EV/ DS impacts	Ergon Energy	615

Incentives helped consumers reduce consumption during peak demand

ID	Title	Organisation	Page
313	Commercial & Industrial Demand Management (DM)	Energex	181
325	eTelligence Project	EWE AG	252
317	Residential Demand Management	Energex	509
295	Summer Energy Demand Trial	United Energy	571

Increasing the reliability of Dynamic Line Rating (DLR) solutions

ID	Title	Organisation	Page
163	FLEXGRID – Improving the flexibility of the grid	Red Eléctrica de España	268

ID	Title	Organisation	Page
Inform the public discussion on the future of the electricity industry			
245	Future Grid Forum	CSIRO	289
Information alone can have a behaviour changing effect			
285	BDR Project	Opower	138
142	Central Victoria Solar City Household Trial	Sustainable Regional Australia (SRA)	163
165	MeRegio (Minimum Emission Region)	ENBW	413
143	Perth Solar City	Western Power	455
320	Renewables-based Neighbour Comparisons Project	Opower	497
In-home display devices help consumers understand their energy consumption			
139	Adelaide Solar City	Origin	104
167	Isernia Smart Grid Project	Enel Distribuzione	352
143	Perth Solar City	Western Power	455
258	Residential Building Energy Efficiency	CSIRO	505
Integrated resource planning would help promote distributed energy			
116	A Distributed Energy Market: Consumer & Utility Interest, and the Regulatory Requirements	Australian PV Institute (APVI)	86
Inverters with advanced functionality help manage high penetration of PV			
234	Analysis of High-Penetration Levels of PV into the Distribution Grid in California (NREL/SCE High-Penetration PV Grid Integration Project)	National Renewable Energy Laboratory	125
Issues with distributed energy resources often go unreported			
10	Carnarvon High Penetration PV Study report	Australian PV Institute (APVI)	158

ID	Title	Organisation	Page
Load control events on average led to load decreases			
288	Smart End-Use Energy Storage and Integration of Renewable Energy Pilot(EnerNOC BPA Pilot)	EnerNOC	543
Load reduction defers network augmentation			
145	Townsville Solar City	Ergon Energy	617
Low income households may reduce their electricity usage during peak			
154	Reward Based Tariffs Trial	Ergon Energy and Energex	514
Low Voltage network support batteries effective in reducing impact			
236	LV Network Modelling	SP AusNet	395
Machine learning and computer vision techniques improve forecasting			
263	Machine learning based forecasting of distributed solar energy production	The Australian National University and NICTA	398
Mapped potential for distributed energy resources			
249	ACT District Energy	AECOM	95
308	The National Feeder Taxonomy Study	CSIRO and Ausgrid	609
138	Urban Solar Atlas City of Port Phillip	Entura Hydro Tasmania	625
Market reform is needed			
116	A Distributed Energy Market: Consumer & Utility Interest, and the Regulatory Requirements	Australian PV Institute (APVI)	86
278	Renewable Islands: Setting for Success	International Renewable Energy Agency (IRENA)	494
229	The Integrated Grid Project	The Electric Power Research Institute	603

ID	Title	Organisation	Page
Micro grids will be viable in the near future			
37	What Happens When We Un-Plug: Exploring the Consumer and Market Implications of Viable Off-Grid Energy Supply	Energy for the people and Alternative Technology Association (ATA)	636
Moderate to high PV penetration observed on most feeders			
232	Maximum Photovoltaic Penetration Levels on Typical Distribution Feeders	National Renewable Energy Laboratory	411
No results yet			
266	Accelerating Renewable Connections	Scottish Power Energy Networks (SP Energy Networks)	90
251	ACT Community Solar Scheme	Environment and Sustainable Development Directorate	93
219	ADDRESS French Pilot	EDF SA	101
240	Broken Hill Solar Plant	AGL Energy	151
292	Capacity Limiting	United Energy	156
302	CBD Embedded Generation Project	Ausgrid	161
286	CIVIS Project	University of Trento	176
26	Climate-based PV Performance and Reliability	Australian PV Institute (APVI)	179
271	Customer PV Voltage Control Project	Ergon Energy	185
170	Customer-Led Network Revolution	Northern Powergrid	187
293	Direct Load Control of Pool Pump/AC	United Energy	202
329	Distribution Scale Energy Storage	Isentropic Ltd	204
315	Distribution Transformer Low Voltage Circuit Monitoring	Energex	207
318	E.ON Smart Grid Control Centre	Ventyx	213
227	ECOGRID EU	Energinet.dk	216
220	E-DeMa Project	RWE Deutschland AGE	220
273	Education Queensland	Ergon Energy	223
287	E-harbours Project	Municipality of Zaanstad	230

ID	Title	Organisation	Page
362	Mapping Potential Network Opportunities for Renewable Energy and Demand Management	Institute for Sustainable Future	407
239	Nyngan Solar Plant	AGL Energy	437
268	Off-river pumped hydro Electricity storage	Australian National University	439
324	Opower's Data Presentment Project	Opower	441
350	Pacific Northwest Smart Grid Demonstration Project	Battelle	451
127	Plug and Play Solar: Simplifying the Integration of Solar Energy in Hybrid Applications	CSIRO	466
316	PRIME PLC Evaluation	Energex	474
351	Qingdao OES Independent Power System Demonstration Project	CNOOC Group	478
250	Recovery of Resources from Biomass and Residual Waste and Sustainable Development	ACT Government, Environment Directorate	480
174	Reforming the Energy Vision (REV)	New York Department of Public Service (NYDPS)	485
241	Residential Battery Storage Trial	SP AusNet	502
300	SGSC: Newington Grid Battery Trial	Ausgrid	524
186	SGSC: Smart Grid, Smart City Project (Overall)	Ausgrid	527
159	SGSC: Substation and Feeder Monitoring	Ausgrid and consortium partners	531
179	Shanghai World Expo	State Grid Corporation of China (SGCC)	533
180	Smart Grid Gotland	Vattenfall	549
178	Smart Melit	Toyota City	553
172	SoLa Bristol	Western Power Distribution	558
114	Staged Development of an Interactive Australian PV Solar Mapping Resource	Australian PV Institute (APVI)	566
225	Stockholm Royal Seaport Project	Stockholm Municipality	568
226	T-City Project	Deutsche Telekom (T-Systems)	583
262	The ANU Solar Radiation and Cloud Measurement Network	The Australian National University	588

ID	Title	Organisation	Page
307	The Future Grid Research Program	The University of Sydney	590
298	UQ 1.22 MW Solar PV Array	University of Queensland	623
296	Virtual Power Plant	United Energy	627
242	Volt VAR Strategy	CitiPower and Powercor	632
217	Weipa Solar Farm	Weipa Solar Farm Pty Ltd	634
76	Yokohama Smart City HEMS Project	Yokohama city	693
177	YSCP CEMS Project	Toshiba Japan	642

Planning tool achieved network savings

265	Planning Future Energy Grids: Renewables	Queensland University of Technology	463

Planning tool used for regulatory planning

265	Planning Future Energy Grids: Renewables	Queensland University of Technology	463

Policy recommendations

275	Improving China's Existing Renewable Energy Legal Framework: Lessons from the International and Domestic Experience	Natural Resources Defense Council	339

Produced a GIS model of electricity demand

56	Unlocking the grid: the future of the electricity distribution network	Barbara Hardy Institute - University of South Australia	620

Produced information resources

235	An advanced platform for development and evaluation of grid interconnection systems using hardware-in-the-loop	National Renewable Energy Laboratory	122
297	DOE Global Energy Storage Database	Scandia National Laboratories, Department of Energy	209
244	Expanding the Value Proposition for Building Integrated Photovoltaics (BIPV): Thin Film Building Integrated Photovoltaic Thermal (BIPVT) Retrofitting of Buildings	BlueScope Steel Limited	260

ID	Title	Organisation	Page
124	Improving accessibility of the System Advisor Model (SAM) for Australian concentrating solar power users	Australian Solar Thermal Energy Association (AUSTELA)	336
281	Network solar policy	Citipower and Powercor	431
270	Solar Resource Mapping for High Prospectively Regions	Geoscience Australia	564
269	Virtual Power Station	CSIRO	629

PV alone does not reduce peak demand

299	Effect of Small Solar PV System on Peak Demand	Ausgrid	225
6	Evaluating the benefits of implementing existing storage technologies with residential PV rooftop systems and Renewable Energy	University of New South Wales, School of Photovoltaics	258
136	SGSC: Distributed Generation and Storage	Ausgrid	521

PV anti-islanding protection needs improvement

11	Alice Springs High Penetration PV Study report	Australian PV Institute (APVI)	119
10	Carnarvon High Penetration PV Study report	Australian PV Institute (APVI)	158

PV can reduce household consumption through behaviour change

140	Alice Solar City	Alice Springs Town Council (ASTC)	116

PV can reduce the impact of installing air conditioners (AC)

113	Impacts of PV, AC, and Other Technologies and Tariffs on Consumer Costs	Australian PV Institute (APVI)	333

PV has a disproportionate impact on black coal generation

188	The Impact of distributed solar generation on the wholesale electricity market	Melbourne Energy Institute (University of Melbourne)	593

ID	Title	Organisation	Page
PV installation did not cause significant effects on the network			
230	High Penetration Photovoltaic Case Study Report	National Renewable Energy Laboratory	314
231	Photovoltaic Systems Interconnected onto Secondary Network Distribution Systems – Success Stories	National Renewable Energy Laboratory	458
PV islanding not currently an issue			
9	Magnetic Island and Townsville Solar City: A Case Study of Increasing PV Penetration in Electricity Networks	Australian PV Institute (APVI)	404
PV reduces spot market prices			
188	The Impact of distributed solar generation on the wholesale electricity market	Melbourne Energy Institute (University of Melbourne)	593
PV requires significant spinning reserve to maintain network stability			
10	Carnarvon High Penetration PV Study report	Australian PV Institute (APVI)	158
PV safety issues still persist			
10	Carnarvon High Penetration PV Study report	Australian PV Institute (APVI)	158
PV tracking systems not financially viable			
155	Central Victoria Solar City Solar Park	Origin	166
PV voltage problems are contingent on the level of demand on the network			
304	Modelling the impact of distributed energy resources on the LV network	SA Power Networks	418

ID	Title	Organisation	Page

PV voltage problems can be resolved

ID	Title	Organisation	Page
10	Carnarvon High Penetration PV Study report	Australian PV Institute (APVI)	158
185	Grid Interactive Inverter program	Essential Energy	301
230	High Penetration Photovoltaic Case Study Report	National Renewable Energy Laboratory	314
9	Magnetic Island and Townsville Solar City: A Case Study of Increasing PV Penetration in Electricity Networks	Australian PV Institute (APVI)	404
304	Modelling the impact of distributed energy resources on the LV network	SA Power Networks	418
231	Photovoltaic Systems Interconnected onto Secondary Network Distribution Systems – Success Stories	National Renewable Energy Laboratory	458
158	SGSC: Active Volt-Var Control Project	Ausgrid (Lead Organisation) and consortium partners	518
136	SGSC: Distributed Generation and Storage	Ausgrid	521
166	Smart Country	RWE Deutschland AG	540

PV, if uncontrolled, can create voltage problems for the network

ID	Title	Organisation	Page
11	Alice Springs High Penetration PV Study report	Australian PV Institute (APVI)	119
233	Deployment of High prove control of distribution feeders by increasing metering and thus monitoring of the feeders, and also measuring solar irradiance to assess the impact on PV generation Resolution Real-Time Distribution Level Metering in Maui	National Renewable Energy Laboratory	196
236	LV Network Modelling	SP AusNet	395
9	Magnetic Island and Townsville Solar City: A Case Study of Increasing PV Penetration in Electricity Networks	Australian PV Institute (APVI)	404
304	Modelling the impact of distributed energy resources on the LV network	SA Power Networks	418
143	Perth Solar City	Western Power	455
136	SGSC: Distributed Generation and Storage	Ausgrid	521

ID	Title	Organisation	Page
161	SYSERWIND – System Services Provided by wind farms	Iberdrola	577
284	The Impact of High Penetration of Solar Photovoltaic Systems on Low Voltage Feeder Power Quality	University of Wollongong	596
145	Townsville Solar City	Ergon Energy	617

Quantity and placement of wind measurement devices is more important than accuracy

146	Emerging challenges in wind energy forecasting for Australia	Centre for Energy and Environmental Markets (CEEM) School of Photovoltaic and Renewable Energy Engineering, University of New South Wales, School of Physics, University of New South Wales	237

Raise the profile of large scale energy storage in Australia

213	Large Scale (e.g. Pumped Hydro) Energy Storage	University of Melbourne Energy Institute	379

Reduced customer load

309	Adsorption Solar Air Conditioning	Ergon Energy	111
310	PowerShade	Ergon Energy	472

Reduced reliance on diesel fuels

137	Doomadgee Solar Farm	Ergon Energy RFI Solar Q Energy	211
196	King Island Renewable Energy Integration Project (KIREIP)	Hydro Tasmania	367

Renters are dis-incentivised from adopting distributed energy

142	Central Victoria Solar City Household Trial	Sustainable Regional Australia (SRA)	163

ID	Title	Organisation	Page
Segmenting the network led to an increase in fault level			
282	TK NOAC scheme fault level mitigation	CitiPower Pty	613
Skillsets are needed to incorporate distributed energy resources			
278	Renewable Islands: Setting for Success	International Renewable Energy Agency (IRENA)	494
Smart Voltage Regulator can regulate voltage			
150	Smart Voltage Regulator	Ergon Energy	556
Solar air conditioning prototype developed and tested			
132	Solar Energy Management System (SEM) for Utilities	CSIRO Ergon Energy GWA Group	561
Solar Hot Water reduced electricity consumption			
140	Alice Solar City	Alice Springs Town Council (ASTC)	116
142	Central Victoria Solar City Household Trial	Sustainable Regional Australia (SRA)	163
Stand alone power solutions have limited applicability in the near future			
37	What Happens When We Un-Plug: Exploring the Consumer and Market Implications of Viable Off-Grid Energy Supply	Energy for the people and Alternative Technology Association (ATA)	636
Storage can be commercially viable with the right value stacking			
214	EPM FOA Frequency Regulation	Ecoult/East Penn Manufacturing	246

ID	Title	Organisation	Page
Storage can combine with PV to reduce peak demand			
237	Bega Library Solar Energy System	Essential Energy	141
277	China Southern Grid's Shenzhen Baoqing Battery Energy Storage Station	China Southern Power Grid	173
6	Evaluating the benefits of implementing existing storage technologies with residential PV rooftop systems	University of New South Wales, School of Photovoltaics and Renewable Energy	258
310	PowerShade	Ergon Energy	472
136	SGSC: Distributed Generation and Storage	Ausgrid	521
276	Zhangbei National Energy Storage and Transmission Demonstration Project (China)	State Grid of China (SGCC)	644
Storage can help control the ramp rate in a system with high renewable penetration			
215	Hampton Wind Farm	Ecoult	308
216	PNM Prosperity	PNM New Mexico	469
Storage can provide frequency regulation to support high penetrations of distributed energy resources			
214	EPM FOA Frequency Regulation	Ecoult/East Penn Manufacturing	246
216	PNM Prosperity	PNM New Mexico	469
Storage devices need careful planning, analysis and predictive algorithms			
155	Central Victoria Solar City Solar Park	Origin	166
136	SGSC: Distributed Generation and Storage	Ausgrid	521

ID	Title	Organisation	Page
Uptake of electric vehicle can lead to network failures in some cases			
194	The impact of the mass adoption of electric vehicles on the Australian electricity grid	The University of Melbourne	599
Voltage control scheme kept voltage variations within distribution code			
280	Leonards Hill Wind Farm	Hepburn Community Owned	385
Wind farms are not suitable for connection to weak distribution feeder networks			
280	Leonards Hill Wind Farm	Hepburn Community Owned	385
Wind generation had to be curtailed			
187	Integrating Renewable Energy - Wind Integration Studies Report	AEMO	349
196	King Island Renewable Energy Integration Project (KIREIP)	Hydro Tasmania	367
161	SYSERWIND – System Services Provided by wind farms	Iberdrola	577
Wind turbines can deliver all required balancing services			
164	DERINT - Large scale virtual power plant integration	DONG Energy	199

1. Solar PV Performance in Tropical Regions / 2. Technical issues in relation to high penetration of PV integrated into smart grid

Project ID	357
Organisation	James Cook University
Organisation Type	Research
Partners	
Story	
Start Date	2010
End Date	2013
Customer Segment	Large commercial, Residential
Customers Involved	1
Cost	60000
Funding Source	State Government
Network	Ergon Energy
Connection Point	Distribution Feeders
Location	Townsville
State	QLD
Country	Australia
Future Plans	Project 1: Data may be publicly available
Contact Name	Associate Professor Ahmad Zahedi
Contact Email	Ahmad.Zahedi@jcu.edu.au
Contact Phone	07-47816907
Contact Link	
Background	Power quality issue as a result of high penetration of solar PV connected to low to medium voltage electricity networks, voltage rise, reverse of power flow, frequency issue, etc.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	By writing and submitting report to the Ergon Energy	Low
	9. Strengthen the network to manage higher renewable energy penetration	By publishing journal and conference papers	Low

Approaches	Approach	Comments

Results	Result	Comments

A Distributed Energy Market: Consumer & Utility Interest, and the Regulatory Requirements

Project ID	116
Organisation	Australian PV Institute (APVI)
Organisation Type	Research
Partners	University of Arizona and CSIRO
Story	Over the years, the decline in Australia's residential electricity consumption has been driven by a combination of factors, including uptake of photovoltaics (PV) and energy efficiency (EE), and responses to increasing electricity prices. The uptake of PV and EE will continue to increase pressure on utilities' income stream and business models. This project aims to develop a new market in distributed energy (DE) services to extend utilities' roles beyond only electricity supply and sales. The project developed a structured approach involving focus groups and general public surveys, as well as interviews with the electricity industry, government agencies and regulators. Key results from this project are summarised below: 1) Integrated Resource Planning (IRP) should become an integral component of network planning so that distributed energy options can be used to decrease network expenditure. 2) Information and training, minimum energy performance standards, house energy rating schemes, feed-in tariffs and white certificate schemes have all been insufficient to effectively integrate distributed energy 3) To drive the uptake of distributed energy, consumers should be able to source their electricity from, and sell their PV electricity to, entities other than their retailer. 4) A regulatory framework based on equal competition between supply-side and demand-side options at all levels (generation, networks and retail), for both network planning and during the day-to-day operations of the electricity market, is required.
Start Date	01-09-2012
End Date	01-08-2013
Customer Segment	None
Customers Involved	
Cost	AUD 173,550
Funding Source	Federal Government , ARENA and the University of Arizona
Network	None
Connection Point	None
Location	
State	
Country	Australia
Future Plans	
Contact Name	Dr Muriel Watt
Contact Email	chair@apvi.org.au
Contact Phone	+61 427 727 368
Contact Link	http://apvi.org.au/a-distributed-energy-market-consumer-utility-interest-and-the-
Background	Over the years, the decline in Australia's residential electricity consumption has been driven by a combination of factors, including uptake of photovoltaics (PV) and energy efficiency (EE), and responses to increasing electricity prices. The uptake of PV and EE will continue to increase pressure on utilities' income stream and business models.

Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach	The project discusses allowing network operators to participate directly in the DE market, with appropriate safeguards such as one - way ring fencing, could help them diversify their business models, reducing their dependence on network tariffs, and again placing downward pressure on network costs. The review found that a proportion of network costs could be paid through a fixed daily charge based on a customer's contribution to network costs more related to their impact.	Med
	4. Inform the regulatory environment for renewable energy	This project proposes a regulatory framework that could form the basis of a distributed energy market that would optimise distributed energy's contribution to least-cost energy services and enable the existing electricity industry transition to the new normal.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The uptake of photovoltaic (PV) and energy efficiency (EE) is likely to continue and will put increasing pressure on utilities' income streams and business model. The responses by utilities and governments to date have essentially attempted to maintain the current business models, however, disruptive technologies such as PV and EE will likely drive the need for more fundamental changes.	Med

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Approaches	**Approach**	**Comments**
	Interviews and Surveys	The project involved focus groups and surveys of the general public, interviews with the electricity industry, government agencies and regulators.
Results	**Result**	**Comments**
	Distributed energy is currently disadvantaged by regulation	A regulatory framework based on equal competition between supply-side and demand-side options at all levels (generation, networks and retail), for both network planning and during the day-to-day operations of the electricity market is required.
	Integrated resource planning would help promote distributed energy resource	Best practice Integrated Resource Planning (IRP) should become an integral component of network planning so that distributed energy options can be used to decrease network expenditure. The proposed Regulatory Investment Test Distribution (RIT-D) is an embryonic form of IRP, but has significant scope for improvement.
	Demand charges improve customer equity	A proportion of network costs could be paid through a fixed daily charge based on a customer's monthly demand peak, making each customer's contribution to network costs more related to their impact. This approach is preferable to current suggestions of higher fixed charges for all customers, or specifically for PV customers, which would disadvantage low energy users and low-income households while also making price signals less cost-reflective.
	Market reform is needed	The important market arrangements required to drive the uptake of distributed energy on a daily basis are: 1) decoupling network operators' revenue from their sales through the use of a revenue cap; 2) mechanisms that allow network operators to participate in the distributed energy market (for example: one-way ring fencing); 3) consumers should be able to source their electricity from, and sell their PV electricity to, entities other than their retailer; and 4) solar access rights should be formalised.

Distributed energy is currently disadvantaged by regulation	Information and training, minimum energy performance standards, house energy rating schemes, and feed-in tariffs and white certificate schemes have been insufficient to effectively integrate distributed energy.

Accelerating Renewable Connections

Project ID	266
Organisation	Scottish Power Energy Networks (SP Energy Networks)
Organisation Type	Network
Partners	University of Strathclyde, Community Energy Scotland, Smarter Grid Solutions
Story	The network in some areas is now fast approaching saturation point as a consequence of the large volume of renewable generation that has already connected. As a result, the capacity available for future connections will be substantially constrained which, by traditional methods, would be facilitated through a programme of significant and costly network reinforcement. SP Energy Networks is developing an on-line analysis trial which will allow developers understand the electrical and financial viability of their project much quicker and without clogging up the Connections process. Using a 2 stage commercial agreement will allow renewable generators onto the network more quickly while signalling wider reinforcement works. Developers will only be given an active network management commercial agreement if they have planning permission, and the agreement will be withdrawn if project milestones are missed, thus avoiding network capacity being over-reserved.
Start Date	1-12-2013
End Date	31-12-2016
Customer Segment	Residential
Customers Involved	
Cost	GBP 8.4m
Funding Source	Regulator-Approved Spend Low Carbon Network Fund
Network	SP Energy Networks
Connection Point	
Location	Dunbar, Eccles and Berwick
State	East Lothian and the Borders
Country	United Kingdom
Future Plans	Yes. Project ends December 2016 but we hope to finish earlier and have the approach as "business as usual" by the end of the project date.
Contact Name	Euan Norris or John Moffat
Contact Email	Euan.Norris@scottishpower.com; jmoffat@scottishpower.com
Contact Phone	+ 44 (0) 141 614 1964; +44 (0) 141 614 3565
Contact Link	http://www.spenergynetworks.com/pages/arc_accelerating_renewable_connection
Background	The network in some areas is now fast approaching saturation point as a consequence of the large volume of renewable generation that has already connected. As a result, the capacity available for future connections will be substantially constrained which, by traditional methods, would be facilitated through a programme of significant and costly network reinforcement. Furthermore, the penetration of higher volumes of embedded generation on the distribution network is already having an impact upon the transmission system to the effect that, within some distribution network areas.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	1. We are developing an online curtailment analysis tool that is as accurate as can be made from data held within SP Energy Networks. This will allow developers to understand the electrical and financial viability of their project much quicker and without clogging up the connections process. 2. Using a 2 stage commercial agreement will allow renewable generators onto the network more quickly while signalling wider reinforcement works. Developers will only be given an active network management commercial agreement if they have planning permission, and the agreement will be withdrawn if project milestones are missed, thus avoiding network capacity being over-reserved.	Med
	8. Establish control over, otherwise influence, intermittent generation sources	Using active network management to control renewable generation in a real time basis allows generators to connect to the distribution network sooner while wider reinforcement work happens concurrently. Curtailment may be experienced by generators but full capacity will be reached on completion of wider reinforcement investment.	Med

Approaches	Approach	Comments
	Demonstration Project	Accelerating Renewable Connections project will facilitate the increased penetration of renewable generation gaining access to the distribution network in a timely manner. This will be achieved by; empowering customers to make informed choices relating to their connection requirements; apply novel commercial and technical approaches that will create the foundation for future connection options; inform the development of business processes required to facilitate a greater level of renewable generation; and build upon the learning developed from relatively small generation projects are unable to connect ahead of major previous and existing Low Carbon Network Funded reinforcement works being completed on the transmission system. Projects to date through collaborating with other distribution network partners.

Results	Result	Comments
	No results yet	Project is ongoing.

ACT Community Solar Scheme

Project ID	251
Organisation	Environment and Sustainable Development Directorate
Organisation Type	Government
Partners	
Story	One in ten Canberra households already has a rooftop solar installation – and this number continues to grow. For households living in apartments or renting however, accessing the benefits of solar can be a challenge. The ACT Government is providing the opportunity for individuals to pool their resources to fund large-scale solar projects, achieving economies of scale with the benefits of direct ownership. This opportunity is provided through a new feed-in tariff for community solar projects. The program will:- • help stimulate community owned medium/large scaled solar generators. • help make community owned solar generation a more accepted part of distributed energy generation. • develop information on preparedness of individual investors in the ACT to commit funds to community owned generators.
Start Date	16-06-2014
End Date	16-06-2015
Customer Segment	Residential
Customers Involved	None to date: program only just commenced
Cost	Around AUD 20,000
Funding Source	State Government
Network	ActewAGL
Connection Point	Distribution Feeders
Location	Canberra
State	ACT
Country	Australia
Future Plans	Possibly, depends on the success (or otherwise) of the scheme.
Contact Name	Greg Buckman
Contact Email	greg.buckman@act.gov.au
Contact Phone	02 62054435
Contact Link	http://www.environment.act.gov.au/energy/community_solar
Background	Program aims to give solar generation access to unit dwellers etc. that could not make use of the 2009 to 2011 ACT micro/medium solar feed in tariff scheme.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	The program will help stimulate community owned medium/large scaled solar generators. The project is currently underway and will be useful for other entities across Australia.	Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The program will help make community owned solar generation a more accepted part of distributed energy generation.	Low
	13. Store and organise information on customer renewable energy deployments	The program will develop information on preparedness of individual investors in the ACT to commit funds to community owned generators.	Med
Approaches	**Approach**	**Comments**	
	Feed-in Tariff	There are many different models for community energy projects which differ in terms of the extent of community involvement and ownership. The underlying principle however is that a collective of individuals and businesses build a generation facility which they then own. This is often undertaken through a partnership with an experienced developer. A direct grant of up to 20 cents per kilowatt-hour for 20 years will be available – slightly higher than the nation leading price achieved under the 2012 and 2013 ACT Large-scale Solar Auctions. The capacity release will be capped at one megawatt, equivalent to around 500 rooftop solar installations.	
Results	**Result**	**Comments**	
	No results yet	The program has just started, and is set to run for a year, so it's too early to assess its success.	

ACT District Energy

Project ID	249
Organisation	AECOM
Organisation Type	Research
Partners	ANU and ACT Government
Story	The ACT Government is considering whether and how to progress district energy systems in the Territory. Distributed generation could reduce demand spikes in key areas in the ACT, particularly the most valuable and sensitive business districts, by using waste heat to heat and cool buildings. Data was gained via interviews on the cost of installing district energy systems (natural gas fired tri-generation) with and without renewable elements (biogas, geothermal, solar thermal). The study included a supplementary report on the regulatory barriers to district energy systems in the ACT context. A new business model would be created around the sale of hot and cold water if this project proceeded to development. The study helped to start discussion around how the Government's policy, planning and regulatory areas would need to work together.
Start Date	01-02-2013
End Date	30-03-2014
Customer Segment	
Customers Involved	
Cost	AUD 120,000
Funding Source	State Government
Network	ActewAGL
Connection Point	
Location	Canberra
State	ACT
Country	Australia
Future Plans	The ACT Government is considering whether and how to progress district energy systems in the Territory.
Contact Name	Bruce Edgerton
Contact Email	bruce.edgerton@act.gov.au
Contact Phone	0402794905
Contact Link	
Background	ACT Climate Change Strategy and Action Plan

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	Data was gained on the cost of installing district energy systems (natural gas fired tri-generation) with and without renewable elements (biogas, geothermal, solar thermal)	Low
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	A new business model would be created around the sale of hot and cold water if this project proceeded to development	Low
	4. Inform the regulatory environment for renewable energy.	The study included a supplementary report on the regulatory barriers to district energy systems in the ACT context.	Low
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	If the Government is to facilitate the delivery of district energy systems it will require a whole of government planning approach. The study helped to start discussion around how the Government's policy, planning and regulatory areas would need to work together.	Low
	9. Strengthen the network to manage higher renewable energy penetration	Distributed generation could stabilise key areas in the ACT- particularly the most valuable and sensitive business districts	Low
	11. Alter local load profile to match a desired level	Using waste heat to heat and cool buildings reduces demand spikes.	Low
Approaches	**Approach**	**Comments**	
	Interviews and Surveys	The ANU students approached all building managers in 3 major ACT town centres (Civic, Woden, Belconnen)	
Results	**Result**	**Comments**	
	Mapped potential for distributed energy resources	The project evaluated a number of business districts and developed heating and cooling maps for these districts.	

ACT Large-scale Solar Feed-in Tariff Auction

Project ID	257
Organisation	Environment and Sustainable Development Directorate
Organisation Type	Government
Partners	
Story	Per the ACT Climate Change Strategy and Action Plan, this feed-in tariff auction is attempting to source more large-scale renewable generation in order to reduce the ACT's greenhouse gas emissions. The solar feed-in tariff auction led to the awarding of feed-in tariff entitlements for 40MW of large-scale solar generation with a weighted feed-in tariff price of $183/MWh which was well below industry expectations.
Start Date	27-1-2012
End Date	19-08-2013
Customer Segment	
Customers Involved	
Cost	AUD 634,000
Funding Source	State Government
Network	ActewAGL
Connection Point	Distribution Feeders, Sub transmission Feeders, Zone Substations
Location	Canberra
State	ACT
Country	Australia
Future Plans	The ACT Government is considering holding future solar and wind auctions.
Contact Name	Greg Buckman
Contact Email	greg.buckman@act.gov.au
Contact Phone	02 62054435
Contact Link	http://www.environment.act.gov.au/energy/solar_auction
Background	Per the ACT Climate Change Strategy and Action Plan, this feed-in tariff auction is attempting to source more large-scale renewable generation in order to reduce the ACT's greenhouse gas emissions.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	The security of a feed-in tariff, and the lack of need for a PPA, made the auction available to a broader range of developers than was the case with schemes like the Solar Flagships program.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The solar auction led to the development of the largest photovoltaic solar farm in Australia bringing with it considerable balance-of-system learnings and cost reductions.	Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	All three solar farms granted feed-in tariff entitlements under the solar auction are addressing network connection issues, their experience should increase network owner acceptance of distributed generation.	Low
Approaches	**Approach**	**Comments**	
	Feed-in Tariff	A feed-in tariff auction was used in attempting to source more large-scale renewable generation in order to reduce the ACT's greenhouse gas emissions.	
Results	**Result**	**Comments**	
	Feed-in tariff auction price lower than expected	The solar feed-in tariff auction led to the awarding of feed-in tariff entitlements for 40MW of large-scale solar generation with a weighted feed-in tariff price of $183/MWh which was well below industry	

ACT large-scale wind feed-in tariff auction II

Project ID	360
Organisation	ACT Government, Environment and Planning Directorate
Organisation Type	Government
Partners	
Story	Per the ACT Climate Change Strategy and Action Plan, this feed-in tariff auction will source more large-scale renewable generation in order to reduce the ACT's greenhouse gas emissions. This feed-in tariff reverse auction will source more large-scale renewable generation in order to reduce the ACT's greenhouse gas emissions. Proposals are directed by a Request for Proposals document and successful proposals are assessed and recommended by an independent Advisory Panel.
Start Date	10/08/2015
End Date	by February 2016
Customer Segment	
Customers Involved	
Cost	$250 000
Funding Source	State Government
Network	Relevant local NEM distribution or transmission network
Connection Point	Distribution Feeders, Sub transmission Feeders, Zone Substations
Location	Relevant local NEM distribution or transmission network
State	
Country	Australia
Future Plans	Are there any data model, or technical documentation which would be available to other organisations who want to adopt a similar approach - Yes, potential through the contact above.
Contact Name	Greg Buckman
Contact Email	Greg.buckman@act.gov.au
Contact Phone	0262054435
Contact Link	http://www.environment.act.gov.au/energy/wind_power
Background	Per the ACT Climate Change Strategy and Action Plan, this feed-in tariff auction will source more large-scale renewable generation in order to reduce the ACT's greenhouse gas emissions.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	Operational data from the wind farm(s) could provide metrics to quantify the benefits and costs of renewable energy.	None
	2. Support the transition to an alternative electricity pricing approach.	The reverse auction provides an alternative source of renewable energy support to the national Renewable Energy Target.	Low
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	The feed-in tariff/contracts-for-difference model encourages distributed generation.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The reverse auction process ensures that all new supported renewable energy has a support cost that is as competitive as possible.	Low
	14. Improve techniques for forecasting renewable energy output.	Potentially. Auction proposal output data could be used to help improve forecasting.	None

Approaches	Approach	Comments

Results	Result	Comments

ADDRESS French Pilot

Project ID	219
Organisation	EDF SA
Organisation Type	Network
Partners	Landis+Gyr and others
Story	The aim of the ADDRESS French pilot carried out in the Brittany Islands of Houat and Hoëdic was to test the whole ADDRESS chain, for example from the needs of the electricity system players to the controlled appliances in the consumers' premises, including also consumers' acceptance studies. Around 30 residential customers and a number of small commercial customers were involved in the project. Contracts signed between EDF and the customers included special clauses related to the protection of consumer data. Besides, a declaration of the consumer data collected was made to Commission nationale de l'informatique et des libertés (CNIL) and appropriate measures have been taken to ensure confidentiality of these data. This test will validate the whole ADDRESS chain: from Active Demand (AD) buyers to controllable appliances at the consumers' premises. The test will be performed in the Houat and Hoedic small islands, in the Brittany Region, under the responsibility of EDF.
Start Date	2012
End Date	2013
Customer Segment	Residential, SME
Customers Involved	Approximately 30 residential customers and a number of commercial customers
Cost	
Funding Source	Commercial Partner, Regulator-Approved Spend
Network	
Connection Point	Customer Connections
Location	Brittany Islands of Houat and Hoëdic
State	
Country	France
Future Plans	The project's result is under evaluation
Contact Name	Marie Miquel
Contact Email	
Contact Phone	
Contact Link	
Background	The recent development of Information and Communication Technologies, advanced metering systems, energy management at the local level (houses, commercial buildings, and industrial facilities) as well as household technologies open new opportunities for demand response. In this context, the ADDRESS European project ("Active Distribution networks with full integration of Demand and distributed energy RESourceS") aims to deliver a comprehensive commercial and technical framework or the development of "Active Demand" in the smart grids of the future, or in other words for the active participation of domestic and small commercial customers in the power system markets and in the provision of services to the different power system participants.

Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach.	Formulation of Active Demand (AD) needs and bids by players based on actual requests from electricity system functions/players or based on requests resulting from simulations of possible problems and players needs. To support this approach on the consumer side, both appropriate technologies have to be developed in the houses or at the interface with the aggregator, and relevant accompanying measures have to be studied to deal with societal, cultural and behavioural factors". Therefore, the project is relevant to Australian context. However, the degree of relevance need to be further evaluated.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	The ADDRESS project takes social validation and consumer engagement as an important focus, aiming to test how well consumers adjust their behaviours to Active Demand (AD). In particular, the AD pilot in France is carried out in the context of combining renewable generation and AD for load balancing.	Med
	11. Alter local load profile to match a desired level	Taking renewable energy production into account for load/generation balance and grid issues.	Med
Approaches	**Approach**	**Comments**	
	Demonstration Project	The main test objective of the French pilot is to demonstrate that the ADDRESS solution works from start to the end by means of: 1. Validation of market design (market simulator) and the ability of players to formulate AD needs and offers to the market or to the aggregator in case of bilateral relationships- Formulation of AD needs and bids by players based on actual requests from electricity system functions/players or based on requests resulting from simulations of possible problems and players needs;- Portfolio management by Aggregator;- AD offer formulation by Aggregator;- Simulated interaction of different entities with aggregation platform and market interaction. 2. Validation of technical validation of AD requests by DSO simulator 3. Validation of home system and interoperability/communication. 4. Verification of AD product provision to AD buyer and of consumers' response 5. Validation of consumer behaviour. 6. Test of combination of AD with Renewable Energy Sources (RES): taking RES production into account for load/generation balance and grid issues.	

Results	Result	Comments
	No results yet	The project's result is under evaluation

Adelaide Solar City

Project ID	139
Organisation	Origin
Organisation Type	Retailer
Partners	BP solar, Big Switch Projects, City of Salisbury, ANZ, and Delfin Lend Lease
Story	The focus of this program was to engage and encourage the residential and business communities to embrace energy efficiency and renewable energy technology to reduce their electricity use (consumption) and bills. The primary objective of the Adelaide Solar City demand management trial was to test consumer behaviours towards cost reflective electricity pricing products, smart metering and telecommunication technologies. To achieve this, Origin Energy introduced two cost reflective pricing structures (Critical Peak Pricing and Time of Use Pricing), implemented a metering and communications platform and provided participants with on line access and in-home displays to enable them to better understand their electricity consumption. The results of the projects were established through consumer questionnaires and data collected through the use of smart meter technologies. The key results from this trial are as follows: 1) Between the periods 2009 to 2011, Critical Peak Pricing participants reduced their electricity usage by an average of 14% on days when a critical peak event was called. 2) During the 2010/11 peak season, 7% of Time of Use Pricing participants (when compared to the control group) shifted their consumption from peak to off-peak periods. 3) 94% of surveyed participants agreed that in-home display devices helped them understand their energy consumption. Providing in-home displays to 481 participants resulted in a reduction of peak electricity consumption of 10.9% during
Start Date	2007-10-06
End Date	2013-06-30
Customer Segment	Large commercial, Residential
Customers Involved	2803 households
Cost	AUD 65M
Funding Source	Commercial Partner, Federal Government Australian Government and the Consortium
Network	SA Power Networks
Connection Point	Customer Connections, Distribution Feeders
Location	Adelaide
State	SA
Country	Australia
Future Plans	
Contact Name	Dario De Bortoli, Program Manager
Contact Email	
Contact Phone	the 2012 critical peak period.
Contact Link	http://www.originenergy.com.au/adelaidesolarcity
Background	The focus of this program was to engage and encourage the residential and business communities to embrace energy efficiency and renewable energy technology to reduce their electricity use (consumption) and bills.

Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach.	Through the cost reflective pricing the project aimed to identify customer preferences for different pricing structures, quantify the impact of behavioural change on energy consumption and determine the potential for replicating the pricing structure outside of the trial area.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	The primary objective of the Adelaide Solar City demand management trial was to test consumer behaviours towards cost reflective electricity pricing products, smart metering and telecommunication technologies.	High

Approaches	Approach	Comments
	Demand Side Incentives	Origin Energy introduced Critical Peak pricing, where energy rates would different during peak (more expensive) and off-peak (less expensive) periods to test consumer behaviour during times of high energy consumption.
	Demand Side Incentives	Origin Energy introduced Time of Use pricing plans which included flat rates during peak and off-peak periods, and seasonal pricing.
	Smart Meters and In-Home Displays	Origin Energy introduced a metering and communications platform and provided participants with on line access and in-home displays to enable them to better understand their electricity consumption.
	Interviews and Surveys	The results of the projects were established through consumer questionnaires and data collected through the use of smart meter technologies.

Results	Result	Comments
	Critical Peak Pricing encourage consumer to reduce electricity usage	Between the periods 2009 to 2011, Critical Peak Pricing participants reduced their electricity usage by an average of 14% on days when a critical peak event was called.

Results	Result	Comments
	Time of Use pricing leads to shift from on-peak to off-peak electricity usage	During the 2010/11 peak season, 7% of Time of Use Pricing participants (when compared to the control group) shifted their consumption from peak to off-peak periods.
	In-home display devices help consumers understand their energy consumption	94% of surveyed participants agreed that in-home display devices helped them understand their energy consumption. Providing in-home displays to 481 participants resulted in a reduction of peak electricity consumption of 10.9% during the 2012 critical peak period.

ADINE Project

Project ID	322
Organisation	Technology Centre Hermia Ltd
Organisation Type	Research
Partners	Tampere University of Technology, ABB Oy, Compower AB, Lund University, Nokian Capacitors Ltd and Jessler & Gsell GmbH
Story	The aim of ADINE project is to develop and to demonstrate new methods for the electric distribution network management including distributed generation (DG). The active network management (ANM) method needs enabling solutions such as protection, voltage and reactive power control and planning and information systems of networks. The actual devices and monitored data from the real-life demonstrations are taken into a combined real-time simulation environment in order to study the interaction of the demonstrations. The tasks of ADINE project include a description of active distribution network and the ANM method to be developed. The combined real-time simulation environment and the way of utilising it at the development of the ANM method are also researched.
Start Date	01-10-2007
End Date	31-12-2010
Customer Segment	Industrial
Customers Involved	3
Cost	AUD 4.64 M (EUR 3.2 M)
Funding Source	Regulator-Approved Spend
Network	Koillis-Satakunnan Sähkö Oy (Virrat, Finland), EirGrid (Dunneill, Irland) and
Connection Point	Distribution Feeders, Sub transmission Feeders, Zone Substations
Location	
State	
Country	Finland, Ireland and Sweden
Future Plans	There are some other European projects followed ADINE project
Contact Name	Sami Repo
Contact Email	sami.repo@tut.fi
Contact Phone	+358408490454
Contact Link	
Background	Since Distributed Generation (DG) often involves renewable energy, it is important to facilitate integration of DG into existing networks. This is the aim of the demonstration project ADINE. It is based on the Active Network Management (ANM) concept, where automation, ICT and power electronics are used to integrate more DG by exploiting active resources instead of just reinforcing the network. The resources are mobilized through ancillary services or requirements. Five enabling solutions within ANM are pushed forward in the project: Protection relay and fault location applications, coordinated protection planning, voltage

Areas of Relevance	Area	Comments	Relevance
	8. Establish control over, or otherwise influence, intermittent generation sources.	Centralized voltage control of medium voltage distribution network based on SCADA/DMS application. Decentralized voltage control of STATCOM and micro turbine. The objective of establishing control over distributed energy sources is quite relevant to Australian context. However, the specific technical design and applications need to be compared with the current situation and condition of Australian network.	Med
	9. Strengthen the network to manage higher renewable energy penetration	Coordinated voltage control may triple medium voltage network hosting capacity for wind power in case of weak distribution network. The focus here is to integrate wind power as one of the distributed renewable energy resources.	Med
	10. Smooth out intermittent generation output	Flicker, harmonics and voltage dip mitigation of distributed generation by STATCOM. Smoothing intermittent generation is quite an important focus and challenge for network companies, although the technical solutions might vary between ADINE and network companies in Australia.	Med
	12. Use distributed energy solutions to address network and system constraints	Active network management concept developed in the project utilise distributed energy resources for network management. The concept of the project fits quite well with the objective of turning renewables from the cause of network constraint to the solution of the issue. Therefore, it is relevant to Australian context.	High

Approaches	Approach	Comments
	Volt / VAR Control	The overall goal of the project is to develop new Active Network Management (ANM) method and enabling solutions to demonstrate the viability of the new method. The goal is achieved through a series of focused and well-coordinated research, technological development, demonstration, dissemination and project management activities. These activities are organized in a number of sub projects (SP) each one combining the logical tasks and complementing resources: SP1 - Project management and dissemination SP2 - Protection of distribution network including DG SP3 - Voltage control of distribution network including DG SP4 - Flexible STATCOM for distribution network SP5 - Development of Active Network Management method.

Results	Result	Comments
	Developed grid support functions	During the project, following enabling solutions were developed and demonstrated: new protection devices, fault location algorithms and coordinated protection planning to adopt the easy interconnection of DG; local voltage control of DG; centralized voltage control of a medium voltage network; new-generation separate compensator STATCOM capable of filtering harmonics, eliminating flickers, compensating reactive power, improving recovery of the network during line fault and controlling the voltage level of the distribution network. The extraordinary feature of this project was to develop and demonstrate the active network management (ANM) method and the enabling solutions simultaneously. As the result ANM is increasing the security of distribution grids, improving the stability of the grid in fault situations and enhancing the optimal management of network. This adds value at European level by increasing the potential for renewable energy and by enabling more efficient management of distribution network assets for network owners. Second the concept of ANM was demonstrated in real-time simulation environment which includes models like DG, STATCOM and distribution network, real devices like control, protection and communication devices and SCADA/DMS and relay configuration and setting software in one combined demonstration. The concept of ANM was also developed in order to allow easier interconnection of DG units.

Results	Result	Comments
		Active network management method developed during the project is strongly based on current practices and available technical solutions. All developed and tested technical solutions and methods are ready for commercial use or product development for commercial use. That is why the feedback of test site owners has been encouraging. They like to see solutions and methods which are useful for their current challenges.

Adsorption Solar Air Conditioning

Project ID	309
Organisation	Ergon Energy
Organisation Type	Network
Partners	
Story	The adsorption solar air conditioning project aimed to determine the cost effectiveness of adsorption chillers for solar cooling. It also looked to determine the reduction in peak demand available from adsorption chillers as a replacement for traditional split systems using hot water storage as a method to store the hot water for peak usage without sunshine. The project trialled solar assisted space cooling via Zeolite-based adsorption chillers to provide cooling from solar radiation. The results have shown a reduction of kVA and kWh load.
Start Date	01-10-2010
End Date	01-05-2013
Customer Segment	
Customers Involved	1
Cost	AUD 114,000
Funding Source	
Network	Ergon Energy
Connection Point	Customer Connections
Location	Blackall
State	QLD
Country	Australia
Future Plans	
Contact Name	Michelle Taylor
Contact Email	michelle.taylor@ergon.com.au
Contact Phone	
Contact Link	
Background	The primary goals of the project are to: - Determine the cost effectiveness of adsorption chillers for solar cooling- Determine the reduction in peak demand available from adsorption chillers as a replacement for traditional split systems using hot water storage as a method to store the hot water for peak usage without sunshine- Compare the results against the Climate well solar cooling project for performance and cost effectiveness.

Areas of Relevance	Area	Comments	Relevance
	12. Use distributed energy solutions to address network and system constraints	The project uses distributed energy resources to reduce customer load. The project has already demonstrated reduced kVA and kWh load.	Med

Approaches	Approach	Comments
	Demonstration Project	The project trialled solar assisted space cooling via Zeolite-based adsorption chillers to provide cooling from solar radiation. The project has worked in conjunction with other programs in western Queensland for demand reduction, with a site location in a demand management area.

Results	Result	Comments
	Adsorption Air Conditioning Not economical	Analysis completed about this generation of solar conditioning has shown it to not be economical at this stage or to be suitable for remote and regional locations. Please contact the project contact for more information.
	Reduced customer load	The solar air conditioning demonstrated a reduce kVA and kWh load. Please contact the project contact for more information.

Agua Caliente Solar Project

Project ID	247
Organisation	First Solar Inc.
Organisation Type	Proponent
Partners	NRG Energy and Mid-American Renewables LLC
Story	The project was developed to meet a PPA agreement under the California Renewables Portfolio Standard (RPS). Being the largest commissioned PV plant in the world, there was the opportunity to develop and implement grid integration solutions that have not been possible on previous projects. Integration of utility scale projects on a grid requires plants to operate in a way that fosters stability and reliability of the grid and meet requirements typically expected of conventional plants. The Agua Caliente project developed ways to integrate renewables into the grid more effectively and to provide grid support. Additionally, site installation efficiencies that were already an industry benchmark continued to be improved during the duration of the implementation phase of the project, further bringing down the cost of implementing PV plants. Grid support functions were developed to enable plants to provide voltage regulations, active power management, and frequency drop and fault ride-through capability. Such capability enables PV plants of this scale to provide grid support when grid disturbances occur, rather than shutdown in an anti-islanding mode required for small-scale PV systems in Australia.
Start Date	01-01-2008
End Date	29-04-2014
Customer Segment	
Customers Involved	1
Cost	>AUD 600M
Funding Source	Commercial Partner
Network	Other
Connection Point	Subtransmission Feeders
Location	Yuma County
State	Arizona
Country	United States
Future Plans	First Solar will be providing operations and maintenance services to the plant owners
Contact Name	Mahesh Morjaria
Contact Email	mahesh.morharia@firstsolar.com
Contact Phone	
Contact Link	http://www.firstsolar.com/Home/About=Us/Projects/Agua-Caliente-Solar-Project
Background	The project was developed to meet a PPA agreement under the California Renewables Portfolio Standard (RPS). Being the largest commissioned PV plant in the world, there was the opportunity to develop and implement grid integration solutions that have not been possible on previous projects, but can now be implemented on future utility scale projects.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	Integration of utility scale projects on a grid requires plants to operate in a way that fosters stability and reliability of the grid and meet requirements typically expected of conventional plants. The grid integration technologies developed for the Agua Caliente have been successfully demonstrated and adopted for other utility-scale PV plants.	High
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The Agua Caliente project not only developed ways to integrate renewables into the grid site installation efficiencies that were already an industry benchmark continued to be improved during the duration of the implementation phase of the project, further bringing down the cost of implementing PV plants.	High
	8. Establish control over, or otherwise influence, intermittent generation sources.	In addition to point 3 above, control systems for utility scale plants were further developed for the requirements of such a large plant, which can be implemented on all sizes of utility scale plants going forward.	Med
	9. Strengthen the network to manage higher renewable energy penetration	Grid support functions were developed to enable plants to provide voltage regulations, active power management, frequency drop and fault ride-through capability. Such capability enables PV plants of this scale to provide grid support when grid disturbances occur, rather than shutdown in an anti-islanding mode required for small-scale PV systems in Australia.	High

Approaches	Approach	Comments
	Large Scale Renewable Plant	As one of the first utility-scale PV plants to be connected to a 500kV transmission line, it has pioneered several innovations in PV plant capability to meet specific requirements for grid reliability and stability as recognized by the NERC. These innovative features include the abilities to regulate voltage, reactive power and power factor; control active power, ramp rates, and curtail power when necessary; ride through faults and disturbances and minimize the intermittency impacts of clouds through optimized use of available generation. The plant can also be controlled remotely to meet grid operator's commands or provide direct controls to grid operator.

Results	Result	Comments
	Developed grid support functions	Grid support functions were developed to enable plants to provide voltage regulations, active power management, frequency drop and fault ride-through capability. Such capability enables PV plants of this scale to provide grid support when grid disturbances occur, rather than shutdown in an anti-islanding mode required for small-scale PV systems in Australia. The project was successfully commissioned in early 2014. It has continued to meet its performance and financial objectives. The grid integration technologies developed for the Agua Caliente have been successfully demonstrated and adopted for other utility-scale PV plants.

Alice Solar City

Project ID	140
Organisation	Alice Springs Town Council (ASTC)
Organisation Type	Government
Partners	Power and Water Corporation, Northern Territory Government (NTG), Arid Lands Environment Centre (ALEC), Northern Territory Chamber of Commerce and Industry (NTCCI), and Tangentyere Counci
Story	The Alice Solar City project sought to demonstrate the impacts of integrating cost-reflective pricing with the uptake of solar, energy efficiency and smart metering technologies. It aimed to introduce policy and procedural changes to facilitate the adoption of PV and smart meter technologies, energy efficiency and load management measures (including cost-reflective pricing).Alice Solar City approached the project through an analysis of customer electricity consumption patterns using home energy surveys as well as follow-up services and support. Cost-reflective tariffs were introduced to offer a more accurate account of households' electricity usage at different times, while smart metering and in-house displays for consumption statistics served as stakeholders' ongoing support tools. Those homeowners who opted to install a subsidised PV system and sell electricity back to the grid were rewarded with an elevated buy-back tariff. Rewards were also given to stakeholders who achieved set percentage reductions in their power consumption. It was found that, on average, customers reduced energy consumption by 4% in the first year and by a further 1.5% the following year after installing PV systems. The financial benefits reaped by CRT customers were not significant enough to sway energy usage behaviours. As such, it was determined that a tariff needs to offer substantial financial attractiveness to have a sizeable leverage on energy usage behaviours. Solar hot water installation resulted in the largest reductions in electricity consumption out of all energy efficiency measures
Start Date	10-03-2008
End Date	01-06-2013
Customer Segment	Industrial, Large commercial, Residential
Customers Involved	2711
Cost	AUD 42M
Funding Source	Commercial Partner, Federal Government
Network	Power and Water (NT)
Connection Point	Customer Connections
Location	Alice Spring
State	NT
Country	Australia
Future Plans	
Contact Name	
Contact Email	
Contact Phone	
Contact Link	http://www.alicesolarcity.com.au/research-and-reports
Background	The Alice Solar City project was designed to combat increasing energy costs resulting from rising peak electricity demand levels across Australia, increasing concern over greenhouse gas emissions, and growing interest in solar energy technology.

Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach.	Demonstrate the economic and environmental impacts of integrating cost-reflective pricing with the concentrated uptake of solar, energy efficiency and smart metering technologies.	Med
	4. Inform the regulatory environment for renewable energy.	Introduce a change in policies, guidelines or mandatory requirements that facilitate the adoption of photovoltaic (PV) and smart meter technologies, energy efficiency and load management measures (including cost-reflective pricing).	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	The Alice Solar City project sought to demonstrate the impacts of integrating cost-reflective pricing with the uptake of solar, energy efficiency and smart metering technologies.	High

Approaches	Approach	Comments
	Load Monitoring & Analysis Home Energy Audits	Analysis of customer electricity consumption patterns. Free home energy surveys with tailored advice and options for follow-up support.
	Demand Side Incentives	Cost reflective tariff, which provided different electricity tariffs for household electricity use during off-peak and peak times, with a safety net for participants to reduce their risk of paying more. Smart metering and in-house displays to provide interactive, visual information on electricity consumption, solar power generation, and costs.
	Feed-in Tariff	An elevated buy-back tariff for homeowners who chose to install an Alice Solar City subsidised photovoltaic system and to sell electricity back to the grid. Rewards for program participants who made set percentage reductions in their electricity consumption compared to their previous electricity accounts for the same billing period.

Results	Result	Comments
	PV can reduce household consumption through behaviour change	Residential customers did not see PV installation as enabling an increase in energy consumption. On average customers reduced their consumption by 4% in the first year and by a further 1.5% the following year after installing PV systems.
	Cost reflective tariffs had little impact on customer behaviour	While the Cost Reflective Tariff customers were able to benefit financially from the tariff, it was a small benefit with a resulting small leverage on energy usage behaviour. Transferable lessons: A tariff needs to offer substantial financial attractiveness to have a sizeable leverage on energy behaviours.
	Solar Hot Water reduced electricity consumption	Analysis of ongoing customer electricity consumption data showed that solar hot water installation resulted in the largest reductions in electricity consumption out of all of Alice Solar City's energy efficiency measures. Solar to solar replacement resulted in an average 11% reduction in annual consumption, while electric to solar resulted in a 16% reduction.

Alice Springs High Penetration PV Study report

Project ID	11
Organisation	Australian PV Institute (APVI)
Organisation Type	Research
Partners	Centre for Energy and Environmental Markets (CEEM) and Power and Water Corporation
Story	Alice Springs' electricity supply system is experiencing increasing levels of photovoltaic (PV) power system penetration. The intention of this case study is to enhance understanding of the technical, economic and regulatory requirements needed to facilitate high levels of PV penetration in electricity grids across Australia. Additionally, it seeks to identify and communicate Power and Water Corporation's (P&W) experiences with increasing levels of PV system penetration on the Alice Springs electricity supply system from a technical perspective. A case study approach was followed whereby discussions were held with staff from key stakeholder organisations, including P&W, Alice Solar City, CAT Projects and Agnew Solar, to collect information on PV penetration issues and experiences. P&W observed significant loss of PV power during several system frequency-drop events in 2010 and, as a result, reduced their low-frequency trip requirement for grid-connected PV inverters to 46Hz, below the lowest emergency load-shedding frequency level for the system. This was done to keep PV systems on-line for as long as possible during frequency-drop events to ensure the situation does not worsen during any rapid increase in system net load. This method could be useful to other utilities, particularly those with similarly small grids. Additionally, a good distribution of PV systems across the network can help reduce the effects on the system of passing clouds (intermittency). Also, the fact that P&W does not own or directly control its network's PV inverters may impose a notable problem in future as more inverters are connected to the network and the potential need for system-wide setting changes increases. In such a case, with third parties involved in the change process, complications may occur.
Start Date	
End Date	01-06-2011
Customer Segment	None
Customers Involved	
Cost	
Funding Source	Federal Government
Network	Power and Water (NT)
Connection Point	None
Location	Alice Spring
State	NT
Country	Australia
Future Plans	
Contact Name	Dr Muriel Watt
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Contact Link	http://apvi.org.au/alice-springs-high-penetration-pv-study-report/
Background	Alice Springs' electricity supply system is experiencing increasing levels of photovoltaic (PV) power system penetration. A good distribution of PV systems across the network can help to reduce localised concentrations of PV capacity and therefore help reduce localised PV penetration effects.

Areas of Relevance	Area	Comments	Relevance
	4. Inform the regulatory environment for renewable energy.	Enhance understanding of the technical, economic and regulatory requirements needed to achieve high levels of PV penetration in electricity grids in Australia.	Low
	9. Strengthen the network to manage higher renewable energy penetration	The specific objectives of the case study are to identify and communicate Power and Water corporation's key experiences to date with increasing levels of PV penetration on the Alice Springs electricity supply system, from a technical perspective, and to identify areas that may require further investigation and/or study.	Med

Approaches	Approach	Comments
	Case Study	Discussions with staff from key stakeholder organisations (Power and Water Corporation, Alice Solar City, CAT Projects and Agnew Solar) were conducted where information on PV penetration experiences and issues were collected. Electricity network systems and areas, and a selection of PV systems were visited in Alice Spring.

Results	Result	Comments
	Dispersion of distributed energy can reduce localised voltage and stability issues	The PV systems are reasonably well spread across the Alice network. A good distribution of PV systems across the network can help to reduce localised concentrations of PV capacity and therefore help reduce localised PV penetration effects. It can also help to reduce the effects on the system of passing clouds, particularly on the system-wide net power demand and hence the centralised generation system.

Results	Result	Comments
	PV anti-islanding protection needs improvement	Significant tripping of PV systems during system frequency drop events was observed. Power and Water Corporation have taken measures to address this issue by reducing inverter low-frequency trip requirements to 46Hz from 49.9Hz. This has been done to keep PV systems on-line for as long as possible during frequency-drop events to ensure the situation is not worsened by a resulting rapid increase in system net load. This may be of relevance/interest to other utilities, particularly those with similar "small grids".
	PV, if uncontrolled, can create voltage problems for the network	Power and Water Corporation has also identified three potential PV penetration effects/issues which are not currently causing problems on the network but may become more significant as PV penetration levels increase. These potential effects/issues are fluctuations in PV power output due to clouds (i.e. intermittency); potential effects on LV system voltage; and reactive power management.
	Control over PV inverter settings needed by networks	Power and Water Corporation (P&W) does not own or directly control the PV inverters connected to its network. It must direct the PV inverter owner or installer to change inverter settings if required by P&W, and this may not always occur in practice. This issue may increase in significance as more inverters are connected to the network and if future system-wide inverter setting changes are required.

An advanced platform for development and evaluation of grid interconnection systems using hardware-in-the-loop

Project ID	235
Organisation	National Renewable Energy Laboratory
Organisation Type	Government
Partners	
Story	An advanced electric power system (EPS) architecture, including increasing amounts of distributed resources, load control, bi-directional power flow, advanced metering, and improved communications is gaining attention and being implemented by many electric utilities. In support of this shifting energy paradigm and new EPS architecture, a swiftly increasing number of renewable energy-based DR installations are occurring, the majority at the EPS distribution system level. As these installations occur, it is essential to ensure that these systems, each of which interface to the EPS using a grid ICS, are properly interconnected with the EPS according to the relevant U.S. standards, which are UL 1741 and IEEE Std 1547. Using the Grid Interconnection System Evaluator an operator can now configure, run, monitor, and view analysed summary results for over/under voltage and frequency and unintentional islanding IEEE Std 1547 grid conformance tests from a single interface.
Start Date	2012
End Date	2013
Customer Segment	Large commercial, Residential, SME
Customers Involved	
Cost	
Funding Source	Federal Government
Network	
Connection Point	
Location	
State	
Country	United States
Future Plans	
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Background	An advanced electric power system (EPS) architecture, including increasing amounts of distributed resources, load control, bi-directional power flow, advanced metering, and improved communications is gaining attention and being implemented by many electric utilities. This new EPS architecture further enables consumer participation and assists utilities in efficiently accommodating various distributed resources (DRs), such as PV, wind, fuel cell, micro turbine, and energy storage technologies.

In support of this shifting energy paradigm and new EPS architecture, a swiftly increasing number of renewable energy-based DR installations are occurring, the majority at the EPS distribution system level. As these installations occur, it is essential to ensure that these systems, each of which interface to the EPS using a grid ICS, are properly interconnected with the EPS according to the relevant U.S. standards, which are UL 1741 and IEEE Std 1547. However, grid interconnection conformance is not the only essential aspect of determining the performance of an ICS; the device's performance under variable resource input and grid output conditions is also important. To this end, NREL has been developing a platform for ICS evaluation using HIL.

IEEE Std 1547, which was harmonized with UL 1741, was developed to provide a standard set of requirements surrounding issues such as voltage regulation, synchronization and isolation, response to abnormal grid conditions, power quality, and islanding for interconnecting ICS with the EPS. IEEE Std 1547.1, IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems, provides a comprehensive set of test procedures for use in determining if a particular ICS meets the requirements of IEEE Std 1547.

Areas of Relevance	**Area**	**Comments**	**Relevance**
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The project aimed to assess a Grid Interconnection System Evaluator (GISE) that leverages hardware-in-the-loop (HIL) simulation techniques to rapidly evaluate the grid interconnection standard conformance of an ICS according to the procedures in IEEE Std 1547.1™.	Med
Approaches	**Approach**	**Comments**	
	Electrical System Modelling	HIL simulation is a technique by which hardware systems and software models can be placed together into a single closed-loop simulation. This is accomplished by using a real-time simulator (RTS) that runs the software model and the communication interface between software and hardware deterministically and in actual time. It can be seen that the GISE is comprised of four major sections: 1. Electrical hardware setup 2. RTS and models 3. Results analyser and plotter 4. Graphical user interface.	
Results	**Result**	**Comments**	
	Produced information resources	Using the Grid Interconnection System Evaluator an operator can now configure, run, monitor, and view analysed summary results for over/under voltage and frequency and unintentional islanding IEEE Std 1547 grid conformance tests from a single interface. The accuracy, repeatability, and applicability to various ICS with different internal topologies of the GISE test execution were also demonstrated.	

Analysis of High-Penetration Levels of PV into the Distribution Grid in California (NREL/SCE High-Penetration PV Grid Integration Project)

Project ID	234
Organisation	National Renewable Energy Laboratory
Organisation Type	Government
Partners	Southern California Edison, Quanta Technology, Satcon Technology Cooperation, Electrical Distribution Design, Clean Power Research
Story	In 2009 Southern California Edison (SCE) was granted permission from the California Public Utility Commission (CPUC) to install a total of 500 MW of distributed photovoltaic (PV) energy within its utility service territory. Some of the PV system interconnections have resulted in distribution circuits that have a significant amount of PV generation compared to customer load, resulting in high-penetration PV integration scenarios. The objectives of this project are to model the expected impacts of high-penetration PV integration, measure the actual impacts of current high-penetration PV distribution circuits, develop, test and demonstrate mitigation techniques to reduce or limit the distribution system-level impacts of high-penetration PV integration, and disseminate the research findings of the project to the distribution engineers faced with challenging PV integration scenarios.
Start Date	2010
End Date	2015
Customer Segment	
Customers Involved	
Cost	AUD 4.2M
Funding Source	Federal Government
Network	Three distribution circuits within Southern California Edison's service territory
Connection Point	Customer Connections, Zone Substations
Location	Fontana, Palmdale and Porterville
State	California
Country	United States
Future Plans	SCE has currently deployed 71 MW of the total planned 500 MW of distribution system interconnected PV within its service territory under the Solar PV Project (SPVP). This project is currently in its final phase with a completion date in early 2015.
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Contact Link	
Background	In 2009 Southern California Edison (SCE) was granted permission from the California Public Utility Commission (CPUC) to install a total of 500 MW of distributed photovoltaic (PV) energy within its utility service territory. Typical installations to date are 1–3 MW peak rooftop PV systems that interconnect to medium-voltage urban distribution circuits or larger (5 MW peak) ground-mounted systems that connect to medium-voltage rural distribution circuits. Some of the PV system interconnections have resulted in distribution circuits that have a significant amount of PV generation compared to customer load, resulting in high-penetration PV integration scenarios. Starting in 2010, the National Renewable Energy Laboratory (NREL) and SCE have assembled a team of distribution modelling, solar resource assessment, and PV inverter technology experts in order to investigate the impacts of high-penetration PV integration on the distribution systems to which they interconnect. The objectives of this project are to model the expected impacts of high-penetration PV integration, measure the actual impacts of current high-penetration PV distribution circuits, develop, test and demonstrate mitigation techniques to reduce or limit the distribution system-level impacts of high-penetration PV integration, and disseminate the research findings of the project to the distribution engineers faced with challenging PV integration

Areas of Relevance	**Area**	**Comments**	**Relevance**
	6. Make the process of integrating renewable energy into the grid more cost-efficient	This project, by reducing the impact of interconnected PV on the distribution system using the PV inverter as an active grid interface, will make future PV interconnections more cost-effective by avoiding traditional PV interconnection system upgrade requirements (e.g. line upgrades)	Med
	9. Strengthen the network to manage higher renewable energy penetration	Develop techniques for analysing the performance of distribution circuits with a high penetration of PV; demonstrate PV impact mitigation alternatives using advanced PV inverter functionality.	Med

Approaches	**Approach**	**Comments**
	Electrical System Modelling	Modelling and simulation of distribution circuits to identify and quantify the impacts of high-penetration PV integration: Under the modelling and simulation task heading, multiple efforts were commenced under the project. The development of PV resource datasets of the appropriate temporal and spatial resolution are under development. Additionally, methods for completing high-penetration PV integration studies are being developed for the current state-of-the-art PV inverter technologies. A report, to be completed later this year, will investigate the usefulness of quasi-static time-series simulation for accurately modelling some low-bandwidth dynamics of the distribution system such as capacitor bank switching, load variability.
	Improve Inverter Design	Development of advanced functionality inverters with functions useful in mitigating the impacts of high-penetration PV integration and laboratory testing of advanced functionality inverters to determine the effectiveness of PV impact mitigation strategies. The development of advanced-functionality inverters is ongoing. Current development efforts include refining the Volt/Var characteristics that may be effective in mitigating some of the PV impacts on an interconnected distribution system.
	Improve transformer design	The laboratory testing undertaken at the Florida State University (FSU) Centre for Advanced Power Systems (CAPS) as part of the SCE HPPV Integration Project had the following three primary objectives: Demonstrate and evaluate the ability of a large PV inverter to implement a limited set of advanced inverter functions - Analyse how effective certain advanced inverter functions are at mitigating the impacts of high-penetration PV integration Advance the state-of-the-art practice in power hardware-in-loop (PHIL) PV inverter testing. All three objectives were met following a week of testing.

Results	Result	Comments
	Inverters with advanced functionality help manage high penetration of PV	Currently, the distribution circuits being studied include an urban circuit with a PV penetration of approximately 46% and a rural circuit with a PV penetration of approximately 60%. In both cases, power flow on the circuit reverses direction, compared to traditional circuit operation, during periods of high PV power production and low circuit loading. Research efforts during year two of the five-year project were focused on modelling the distribution system level impacts of high-penetration PV integrations, the development and installation of distribution circuit data acquisition equipment appropriate for quantifying the impacts of high-penetration PV integrations, and investigating high-penetration PV impact mitigation strategies. The quasi-static time-series test feeder was developed to be used as a tool and platform for benchmarking PV interconnection studies and the resulting PV impact mitigation solutions. Using the test feeder developed under the SCE HPPV Integration Project, it is easy to investigate a wide range of PV impacts caused by large PV systems. As part of the project, an advanced-capability PV inverter will be installed in the SCE distribution system on one of the study feeders.

Analysis of Variations in Instantaneous Weather Effects across the Geographic Boundaries of an Electricity Grid, and the Development of an Improved Estimate for Maximum Solar Grid Penetration without Energy Storage

Project ID	238
Organisation	CAT Projects
Organisation Type	Other
Partners	Power Water Corporation
Story	This project aims to understand the integration issues caused by localised weather that are preventing a large increase in the number of grid-connected solar power generators. To do this, the project will utilise a network of solar monitoring stations to develop an improved estimate for the maximum number of solar power generators that can be connected to the electricity grid without energy storage, taking into account the generators' distribution across the geographical area of the grid. The project found that the variability in PV irradiance is often cited as a major impediment to high levels of PV penetration into existing electrical networks. The data and the discussions presented to date shows very clearly that this variability in irradiance and therefore PV generation can be strongly mitigated against by dispersing PV generation across the Alice Spring network. The most effective way to spatially disperse this PV generation is through increasing the quantity of PV sites that are connected into the network.
Start Date	06-06-2012
End Date	30-06-2014
Customer Segment	
Customers Involved	
Cost	AUD 540,000
Funding Source	Commercial Partner, Federal Government, State Government
Network	
Connection Point	Distribution Feeders
Location	Alice Springs
State	NT
Country	Australia
Future Plans	The project is still however under way and final conclusions are some weeks off completion.
Contact Name	Paul Rodden
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Contact Link	Final Report Pending
Background	The study's innovation relates to the application and deployment new strategies for the deployment of mature commercialised PV technologies in existing electricity networks. Utilising a distributed network of solar monitoring stations, this project will develop an improved estimate for the maximum penetration of grid-connect solar generators achievable without energy storage; that takes into account the solar generators' distribution across the geographical area of the grid. In general terms the analysis carried out by this project will increase the confidence with which solar can be integrated into electricity networks. Integration issues, caused by limitations in the response time of base-load generators to variations in solar input caused by localised weather effects, have been identified as the current limiting factor to the penetration of grid-connect solar generators. The data collection and analysis is of immediate relevance to solar deployment projects that are currently being planned in the Northern Territory and other parts of Australia. The findings will increase the confidence with which performance based Power Purchase Agreements (PPAs) can be formulated, and have the potential to lead to lower costs for green power generation under these structures.

Areas of Relevance	Area	Comments	Relevance
	13. Store and organise information on customer renewable energy deployments	The project will utilise a network of solar monitoring stations to develop an improved estimate for the maximum number of solar power generators that can be connected to the electricity grid without energy storage, taking into account the generators' distribution across the geographical area of the grid. The project found that the variability in PV irradiance is often cited as a major impediment to high levels of PV penetration into existing electrical networks.	high
	6. Make the process of integrating renewable energy into the grid more cost-efficient	In general terms the analysis carried out by this project will increase the confidence with which solar can be integrated into electricity networks.	Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	In general terms the analysis carried out by this project will increase the confidence with which solar can be integrated into electricity	Med

Approaches	Approach	Comments
	Renewable Energy Resource Mapping	The study aims to quantify the mitigation of geographical distribution on instantaneous weather effects by comparing the data from and array of pyrometers, anemometers and temperatures sensors installed across the extent of the Alice Springs grid's area. Nine monitoring station were setup across a 30km diameter area and a full year of 5 second irradiance data collected at each site. This data was then analysed over a spatial, temporal and quantitative ranges to determine the impacts of these on irradiance and therefore PV output variability. These results were then overlaid against the variability of the Alice Springs network to determine a maximum penetration value for PV on the grid without storage.

Results	Result	Comments
	Dispersion of distributed energy can reduce localised voltage and stability issues	Variability in PV irradiance is often cited as a major impediment to high levels of PV penetration into existing electrical networks. The data and the discussions presented to date shows very clearly that this variability in irradiance and therefore PV generation can be strongly mitigated against by dispersing PV generation across such a network. The most effective way to disperse this PV generation is through increasing the quantity of PV sites that are connected into the network. These sites must be spatially dispersed to achieve this effect but it should be recognised that as long as there is reasonable spatial dispersion then by far the most important determinant in reducing the variability of PV generation is to increase the total number of sites. The project is still however under way and final conclusions are some weeks off completion.

Australian Renewable Energy Mapping Infrastructure (AREMI)

Project ID	358
Organisation	Data61 (previously NICTA)
Organisation Type	Research
Partners	CSIRO Digital Productivity Business Unit
Story	The AREMI platform is built upon a suite of data sets and data services which will serve to develop the Australian Energy Sector. AREMI is ahead of schedule with regard to data integration into the platform thanks to active engagement with all relevant data custodians and ARENA funded project owners. There are over 60 layers of data currently integrated on AREMI. The AREMI/Geoscience Australia collaboration has resulted in making the datasets most requested by industry publicly available. These include transmission line and power station data which were not previously accessible to the public. AREMI – the Australian Renewable Energy Mapping Infrastructure – provides free, open access to spatial data for the renewable energy industry. AREMI makes it easier for renewable energy projects to get off the ground in Australia. We provide a 'one stop shop' for all open geospatial data relevant to the energy sector from government, industry and research. Prior to the development of AREMI energy sector geo-spatial data was only available in disparate locations. Now, energy project developers can freely access spatial information such as existing electricity infrastructure to assist with site identification. State and local governments can use the open data AREMI provides to assist with environmental and regulatory planning approvals, and tracking and promoting projects in their region. The AREMI platform enables financiers and investors to explore the potential success of proposed ventures. AREMI also acts as a repository for ARENA-funded mapping projects to enable their access in one consolidated location.
Start Date	September 2014
End Date	Still underway. AREMI main development completion date June 2016, AREMI
Customer Segment	Industrial, Large commercial, Residential, SME
Customers Involved	166
Cost	Over $3 million
Funding Source	Federal Government, State Government
Network	This project aims to map distribution networks in Australia but has not yet
Connection Point	None
Location	
State	
Country	Australia
Future Plans	AREMI will be under continued development until June 2016
Contact Name	Dr Michelle Nic Raghnaill
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Contact Phone	+61 2 6267 6261
Contact Link	http://nationalmap.gov.au/renewables/
Background	AREMI – the Australian Renewable Energy Mapping Infrastructure – provides free, open access to spatial data for the renewable energy industry. AREMI makes it easier for renewable energy projects to get off the ground in Australia. We provide a 'one stop shop' for all open geospatial data relevant to the energy sector from government, industry and research. Prior to the development of AREMI energy sector geo-spatial data was only available in disparate locations. Now, energy project developers can freely access spatial information such as existing electricity infrastructure to assist with site identification. State and local governments can use the open data AREMI provides to assist with environmental and regulatory planning approvals, and tracking and promoting projects in their region. The AREMI platform enables financiers and investors to explore the potential success of proposed ventures. AREMI also acts as a repository for ARENA-funded mapping projects to enable their access in one consolidated location.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	Informs objective. Provides data allowing energy market stakeholders perform cost benefit analysis thus promoting renewable energy development	Med
	4. Inform the regulatory environment for renewable energy.	Fully informs objective. State and local governments can use the open data AREMI provides to assist with environmental and regulatory planning approvals, and tracking and promoting projects in their region	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	Fully informs objective. AREMI displays all renewable and non-renewable energy infrastructure and resource information to the public on line for free. This engages customers to modify behaviour in support of distributed energy resources should they choose to do so.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Fully informs objective. By providing a 'one stop shop' of energy infrastructure information AREMI Make the process of integrating renewable energy into the grid more cost-efficient. AREMI increases both public and private investments in renewable energy by reducing time and costs during pre-competitive planning stages.	High
	8. Establish control over, or otherwise influence, intermittent generation sources.	Informs objective. AREMI influences intermittent generation sources.	Low
	13. Store and organise information on customer renewable energy deployments	Fully meets objective. AREMI will make customer renewable energy deployment information publically available with the consent of the customer.	Med

Approaches	Approach	Comments

Results	Result	Comments

Australian Solar Energy Forecasting System (ASEFS) – Phase 1

Project ID	283
Organisation	CSIRO
Organisation Type	Research
Partners	Australian Energy Market Operator (AEMO), Bureau of Meteorology, NREL (USA), UNSW, UniSA
Story	Solar generating capacity in the National Electricity Market (NEM) is rapidly expanding and reaching a stage where proper forecasting will be needed to allow expansion to continue. Accurate supply and demand forecast models are necessary to increase commercial viability and ensure stability of the electricity grid. This project installed the first phase of the Australian Solar Energy Forecasting System (ASEFS) at the Australian Energy Market Operator (AEMO). This system is required to enable the integration of solar energy generation at all scales into the national grid and allow operators of larger systems to participate in the National Energy Market. It is configured as an extension to the Australian Wind Energy Forecasting System (AWEFS), which has been successfully operating within AEMO market systems since 2008. Without such forecasting systems wind and solar renewable energy generation will be subject to increasing levels of curtailment, undermining both their viability and their significant contribution to greenhouse gas reduction. This project installed the first operational solar energy production forecasting system for the National Grid. The ASEFS system has been successfully delivered, installed and commissioned into the live market system at AEMO.
Start Date	01-01-2013
End Date	01-06-2015
Customer Segment	
Customers Involved	
Cost	AUD 7.595 M
Funding Source	Federal Government
Network	None
Connection Point	
Location	
State	
Country	Australia
Future Plans	There are plans to develop operational versions of the improved forecasting techniques developed during the scientific component of the ASEFS project.
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Contact Email	Peter.coppin@csiro.au
Contact Phone	02 63246 5576
Contact Link	http://asi.rb.com.au/SiteFiles/australiansolarinstitutecomau/ASI_Solar_Energy_For
Background	This project installed the first phase of the Australian Solar Energy Forecasting System (ASEFS) at the Australian Energy Market Operator (AEMO). This system is required to enable the integration of solar energy generation at all scales into the national grid and allow operators of larger systems to participate in the National Energy Market. It is configured as an extension to the Australian Wind Energy Forecasting System (AWEFS), which has been successfully operating within AEMO market systems since 2008. Without such forecasting systems wind and solar renewable energy generation will be subject to increasing levels of curtailment, undermining both their viability and their significant contribution to greenhouse gas reduction.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	As installed capacity of wind and solar generation on the national grid rises, without such forecasting systems, wind and solar renewable energy generation would be subject to increasing levels of curtailment, undermining both their financial viability and ensuring stability of the electricity grid.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources.	The forecasting system will provide information that will allow operators of large solar generation plant to connect to and participate in the National Energy Grid and Market.	Med
	14. Improve techniques for forecasting renewable energy output.	This project installed the first operational solar energy production forecasting system for the National Grid. The ASEFS system has been successfully delivered, installed and commissioned into the live market system at AEMO.	High

Approaches	Approach	Comments
	Weather Forecasting	This first Phase provided, by May 2014, an operational system that will utilise basic forecasting based on weather forecast products and statistical techniques to cover all of the AEMO-required forecasting timeframes from 5 mins to 2 years. The system caters for large-scale PV and solar-thermal plants. It also provides researcher access to allow for the development by Australian Institutions of more advanced techniques for incorporation in the operational system. A number of research institutions provide technical input and undertake research and development on enhancements to the system, including the Bureau of Meteorology(BoM), the University of NSW (UNSW), the University of South Australia (UniSA) and the National Renewable Energy Laboratory (NREL) in the USA.

Results	Result	Comments
	Develop the Solar Energy Forecasting System	The ASEFS system has been successfully delivered, installed and commissioned into the live market system at AEMO. The system was live in the AEMO system by the target date of 2nd May 2014. The scientific program to design improvements to the system continues until June 2015.

BDR Project

Project ID	285
Organisation	Opower
Organisation Type	Proponent
Partners	A regulated utility located on the East Coast of the United States
Story	The main objective of BDR project is to seek a way to scale dynamic pricing to the entire customer base of the utility and encourage broad participation and awareness. The project supports the integration of renewable and distributed energy resources in the way that If the load curves are impacted by the integration of renewables, then behavioural demand response can be a valuable tool to encourage the right customers to reduce their usage at the right times in the event of a critical peak period. By shaving peak demand when renewables come off line (such as when the sun sets), behavioural demand response can reduce the need to rapidly ramp up additional capacity.
Start Date	01-05-013
End Date	01-09-2013
Customer Segment	Residential
Customers Involved	300,000
Cost	
Funding Source	Regulator-Approved Spend
Network	PJM in the United States
Connection Point	Customer Connections
Location	
State	Maryland
Country	United States
Future Plans	Yes, Opower is deploying to 1 million customers this summer (2014) across four ISOs in the United States, including the utility involved in this project.
Contact Name	Nick Payton
Contact Email	nick@opower.com
Contact Phone	+1 571 384 1393
Contact Link	
Background	The utility was seeking a way to scale dynamic pricing to their entire population to better leverage their AMI investment and in a way that encouraged broad participation and awareness.

Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach.	This program aligned wholesale costs with retail prices by providing a rebate to customers who saved during peak hours. The programme implemented an innovative methodology of testing and scaling up the new pricing schemes; however, its applicability in Australia need to be further evaluated.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	This project also facilitated moving the utility to advanced metering, which holds the potential for effectively introducing additional forms of distributed resources into resource planning. The business model developed here is to better help network companies.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	Opower's behavioural demand response solution is another method that can be used to reduce capacity demand on specific parts of the grid at specific times. The project has a clear focus on customer engagement with behavioural demand response which is very innovative and could be an approach in Australia.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Any shifting of use from hours when renewables are generating less to hours when they are generating more energy reduces the need for expensive storage. Reducing the need for energy storage is a cost-efficient way of reducing technical component costs for integrating and managing renewables. Opower uses software solution to avoid huge hardware investment is very innovative.	Med
	11. Alter local load profile to match a desired level	This program was used to shift load from peak (high cost) to off-peak (low-cost) times of service. The result of the project shows a quite positive impact on load shifting.	Med
	12. Use distributed energy solutions to address network and system constraints	This program used end-use customer behaviour to lower usage during times when delivery of electricity was highly constrained. Considering consumer demand as a source of balancing and distributed energy resources is quite a unique perspective, and worth exploring now and in the future.	Med

Approaches	Approach	Comments
	Demand Side Incentives	This project involved Opower delivering millions of communications on demand to residential customers that increased awareness of and participation in a peak-time rebate program through which customers were paid financial incentives to save during peak usage hours.
	Information alone can have a behaviour changing effect	Customers saved on average 5% during peak hours, and customers who received multiple forms of communication saved 15% during peak hours. The program saw 93% participation across 100% of AMI customers (over 300,000 in total), and 82% earned a rebate, which are both significantly greater than prior programs.

Bega Library Solar Energy System

Project ID	237
Organisation	Essential Energy
Organisation Type	Network
Partners	Bega Shire Council
Story	Essential Energy installed a solar energy storage demonstration system that would be linked closely to the local community, and could be used to demonstrate the benefits of combined systems as well as used to raise awareness of the most efficient use of these technologies. To do this, Essential Energy installed a 20kW solar array and energy storage system on the Bega community library and provided real time system performance information via a website that could be viewed by community members. The project confirmed that up to 15kW of energy was fed back into the grid on a daily basis between 5pm and 8pm. The library achieved an approximate saving of 12,000kWh of energy in the 12 month period of operation of the system which was from the excess energy generated by the solar system. The energy storage system provided a consistent and known output to the grid and the energy supply was maintained for approximately 8 hours during an unplanned network outage.
Start Date	01-08-2012
End Date	01-12-2013
Customer Segment	SME
Customers Involved	1
Cost	AUD 235,000
Funding Source	Discretionary Spend
Network	Essential Energy
Connection Point	Customer Connections
Location	Bega
State	NSW
Country	Australia
Future Plans	Some minor equipment failures occurred during the course of the project. One interesting learning was the difference in solar output between winter and summer, which showed that solar output tended to be higher in the cooler months.
Contact Name	Peter Newell
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Contact Phone	02 65898444
Contact Link	
Background	Essential Energy as part of its Intelligent Network Community projects in Bega wished to install a solar/energy storage demonstration system that would be linked closely to the local community, and could be used to demonstrate the benefits of combined systems as well as used to raise awareness of the most efficient use of these technologies. The specific outcomes of the project were: i) reduce the intermittent nature of solar only generation ii) provide energy generation at times of day beneficial to the network iii) Demonstrate the value of creating a "micro-grid" iv) Educate and raise awareness of key stakeholders in the use of hybrid solar and energy storage systems.

Areas of Relevance	Area	Comments	Relevance
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	Essential Energy installed a 20kW solar array and energy storage system on the Bega community library and provided real time system performance information via a website that could be viewed by community members. The project was used to raise customer awareness around the benefits of combination of solar and storage.	Med
	10. Smooth out intermittent generation output	The use of energy storage removed the intermittent nature of PV generation. The project confirmed that up to 15kW of energy was fed back into the grid on a daily basis between 5pm and 8pm. The library achieved an approximate saving of 12,000kWh of energy in the 12 month period of operation of the system.	Low
	11. Alter local load profile to match a desired level	Energy storage was able to supply capacity to the grid during evening peak (5pm to 8pm) using energy captured during the day.	Med
	Other	The storage system was able to support the library load on at least one occasion when the electricity grid experienced an unplanned outage.	
Approaches	**Approach**	**Comments**	
	Distributed Energy Solutions	To facilitate the successful outcome of this project the following criteria were used: i) A highly visible building with significant community use was required - Bega Community Library was selected ii) Installation of a 20kW solar array and energy storage system iii) Near real-time system performance information was feed to a web site that could be viewed by community members iv) Information kiosk and supporting educational material was established at the library v) System mode of operation was to charge batteries on a daily basis, excess energy capacity after batteries are charged, fed to library, energy feed back into the grid at peak times. vi) Energy system needed to be able to support the library vii) Environmental data such as temperature, solar irradiation, and wind speed were measure to allow some correlation of climatic conditions.	

Results	Result	Comments
	Storage can combine with PV to reduce peak demand	The project confirmed that up to 15kW of energy was fed back into the grid on a daily basis between 5pm and 8pm. The library achieved an approximate saving of 12,000kWh of energy in the 12 month period of operation of the system. This was from the excess energy generated by the solar system. The energy storage system provided a consistent and known output to the grid. The library energy supply was maintained for approximately 8 hours during an unplanned network outage.

BESOS Project

Project ID	319
Organisation	ETRA I+D
Organisation Type	Other
Partners	10 entities of 4 different countries - Germany, Greece, Portugal and Spain
Story	The BESOS project is part of the EU FP7 program, whose main goal is the gradual reduction of the EU's carbon footprint via development and application of new technologies, i.e. making the European economy more energy efficient and sustainable through use of advanced technology. In this context, the aim of BESOS project is to enhance existing neighbourhoods with a decision support system to provide coordinated management of public infrastructures in Smart Cities, and at the same time to provide citizens with information to promote sustainability and energy efficiency, which include the integration of Distributed Energy Resources. BESOS project started in October 2013 and its activity will continue for 3 years. The project is developed by an international consortium that includes 10 entities of 4 different countries - Germany, Greece, Portugal and Spain .Barcelona and Lisbon will play a critical role in BESOS project, based on their commitment to sustainability, efficiency and respect for the environment. Both cities will host the pilot tests of the technologies developed during the project. The project pilots are testing the integration of different types of renewable generation and microgeneration plants into the smart grid.
Start Date	01-10-2013
End Date	30-09-2016
Customer Segment	Industrial, Large commercial, Residential
Customers Involved	2,000
Cost	Approximately AUD 6.68 Million (EUR 4,610,538)
Funding Source	Federal Government
Network	Barcelona and Lisbon
Connection Point	Customer Connections, Distribution Feeders
Location	Barcelona and Lisbon
Country	Spain and Portugal
Future Plans	The BESOS project seeks to continue and expand the results in bigger environments in future research project.
Contact Name	Lola Alacreu
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Contact Link	
Background	Energy efficient Smart Cities rely on highly heterogeneously deployed infrastructure and services, e.g. public lighting system, urban heating system, public buildings, electric vehicles, micro-generation, residential prosumers, etc. All these systems are currently managed by isolated Energy Management Systems (EMS), that hardly have capabilities to offer information and services to third parties in order to achieve advanced coordinated energy saving strategies. This challenging scenario has motivated the extensive adoption of new business models where not only the maintenance of the public infrastructure has been outsourced, but also the management of any process leading to a saving of costs, energy or CO2 emissions. The municipalities and facility owners responsible of public services have established contracts with specific Service Level Agreements with Energy Service Companies (ESCOs) and Facility Managers (FM) that, based on such SLAs, run the smart city trying to a) reduce costs, so they can obtain a business benefit, b) guarantee the levels of Quality of Service (QoS) established in such contracts. The latest is a key constraint of this kind of service schema since, by the end of the day, citizens will be the ones living the outcome of the approach, and they will demand to maintain similar - if not better - levels of QoS.BESOS is an EU Research and Development project that proposes the development of an advanced, integrated, management system which enables energy efficiency in smart cities from a holistic perspective. To that end, the Energy Management Systems deployed in a typical district that are consuming or producing energy, and which nowadays normally count with an isolated IT management solution, will be able to share data and services through and open trustworthy platform among themselves and to external third party applications.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The project includes different types of renewable generation and microgeneration plants in order to use cleaner energy in smart cities and balance the smart grid. The project measures a comprehensive set of renewable and micro-generation, and the potential benefit and cost associated with the integration of these Distributed Energy Resources, which could fit with the Australian context.	High
	2. Support the transition to an alternative electricity pricing approach	The project will support an alternative pricing approach by means of new strategies in order to optimize the use of energy and reduce costs. The relevance of the pricing approach experimented in this project need to be further evaluated, since it is mainly developed for European countries.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The Energy Management Systems deployed in a typical district that are consuming or producing energy, and which nowadays normally count with an isolated IT management solution, will be able to share data and services through and open trustworthy platform among themselves and to external third party applications. The applicability of the Energy Management System developed in this project need to be further evaluated in Australian context. However, the knowledge and findings from the project can be valuable.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources	The project will provide to the customers with end-users applications in order to provide them with information about their environmental behaviour and motivate them to change their habits to support distributed energy resources. The practice of the project is highly relevant to meet the desired outcome of customer engagement, which could be a good reference to the customer engagement practice in Australia.	High
	6. Make the process of integrating renewable energy into the grid more cost-efficient	By means of new strategies, the renewable energy generated will be integrated in the grid in order to save costs and being more efficient. Developing long-term strategy for cost efficient integration of renewable is very critical to the success of actual implementation.	High
	8. Establish control over, or otherwise influence, intermittent generation sources	By means of Monitoring and Control cockpit developed in BESOS project, control over the generation will be enabled. Monitoring and Controlling practices are widely used to manage Distributed Generation and Energy Resources.	Med
	11. Alter local load profile to match a desired level	The load profile of the different Energy Management Systems deployed in a Smart City, will be modified by means of strategies in order to balance the grid. The project takes a holistic view of Smart City, on top of distribution network, which has a very clear future focus and could be a good reference for Australian regulators and network companies when conducting long-term strategic planning.	Low

Areas of Relevance	Area	Comments	Relevance
	14. Improve techniques for forecasting renewable energy output	The simulation developed in this project will provide better forecasting of the renewable energy output. The simulation for forecasting is a common approach as seen in many other international projects.	Med

Approaches	Approach	Comments
	Energy Efficiency Measures	BESOS strategic goal is to enhance currently existing neighbourhoods with decision support system (DSS) to provide coordinated management of public infrastructures in Smart Cities, and at the same time provide citizens with information to promote sustainability and energy efficiency. The project will target two main stakeholders: the owners of the infrastructure -e.g. municipalities - and its operators - e.g. ESCOs and facility managers (FM). The former will be provided with a Business Balanced Score Card to audit the Service Level Agreements (SLA) established with the ESCOs and FM against a number of Key Performance Indicators (KPI). The latter will make use of the same tool to analyse new business models, and will be also provided with a DSS Cockpit to Monitor and Control (M&C) information from the infrastructure and establish coordinated energy efficiency strategies. Two leading cities in Europe, Lisbon and Barcelona, will act a test-beds of the BESOS approach.

Results	Result	Comments
	Enables energy efficiency in smart cities	BESOS proposes the development of an advanced, integrated, management system which enables energy efficiency in smart cities from a holistic perspective. BESOS targets specifically public authorities -i.e. municipalities - responsible of a number of public services demanding energy, and the entities in charge of managing such services - i.e. ESCOS. In any case, it is the responsibility of the city to grant the efficiency - also from the energy point of view - of such public services. Thus, on the one hand, the Business Balanced Score Card will offer public authorities with a high level view of the energy and business processes on going in a smart city in order to audit the actuation and results of the ESCOs and Facility Managers operating on it. On the other hand, the DSS cockpit will support such entities to introduce new coordinated management schemes and to take benefit of the availability of a more open market.

Breaking the solar gridlock

Project ID	47
Organisation	The Australian Solar Thermal Energy Association (AUSTELA)
Organisation Type	Association
Partners	The Centre for Energy and Environmental Markets (CEEM) and Institute for Sustainable Futures (ISF)
Story	This project was undertaken to quantify the potential benefits from installing concentrating solar thermal power (CSP) generation at constrained network locations in the Australian National Electricity Market (NEM). The primary objectives of this study were to identify and map locations where CSP could provide cost-effective network support services, quantify CSP's economic benefits to the plant owner and to the network, and engage network service providers regarding the potential for CSP utilisation as an alternative to network augmentation. The project quantified and mapped potentially avoidable network investment, modelled and mapped indicative firm capacity, identified areas where CSP may provide cost effective network support and conducted case studies. The study identified that CSP could avoid the need for network augmentation in 72% (48 locations) of the constrained areas studied. The modelling showed that CSP can generate during 80% of the network's acute peak demand periods in all seasons and most locations. In winter, it is less reliable due to lower solar resources, but this can be improved by increasing storage levels. This study identified $0.8 billion of potentially avoidable network investment, and 533MW of cost effective CSP which could be installed at grid constrained locations in the next 10 years. Another key finding is that in order for CSP and other distributed energy solutions to compete effectively with traditional network solutions, the availability and accessibility of network information requires improvement.
Start Date	01-09-2012
End Date	31-08-2013
Customer Segment	None
Customers Involved	
Cost	AUD 179,965
Funding Source	Commercial Partner, Federal Government, ARENA, Ergon and AUSTELA
Network	Ergon Energy
Connection Point	
Location	Millchester, Charleville, Gunnedah-Narrabri-Moree, Riverland and Wemen
State	NSW, QLD, SA, VIC
Country	Australia
Future Plans	The Institute for Sustainable Futures, University of Technology Sydney, is going to work with network service providers over the next three years to develop a system whereby network opportunity maps will become publicly available and updated on an annual basis.
Contact name	Jay Rutovitz - ISF (report lead author), Juergen Peterseim, Ben Elliston, Stephen Harris, Steve Mohr, Keith Lovegrove, Andrew Want, Edward Langham, Iain MacGill
Contact Email	Jay.Rutovitz@uts.edu.au
Contact Phone	+ 61 2 9514 4950 (general number of ISF-no personal number could be found)
Contact Link	http://breakingthesolargridlock.net/
Background	This project was undertaken to quantify the potential benefits from installing concentrating solar thermal power (CSP) generation at constrained network locations in the Australian National Electricity Market (NEM).

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	Engage network service providers regarding the potential for utilisation of CSP as an alternative to network augmentation.	Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	Quantify the potential effect of network support payments on the business case for CSP and assist network service providers to evaluate strategies utilising distributed renewable energy generation to meet current and future constraints in electricity networks.	Low
	12. Use distributed energy solutions to address network and system constraints	Identify and map locations where CSP could provide cost-effective network support services. The study identified that CSP could avoid the need for network augmentation in 72% (48 locations) of the constrained areas studied.	High

Approaches	Approach	Comments
	Capacity Mapping	Quantify and map potentially avoidable network investment, model and map indicative firm capacity, identify areas where CSP may provide cost effective network support and conduct case studies.

Results	Result	Comments
	CSP could avoid the need for network augmentation in constrained areas	This study confirms that CSP can play an imperative and economically efficient role in Australia's future electricity system as a viable alternative to traditional network augmentation solutions in addressing electricity grid constraints. The study identified that CSP could avoid the need for network augmentation in 72% (48 locations) of the constrained areas studied. This study identified $0.8 billion of potentially avoidable network investment, and 533MW of cost effective CSP which could be installed at grid constrained locations in the next 10 years.
	Distributed energy solutions need access to better network information	In order for CSP and other distributed energy solutions to compete effectively with traditional network solutions, the availability and accessibility of network information requires improvement.
	CSP could avoid the need for network augmentation in constrained areas	The modelling showed that CSP can generate during 80% of the network's acute peak demand periods in all seasons and most locations. In winter, it is less reliable due to lower solar resources, but this can be improved by increasing storage levels.

Broken Hill Solar Plant

Project ID	240
Organisation	AGL Energy
Organisation Type	Network
Partners	First Solar (Australia) Pty Ltd
Story	Broken Hill has one of the highest levels of solar radiation in NSW, making it an ideal location for a solar power plant. The solar plant will occupy approximately 140 hectares of land bounded by the Barrier Highway to the north and the Peterborough-Broken Hill rail line to the south. This project will help the large-scale solar industry develop in Australia, encourage economic and industry development.
Start Date	01-07-2012
End Date	31-12-2015
Customer Segment	
Customers Involved	1
Cost	AUD 150 M
Funding Source	Discretionary Spend, Federal Government, State Government
Connection Point	Distribution Feeders
Location	Broken Hill
State	NSW
Country	Australia
Future Plans	On completion of construction, First Solar will be the Operations and Maintenance subcontractor for the first 5 years of operation.
Contact Name	Nicole Ghiotto
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Contact Phone	
Contact Link	http://www.agl.com.au/about-agl/how-we-source-energy/renewable-energy/broken-hill-solar-plant
Background	The Australian government released its Solar Flagships program in 2009 as a way to kick-start the utility scale solar market in Australia. The major barrier to utility scale project was the absence of experience and projects in the Australian context, and implementing the first projects would reduce barriers for subsequent projects.

Areas of Relevance	Area	Comments	Relevance
	8. Establish control over, or otherwise influence, intermittent generation sources.	Utility scale PV plants are designed to meet a different set of generation or network standards than small scale PV. Utility scale PV plant outputs are controllable and can be set-up to react more pro-actively to grid disturbances that are more in line with conventional generation than small-scale PV anti-islanding measures can	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Building utility scale plants develops localised capacity and expertise to build further plants in future - subsequent plants can be sold at lower cost thanks to in-country supply chain and suppliers.	Low
Approaches	**Approach**	**Comments**	
	Large Scale Renewable Plant	Building the first few utility scale projects on the NEM is important to prove that these plants can be developed and implemented at this scale, which will develop investor and financier understanding of this market, and reduce their perceived risk of this scale of project. Various stakeholders in the development process (including local and state government planning agencies and the network operator AEMO) also gained familiarity with this type of project through implementation of the Broken Hill plant.	
Results	**Result**	**Comments**	
	No results yet	The project has successfully completed its development phase and is due to commence construction around July 2014.	

Business Model Implementation Project

Project ID	290
Organisation	Ergon Energy
Organisation Type	Network
Partners	Marchment Hill Consulting
Story	Customers have expressed their concern with increasing electricity prices in recent times. At some point in the future, the price and operating costs of a standalone system, (such as solar PV and battery storage) may become cheaper than being connected to the electricity network. This could trigger an exodus of customers from the grid. A declining number of customers and a declining share of the energy market would mean higher prices for those customers who remain on the grid, prompting a further exodus, and threatening the viability of our business. To be viable in the future there is a need to adopt a new business model; find new ways to operate, enable new markets and services, and provide new value to customers. Ergon Energy implemented an organisational structure which enables a focused and coordinated method to engage with DM market participants. This new organisational structure plays an important role in supporting network planners to consider non-network solutions where network constraints exist.
Start Date	2013
End Date	2014
Customer Segment	
Customers Involved	
Cost	
Funding Source	Discretionary Spend
Connection Point	
Location	Brisbane
State	QLD
Country	Australia
Future Plans	While the project is complete the organisational structure is now in place and the Channel Partnerships group is looking to trial the market engagement approach with live opportunities.
Contact Name	David Heberlein
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Contact Phone	
Contact Link	
Background	Customers are feeling the pain of successive price rises over recent years and expressing their concern. Regulators, Governments, and competitors are listening and responding. At some point in the future, the price and operating costs of a standalone system, (such as solar PV and battery storage) may become cheaper than being connected to the electricity network. This could trigger an exodus of customers from the grid. A declining number of customers and a declining share of the energy market would mean higher prices for those customers who remain on the grid, prompting a further exodus, and threatening the viability of our business. To be viable in the future there is a need to adopt a new business model; find new ways to operate, enable new markets and services, and provide new value to customers.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	The project aimed to implement a new business model to allow for the integration of DM options into the traditional network planning process. The business model was designed to give each option (network and non-network) equal value. Through this project, Ergon Energy implemented an organisational structure which enables a focused and coordinated method to engage with DM market participants.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	The project involved a business re-organisation which included the creation of a Network Optimisation division (replacing the old Asset Management group) focussed on optimising the assets, rather than simply managing and growing them, and the creation of a Chanel Partnerships team within Network Optimisation to manage interaction with external parties for the delivery of distributed energy resources on the network. This organisational structure plays an important role in supporting network planners to consider non-network solutions where network constraints exist. This business model can be implemented across other distribution networks.	High
	11. Alter local load profile to match a desired level	The internal structural changes aimed to increase the utilisation of DM service providers to alter the load profile of end customers to alleviate network constraints. These changes can help provide new value to customers and enable new markets and services. This business model can be implemented across other distribution networks.	Med

Approaches	Approach	Comments
	Organisational Restructure	The first step the project took to achieve its intended results was to re-define and transition to an organisational structure that positions Ergon Energy with the required processes, skills and structure to incorporate DM into the traditional approach to network planning and improve customer advocacy.
	Commercial Venture	The second step the project took to achieve its intended results was development processes and a commercial model to coordinate and guide Ergon Energy through the process of utilising demand aggregation and demand management providers including methods of communication (E.g. sharing of constraint information, implementation of DM) with DM service providers.
Results	**Result**	**Comments**
	Developed of a new organisational structure	Ergon Energy implemented an organisational structure which enables a focused and coordinated method to engage with DM market participants. This new organisational structure plays an important role in supporting network planners to considered non-network solutions where network constraints exist. To enable this capability the new organisational structure has two very important teams facilitating market engagement and enablement, these are: Channel Advocates: 1. Engage with the DM service providers and end customers to understand the evolving market and customer needs/ expectations 2. Communicate DM market capability, options, ideas and information to network planners to assist with their ability to plan the network using non-network solutions Channel Managers: 1. Facilitate interactions and partnerships with DM service providers to communicate Ergon Energy's constraint requirements and pricing options 2. Manage DM contracts with service providers

Capacity Limiting

Project ID	292
Organisation	United Energy
Organisation Type	Network
Partners	
Story	The use of heavy air-conditioners and appliances on hot days especially during peak demand times adds stress to the network. This can be controlled by introducing 'Capacity Limiting' limits during peak demand periods. This trial aims to understand if this tool can be utilised to reduce peak load, hence reducing the need to network augmentation. One of the main goals of the trial is to raise awareness in customers of their appliance use and the impact on the network. The trial also aims to understand if capacity limiting on peak demand days can reshape the load profile on the distribution network and at the local premises.
Start Date	TBA
End Date	TBA
Customer Segment	Residential
Customers Involved	This project is yet to start
Cost	
Funding Source	Regulator-Approved Spend

Network	United Energy
Connection Point	Distribution Feeders, Zone Substations
Location	United Energy distribution area
State	VIC
Country	Australia
Future Plans	The project has not been implemented yet.
Contact Name	Sharon Tissai-Krishna
Contact Email	sharon.tissai-krishna@ue.com.au
Contact Phone	03 8846 9828
Contact Link	
Background	Heavy Air conditioner and appliance use on hot days adds stress to the network at peak demand times. Homes with 4-5 RCAC air conditioners place a particularly high degree of stress on the network. Capacity Limiting limits the peak capacity of electricity for the duration of the event period. The trial aims to understand if this tool can be utilised to reduce peak load, reducing the need to network augmentation.

Areas of Relevance	Area	Comments	Relevance
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	One of the goals of the trial is to raise awareness in customers of their appliance use and the impact on the network. UE will understand the level of incentive and assistance that is required to allow customers to manage their load at peak times.	Med
	11. Alter local load profile to match a desired level	The trial aims to incentivise customers to limit their capacity requirements to a pre agreed level at peak times and provide the network with the ability to directly control to the agreed limit. UE is using demand side management to address network or wholesale market constraints.	Med
	12. Use distributed energy solutions to address network and system constraints	The load reduction through supply capacity control is expected to reduce stress on the network during peak demand periods and help alleviate network constraints.	Low

Approaches	Approach	Comments
	Demand Side Incentives	The trial seeks to understand if capacity limiting on peak demand days can reshape the load profile on the distribution network and at the local premises. UE will understand the level of incentive and assistance that is required to allow customers to manage their load at peak times.

Results	Result	Comments
	No results yet	The project has not been implemented yet.

Carnarvon High Penetration PV Study report

Project ID	10
Organisation	Australian PV Institute (APVI)
Organisation Type	Research
Partners	Centre for Energy and Environmental Markets (CEEM)
Story	Carnarvon is a small isolated grid with relatively high density of PV penetration as a function of system load. This presents particular technical integration challenges that will likely emerge in the future for other isolated grids in Australia and internationally as the fuel and emissions savings of PV become increasingly valuable. The intention of this case study is to enhance understanding of the technical, economic and regulatory requirements needed to facilitate high levels of PV penetration in electricity grids in Australia. Additionally, it seeks to document the technical experiences of various stakeholders in integrating high levels of PV into the Carnarvon grid and investigate any noticeable effects on the stable operation of the Carnarvon network in line with its nature as an isolated grid. By engaging key stakeholders to discuss PV integration experiences, data was gathered and processed to investigate relevant technical issues. From the conclusions drawn from these discussions, there was one recorded instance of multiple PV systems disconnecting on the Carnarvon distribution network due to a system wide frequency disturbance. To tackle this problem, sufficient spinning reserves is used to operate the network. There have been two recorded instances of significant LV network voltage rises in Carnarvon. Both problems were resolved and the networks brought back within acceptable limits by reconfiguring the distribution transformer tap changer or line augmentations.
Start Date	
End Date	01-04-2012
Customer Segment	None
Customers Involved	
Cost	
Funding Source	Federal Government
Network	Horizon Power
Connection Point	None
Location	Carnarvon
State	WA
Country	Australia
Future Plans	
Contact Name	Dr Muriel Watt
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Contact Phone	+61 427 727 368
Contact Link	http://apvi.org.au/carnarvon-high-penetration-pv-study-report/
Background	Carnarvon is a small isolated grid with relatively high density of PV penetration as a function of system load. This presents particular technical integration challenges that will likely emerge in future for other isolated grids in Australia and internationally as the fuel and emissions savings of PV become increasingly valuable.

Areas of Relevance	Area	Comments	Relevance
	4. Inform the regulatory environment for renewable energy	The project enhanced the understanding of the technical, economic and regulatory requirements needed to facilitate high levels of PV penetration in electricity grids in Australia.	Low
	9. Strengthen the network to manage higher renewable energy penetration	The project documented the technical experiences of various stakeholders in integrating high levels of PV into the Carnarvon grid, particularly those of Horizon Power (the generator and network operator). Investigate any effects the high penetration of PV may be having on the stable operation of the Carnarvon network in line with its nature as an isolated grid. The project investigated whether the existing levels of PV penetration on Carnarvon's LV networks are causing power quality issues.	Med

Approaches	Approach	Comments
	Case Study	The case study approached followed the following steps: engage key stakeholders, undertake a site visit to interview all relevant stakeholders and discuss their experiences with PV integration, gather and process data to investigate technical issues. Stakeholders were asked questions that focused on the technical challenges associated with integrating a high penetration of PV systems in Carnarvon.

Results	Result	Comments
	PV anti-islanding protection needs improvement	On the Carnarvon distribution network, there was one recorded instance of multiple PV systems disconnecting due to a system wide frequency disturbance. This resulted in additional load for the central generator to cover rapidly. A lack of standardisation amongst inverter anti islanding protection settings within AS4777 is also a concern. The current management strategy is to operate the network with sufficient spinning reserve to maintain the network if PV systems disconnect. This case study proposed a review of PV inverter protection settings and the set up of community solar farms with feed in management.

Results	Result	Comments
	Issues with distributed energy resources often go unreported	One further problem in identifying the impacts of PV systems in Carnarvon was the absence of reporting of PV related issues. This could either stem from lack of awareness of the problems with PV systems or the minimal effect the problems have had on people's lives. For further development in this area more care needs to be taken to educate stakeholders and carefully monitor PV system issues to ensure they are captured and dealt with appropriately in the future.
	PV voltage problems can be resolved	There have been two recorded instances of significant LV network voltage rises in Carnarvon. Both problems have been resolved and the networks brought back within acceptable limits by reconfiguring the distribution transformer tap changer or line augmentations.
	PV safety issues still persist	There has been one reported instance of a fire caused by a PV system, made even more serious due to continued PV generation during the fire. Management procedures are in place to ensure correct panel installations
	PV requires significant spinning reserve to maintain network stability	There have been no recorded system-wide fluctuations in load due to PV output variability (due to cloud fluctuations). However significant fluctuations have been observed on a localised level. It is possible that with increased PV penetration this effect will be more evident on the supply network.

CBD Embedded Generation Project

Project ID	302
Organisation	Ausgrid
Organisation Type	Network
Partners	
Story	The triplex electricity network in the Sydney CBD presents technical challenges for connecting embedded generation (EG), primarily related to fault level and feeder imbalance issues. The primary aim of the project is to develop a cost effective technical solution to enable customers to connect to the triplex network in the Sydney CBD. The project is ongoing, and is expected to be completed in April 2015.
Start Date	01-11-2011
End Date	01-04-2015
Customer Segment	Large commercial
Customers Involved	1
Cost	Phase 1 - AUD 40,000; Phase 2 - AUD 420,000
Funding Source	State Government
Network	Ausgrid
Connection Point	Customer Connections, Distribution Feeders, Zone Substations
Location	Sydney CBD
State	NSW
Country	Australia
Future Plans	The project is ongoing, and is expected to be completed in April 2015.
Contact Name	Rachele Williams
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Contact Phone	+61292697369
Contact Link	
Background	The triplex electricity network in the Sydney CBD presents technical challenges for connecting embedded generation (EG), primarily related to fault level and feeder imbalance issues. This project is to investigate a possible alternative method for connecting EG to this network in a safe and economic solution that will not compromise reliability of supply. There are plans for a significant number of gas fired trigeneneration plants to be installed in this area.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	Measuring the potential costs of generation connection in the CBD	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The primary aim of the project is to develop a cost effective technical solution to enable customers to connect to the triplex network in the Sydney CBD.	Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The project will develop a standard generator connection for the Sydney CBD triplex network. At present there is no acceptable solution.	High
	12. Use distributed energy solutions to address network and system constraints	Connection of this type of EG in commercial areas has the potential to address network constraints through the use of Egs for network support during peak demand events.	Med

Approaches	Approach	Comments
	Customer Acceptance Testing	This is a pilot project to install the proposed technology at a customer site with an existing generator. This will demonstrate the proposed solutions viability.

Results	Result	Comments
	No results yet	This project is in progress and results are not yet available. The likely technical solution is currently in the detailed design stage. Results from a preliminary design phased suggest that the project has a high likelihood of success.

Central Victoria Solar City Household Trial

Project ID	142
Organisation	Sustainable Regional Australia (SRA)
Organisation Type	Association, Network, Research, Retailer
Partners	Powercor, Bendigo and Adelaide Bank, Origin and Central Victorian Greenhouse Alliance and The University of Ballarat (research partners)
Story	The Central Victoria Solar City (CVSC) trial addressed a range of points and derived key results relevant to the design of Australian energy policy. The impact evaluation approach used sought to answer a fundamental question: what would have happened without the program? This was estimated using a control group alongside the intervention group whose members volunteered for the program. A quasi-experimental design was adopted for this study, as was a pre-post design with matched control groups to enable measurement of changes in electricity use attributable to the CVSC program's interventions. CVSC determined that the program could be credited for average net energy savings (savings made over and above those made by matched control groups) in a number of areas; home energy assessments' consumption reduced by 9%, solar hot water consumption reduced by 22%, household solar PV reduced consumption by 13%, in-home displays reduced consumption by 5%, and retrofits reduced consumption by 5%. The average energy saving achieved across all residential interventions was 13%. The household intervention group overall saved approximately 2kWh per day or 730kWh per annum.
Start Date	10-12-2008
End Date	18-06-2013
Customer Segment	Residential
Customers Involved	1724
Cost	AUD 42M
Funding Source	Commercial Partner, Federal Government
Network	Powercor
Connection Point	Customer Connections
Location	Multiple cities
State	VIC
Country	Australia
Future Plans	
Contact Name	
Contact Email	
Contact Phone	
Contact Link	http://www.sustainableregionalaustralia.com.au/central-victoria-solar-city.php
Background	The Central Victoria Solar City (CVSC) trial addressed a range of points and derived key results relevant to the design of Australian energy policy.

Areas of Relevance	Area	Comments	Relevance
	4. Inform the regulatory environment for renewable energy.	Central Victoria Solar City (CVSC) included several points of difference that made the trial and its results relevant to the big picture policy debate underway in Australia today. The project team and consortium responsible for the implementation of the program will share the findings included in this report with the Australian Government and key players in the design of Australian energy policy.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	The objective of the Household Solar PV trial was to measure the impact of household solar electricity systems on electricity consumption behaviour.	High

Approaches	Approach	Comments
	Interviews and Surveys	Three major data sources were collected and monitored for the household study: electricity consumption, participant surveys and climate data.
	Home Energy Audits	To collect information about the determinants of household energy consumption, baseline surveys were administered with all participating households as part of the sign-on process. Two follow-up surveys, delivered in 2012 and 2013, were also used to measure changes in household characteristics, adoption of Household Energy Assessment recommendations, program satisfaction, free-ridership, spill-over and attitudes and barriers relating to energy efficiency and adoption of solar technologies.
	Smart Meters and In-Home Displays	The project's In-Home Display trial demonstrated the value of smart meters in delivering real time energy use feedback to participants.
	Distributed Energy Solutions	The Solar Hot Water (SHW) sub-trial sought to identify the barriers to the uptake of solar hot water in the Central Victorian region and the effect that solar hot water had on house hold energy consumption.

Results	Result	Comments
	Distributed energy solutions reduce energy consumed from the network	CVSC found that the following average net energy savings (savings made over and above those made by matched control groups), could be directly attributed to the program: Home Energy Assessments - reduced consumption by 9%; Solar Hot Water – reduced consumption by 22%; Household Solar PV – reduced consumption by 13%; In-Home Displays – reduced consumption by 5%; Retrofits – reduced consumption by 5%; the average energy saving achieved across all residential interventions was 13%.
	Renters are dis-incentivised from adopting distributed energy	Results were not shared equally among residents of central Victoria, with almost a quarter of the intervention group falling into the top two household income categories. Renters were significantly under represented with only 2 per cent of the intervention group renting their home. More work is needed to address split incentives between landlords and tenants and to address cost barriers for low income households in accessing energy savings.
	Solar Hot Water reduced electricity consumption	The CVSC trial found that replacing electric storage hot water systems with solar water heaters was a highly effective way of reducing household electricity use, with gross savings of 41% of average daily consumption being achieved by participants (with 22% of savings being directly attributable to the effect of the CVSC program).
	Information alone can have a behaviour changing effect	The CVSC trial found that participants with an In-Home Display saved an average of 5% on their average daily consumption by monitoring use alone. This is significant when it is considered that the communication was not coupled with a price signal, such as a ‘cost reflective pricing tariff’, to shift usage to a different time during the day.

Central Victoria Solar City Solar Park

Project ID	155
Organisation	Origin
Organisation Type	Retailer
Partners	Powercor and Bendigo Bank
Story	The solar parks at Bendigo and Ballarat were developed under the Central Victoria Solar City program to understand the reliability of medium-scale solar PV technology, the business model required for commercial success, and the technical elements of building and operating a solar park. To do this, two solar parks were built in each city of Bendigo and Ballarat. The Bendigo Solar park has a 333kW capacity, of which 16kW is mounted on tracking systems and the balance installed as a fixed array. In addition to this, the Bendigo Park is supported with a battery storage system. The Ballarat Solar Park has a capacity of 330kW of which 16kW is mounted on tilted oscillating tracking systems. A simulated feed-in tariff and simulated capital allowance was developed to test the revenue required to sustain operation of a solar park. Bendigo Solar Park achieved the greatest increase in generation from the tracking systems, which produced 21% more electricity than fixed arrays of the same capacity at the Bendigo Park. The Ballarat tracking systems delivered 12% more electricity than fixed arrays of the same capacity at the Ballarat site. Although the tracking systems did produce significantly more electricity, the maintenance issues in the CVSC suggested that tracking systems were not a financially viable strategy for increasing generation at Bendigo or Ballarat. The tracking equipment was not cost effective. The storage batteries installed at Bendigo Solar Park did not present an effective storage solution.
Start Date	10-12-2008
End Date	18-06-2013
Customer Segment	None
Customers Involved	
Cost	AUD 42M
Funding Source	Commercial Partner, Federal Government
Network	Powercor
Connection Point	
Location	Bendigo and Ballarat
State	VIC
Country	Australia
Future Plans	
Contact Name	
Contact Email	
Contact Phone	
Contact Link	http://www.sustainableregionalaustralia.com.au/central-victoria-solar-city.php
Background	The solar parks at Bendigo and Ballarat were developed under the Central Victoria Solar City program to provide new knowledge on the reliability of medium-scale solar PV technology and insight into the business model required for commercial success.

Areas of Relevance	Area	Comments	Relevance
	10. Smooth out intermittent generation output	An energy storage system was designed and installed at the Bendigo Solar Park to test the feasibility of storing energy from peak generation times when demand is low, and discharging it to the grid during peak demand periods. It was found that whilst the batteries performed to specification they do not present an effective storage solution because much larger capacity is needed to store enough energy to facilitate maximum use of energy generated by a medium scale asset. These findings are relevant to other Solar Parks around Australia.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	To know more about the economic model for medium scale solar, including the rate of the feed-in tariff and the power purchase agreement needed to make a solar park in a paddock, as opposed to rooftop solar PV, commercially viable.	Med
	1. Measure or quantify the benefits and costs of renewable energy.	The project aimed to better understand the technical elements of building and operating a solar park, including the design process, cost of materials, reliability, seasonal generation and maintenance costs involved.	High

Approaches	Approach	Comments
	Large Scale Renewable Plant	Two solar parks were built in each city of Bendigo and Ballarat. The Bendigo Solar park has a 333kW capacity, of which 16kW is mounted on tracking systems and the balance installed as a fixed array. In addition to this, the park is supported with a battery storage system. The Ballarat Solar Park has a capacity of 330kW of which 16kW is mounted on tilted oscillating tracking systems. Both the solar parks were connected to the electricity grid. Powercor provided discounted connection fees for both solar parks and worked closely with Origin and other consortium members during the commissioning of the parks.
	Economic Modelling	Develop a simulated feed-in tariff and simulated capital allowance, to be claimed on a quarterly basis, based on the parks' generation. These were established to test the revenue required to sustain operation of a solar park of this size and offered in place of a one off capital grant.

Results	Result	Comments
	Storage devices need careful planning, analysis and predictive algorithms	An energy storage system was designed and installed at the Bendigo Solar Park to test the feasibility of storing energy from peak generation times when demand is low, and discharging it to the grid during peak demand periods. Overall, the system had capacity to store and discharge approximately 60kWhs of energy each day, which is approximately 5% of the Park's total daily capacity. Whilst the batteries performed to specification they do not present an effective storage solution because much larger capacity is needed to store enough energy to facilitate maximum use of energy generated by a medium scale asset.
	PV tracking systems not financially viable	Tracking Versus Fixed Arrays Annual averaged generation data recorded from tracking systems demonstrated a significant variance when compared with the fixed arrays. Bendigo Solar Park achieved the greatest increase in generation from the tracking systems, which produced 21% more electricity than fixed arrays of the same capacity at the Bendigo park. The Ballarat tracking systems delivered 12% more electricity than fixed arrays of the same capacity at the Ballarat site. The variance in the tracking result between Bendigo and Ballarat can be explained by maintenance issues with the Ballarat trackers. Although the tracking systems did produce significantly more electricity, the maintenance issues in the CVSC trial suggest that tracking systems were not a financially viable strategy for increasing generation at Bendigo or Ballarat. The relative cost of the tracking equipment and the maintenance they required was greater than the increased income earned by optimising generation. The role of the tracking equipment in educating key stakeholders in the electricity generation from solar PV process was valuable.

Characterising the effect of high penetration solar intermittency on Australian electricity networks

Project ID	260
Organisation	CSIRO
Organisation Type	Government, Research
Partners	Energy Networks Association (ENA), Australian Energy Market Operator (AEMO)
Story	This project was undertaken to provide an in-depth analysis of worldwide research and practical results on renewable generation intermittency, examining what common conclusions can be made from other efforts in this area, and how these might apply in the Australian context. The intermittency of solar power in the operation of Australian electricity networks was explored further by conducting an Australian industry workshop and a follow-up survey to obtain the views of key solar industry experts. High-resolution solar data was collected and analysed from three different solar power installations around Australia to evaluate observed output power ramp rates and the corresponding frequency of their occurrence. A simulation model was developed at CSIRO to examine the likely impacts of solar output power fluctuations on various types of Australian electricity networks with different penetration levels of solar power. The project identified that the effects of solar intermittency is not uniform, but can be managed. It also identified that further research and demonstration work on this topic is required in Australia and that accurate solar forecasting is essential. One of the project's key findings was that a solution to integrate high solar power penetration is to strengthen the network to which it is connected to. This, however, can be a very expensive solution and could be combined with other solutions outlined to make the integration more cost-efficient.
Start Date	10-01-2011
End Date	28-02-2012
Customer Segment	
Customers Involved	
Cost	AUD 700,000
Funding Source	Federal Government
Network	Applies to all distribution networks in Australia
Connection Point	Customer Connections, Distribution Feeders, Zone Substations
Location	Various locations
State	
Country	Australia
Future Plans	Yes, we are currently working on projects that are based on future work identified in this project. This includes the ARENA Plug and Play Solar project and various projects on short-term solar forecasting.
Contact Name	Saad Sayeef
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Contact Phone	+61249606131
Contact Link	http://www.csiro.au/science/Solar-Intermittency-Report

Background	This project was undertaken to provide an in-depth analysis of worldwide research and practical results on renewable generation intermittency, examining what common conclusions can be made from other efforts in this area, and how these might apply in the Australian context. The intermittency of solar power in the operation of Australian electricity networks was explored further by conducting an Australian industry workshop and a follow-up survey to obtain the views of key solar industry experts. High-resolution solar data was collected and analysed from three different solar power installations around Australia to evaluate observed output power ramp rates and the corresponding frequency of their occurrence. A simulation model was developed at CSIRO to examine the likely impacts of solar output power fluctuations on various types of Australian electricity networks with different penetration levels of solar power.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	The project identified the cost impacts of solar power intermittency and provided examples reported in existing literature.	Low
	4. Inform the regulatory environment for renewable energy.	This project identified the challenges associated with high penetration solar intermittency. One of the key findings of the project was that high penetration solar intermittency can be managed using a few different approaches and the challenge is to find a solution or combination of solutions that will mitigate solar intermittency in a cost-effective manner. The issue of solar intermittency has to be evaluated on a case-by-case basis.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	As mentioned in (4) above, there are ways of effectively integrating high penetration solar power without any adverse impacts of the variability factor but the challenge is to find cost-efficient solutions or combinations of solutions.	Low
	9. Strengthen the network to manage higher renewable energy penetration	One of the project's key findings was that a solution to integrate high solar power penetration is to strengthen the network to which it is connected to. This, however, can be a very expensive solution and could be combined with other solutions outlined to make the integration more cost-efficient.	Low
	10. Smooth out intermittent generation output	The project collected and analysed high-resolution solar power data from three different solar installations in Australia, namely the Desert Knowledge Australia Solar Centre (DKASC), University of Queensland and CSIRO Newcastle site. Ramp rates of solar power variability at these three sites were analysed and reported. The project also explored the smoothing of intermittent solar power output that is achieved by spatial diversity of solar installation.	High
	14. Improve techniques for forecasting renewable energy output.	The project analysed ramp rates of solar power output at three different solar installations in Australia. The variability observed indicates the necessity to forecast solar power output with high time resolution.	Low

Approaches	Approach	Comments
	Literature Review	Review worldwide research and practical results on renewable generation intermittency, examining what common conclusions can be made from other efforts in this area, and how these might apply in the Australian context. The project report summarises the current state of research on renewable generation intermittency, focussing on centralised and distributed photovoltaics and concentrating solar thermal although wind intermittency is also addressed briefly.
	Interviews and Surveys	Conduct an industry workshop and follow-up survey to obtain the views of key solar industry experts on solar intermittency in the Australian context.
	Literature Review	Collect and analyse high-resolution solar power data from numerous solar power installations of varying sizes in Australia.
	Market Modelling	Build a model to explore the likely effects of output power fluctuations on different types of Australian electricity networks with different penetration levels. Develop a model to simulate and predict the power output of an existing or proposed PV plant.

Results	Result	Comments
	Understand challenges and opportunities behind intermittency and grid integration	The final report provides an in-depth analysis of worldwide research and practical results on renewable generation intermittency, examining what common conclusions can be drawn from other efforts in this area, and how these may apply in the Australian context. The project produced several critical findings that help to understand the challenges and opportunities behind intermittency and grid integration. These include: • Intermittency could stop the adoption of renewable generation • Existing research has conflicting outcomes, suffers from a lack of quality data and consequently often overemphasises anecdotal evidence • The effect of solar intermittency is not uniform • The amount of high penetration solar generation that can be integrated is application specific • Solar intermittency can be managed • Accurate solar forecasting is essential • Research and demonstration work is required in Australia Ramp rates of solar power output of three different Australian solar PV installations were analysed. Power output reductions exceeding 66% of plant rating within a ten second period were observed.

China Southern Grid's Shenzhen Baoqing Battery Energy Storage Station

Project ID	277
Organisation	China Southern Power Grid
Organisation Type	Government, Network
Partners	Peak/Frequency Regulation and Generation Company
Story	China Southern Power Grid (CSG) -- the second largest utility company in the world -- has completed construction of China's largest battery energy storage station (ESS) as well as the World's first megawatt-level, grid-connected, environmentally-friendly, Iron-phosphate (Fe) battery storage station for commercial use. Battery units are connected at the 10 kV bus of the 110 kV Biling substation via 10/0.4 kV transformers. A battery unit consists of battery, power conversion system (PCS) and battery management system (BMS). The storage station can work in several modes. It can adjust its output according to a scheduled curve given by the dispatch centre or a fixed curve for load levelling, or participate in advanced regulation and backup services. The storage station was planned to have a capacity of 10 MW/40 MWh, divided equally into two phases. 4 MW/16 MWh of the phase I project has already been put into operation, and of the rest 1 MW/4 MWh will be installed in the near future. Through the nature of the project, it deals with some network demand problems and the ability for battery storage to solve these problems.
Start Date	2012
End Date	
Customer Segment	Industrial, Large commercial, Residential
Customers Involved	
Cost	
Funding Source	Federal Government, State Government
Network	China's Southern Power Grid
Connection Point	
Location	Longgang, Shenzhen
State	Guangdong
Country	China
Future Plans	
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Background	For commercial and research purposes

Areas of Relevance	Area	Comments	Relevance
	8. Establish control over, or otherwise influence, intermittent generation sources	Combination of renewable energy generation and battery storage to control energy throughput into the network	Med
	9. Strengthen the network to manage higher renewable energy penetration	Enables large scale renewable energy generation to enter the network through a safe and controllable system	Med
	10. Smooth out intermittent generation output	Battery storage used to smooth out intermittent generation output	Med
	12. Use distributed energy solutions to address network and system constraints	Through the nature of the project, it deals with some network demand problems and the ability for battery storage to solve these problems	Med

Approaches	Approach	Comments
	Storage, Grid-Connected	Battery units are connected at the 10 kV bus of the 110 kV Billing substation via 10/0.4 kV transformers. A battery unit consists of battery, power conversion system (PCS) and battery management system (BMS). The storage station can work in several modes. It can adjust its output according to a scheduled curve given by the dispatch centre or a fixed curve for load levelling, or participate in advanced regulation and backup services. Functions of the Energy Storage System include: Load-following/Load Levelling or charging during the grid's lowest-usage-periods (i.e. night-time) which make other generation sources like ICE, Coal or Nuclear much more efficient (since the night usage of these stations may be as low as 40% utilized, but they still must run all night); Dispatchable energy during periods of high demand to peak-shave (i.e. day-time spikes in demand); FRR/power quality services to allow millisecond fast frequency adjustments on the grid caused by irregular sources (like wind or solar or power outages) and RRI/ramp-rate control and arbitrage for large renewable installations attached to the grid; Electricity balancing and regulating voltages (reactive power/VAR support) on the grid due to irregular sources like named above; Back-up power sources which guarantees distributed power supply closer to demand consumption during crucial events (e.g. summer outages and cascading regional brown outs which could shut down production and commerce)

Results	Result	Comments
	Deployment of Storage	The storage station was planned to have a capacity of 10 MW/40 MWh, divided equally into two phases. 4 MW/16 MWh of the phase I project has already been put into operation, and of the rest 1 MW/4 MWh will be installed in the near future.
	Storage can combine with PV to reduce peak demand	Through the nature of the project, it deals with some network demand problems and the ability for battery storage to solve these problems.

CIVIS Project

Project ID	286
Organisation	University of Trento
Organisation Type	Research
Partners	KTH, Aalto, Imperial College, Karlsruhe IT, TU Delft, TNO, ENEL FOUNDATION, IST, KIT, FBK, CREATE-NET and REPLY
Story	CIVIS (Cities as drivers of social change) project aims at moving one step further from the conventional "transaction-centric" role of ICT in smart grids to a more "holistic", socio-technical perspective whereby ICT plays a crucial role in harnessing the potential of social systems and dynamics in achieving a more efficient and environmentally compliant energy system, reshaping in novel ways how energy is generated and used. A multidisciplinary consortium will integrate and upgrade existing developments into a new platform with a three-tier-structure: (1) the energy network, (2) the information network and (3) the social network. CIVIS follows an experimentally-driven research approach, whereby R&D activities are complemented and sustained by testing in real-life environments in close cooperation with the relevant stakeholders. It will adopt logic of system integration, whereby the focus will be on smartly integrating and reusing existing ICT solutions, allowing for cost effectiveness and scalability. At the local level, a pivotal role is played by two pilot sites, seen as innovation eco-systems where the various stakeholders will be involved in the deployment and testing of the CIVIS ICT based distributed energy system .With respect to the impacts of the project, the pilot sites will be leveraged by the Consortium and a board of local stakeholders, ranging from DSOs to municipalities, to ensure the CIVIS system is adopted by users and by the other players of the energy value chain enabling new forms of social innovation and business models.
Start Date	2013
End Date	2016
Customer Segment	Residential, SME
Customers Involved	Approximately 500
Cost	EUR 4.46 Million (AUD 6.46 Million)
Funding Source	
Network	Hammarby Sjöstad (Stockholm), Storo (Trento) and San Lorenzo (Trento)'s
Connection Point	
Location	Hammarby Sjöstad (Stockholm); Storo (Trento) and San Lorenzo (Trento)
State	
Country	Sweden and Italy
Future Plans	The project is designed to be scalable and to provide prototyped results that could be expanded with further iterations of the project (or parts of it)
Contact Name	Matteo Bonifacio
Contact Email	matteo.bonifacio@unitn.it
Contact Phone	
Contact Link	
Background	In the future, low-carbon smart energy grids will be characterized by the pervasive adoption of Information and Communication Technology (ICT) as well as distributed and bidirectional energy and information flows. Users, individually and collectively, will become energy prosumers, interacting with each other and will need to adapt their behaviours, strategies and means of energy generation, distribution, storage, and consumption. CIVIS project's aim is to contribute to the design of a fairer, more sustainable, energy-optimised smart city. The project focuses on the ICT-enabled social dimension to harness the potential of innovation of individuals and collectives with respect to energy presumption. CIVIS will link energy, ICT and society to achieve significant impacts in terms of CO2 reduction, integration of renewables and new forms of social innovation.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	New ICT enabled Business Models will be designed in this project. Developing new business model with the integration of ICT is a common trend, however, the current project makes the ICT as the centre piece. Its relevancy to Australian market situation requires further discussion.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	Energy related Social Innovation Impacts will be developed and explored. The project approaches customer engagement from a new angle. It could add new knowledge to the current customer engagement research and practices in Australia.	Med

Approaches	Approach	Comments
	Demonstration Project	The CIVIS project follows an experimentally driven approach, whereby R&D activities are complemented and sustained by testing and validation in real-life environments. The project foresees testing of the concepts and technology in two existing pilot sites, located in Italy and in Sweden. The pilot sites will be used to test and validate the technical developments of the project as well as to assess their impacts in terms of energy savings, CO2 reduction, changes in users' perception and social dynamics.

Results	Result	Comments
	No results yet	The project is ongoing.

Climate-based PV Performance and Reliability

Project ID	26
Organisation	Australian PV Institute (APVI)
Organisation Type	Research
Partners	
Story	This project involves a web-based survey for use by anyone who owns, operates, installs or inspects a photovoltaic (PV) system and/or has detected a fault/problem with whole or part of the system. The idea of the project is to take into consideration the relationship between a broad spectrum of climate conditions in different locations and to extract technical, operational and performance data. This data will then be analysed to highlight technical aspects of PV system that require improvement, inform development to analyse areas for future improvement, development of standards and guidelines, and enable comparisons to be made of performance, reliability and economics in different climate zones. Additionally, by providing information on performance and reliability of PV systems in Australian climate conditions, this project aims to increase overall investment confidence in PV markets and establish internationally agreed methods of assessing and communicating information about PV performance and reliability
Start Date	
End Date	
Customer Segment	None
Customers Involved	
Cost	
Funding Source	Federal Government
Network	
Connection Point	Customer Connections, Distribution Feeders, Sub transmission Feeders, Zone
Location	Multiple cities
State	ACT, NSW, NT, QLD, SA, TAS, VIC, WA
Country	Australia
Future Plans	
Contact Name	Dr Muriel Watt
Contact Email	Chair@apva.org.au
Contact Phone	+61 427 727 368
Contact Link	http://apvi.org.au/climate-based-pv-performance-and-reliability/
Background	This project involves a web-based survey for use by anyone who owns, operates, installs or inspects a photovoltaic (PV) system and/or has detected a fault/problem with whole or part of the system.

Areas of Relevance	Area	Comments	Relevance
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	A web-based survey has been developed for anyone who owns, operates, installs or inspects a PV system and/or has detected fault/problem with whole or part of the system. This engagement will help increase the understanding of the PV industry about the types of problems that are found with different system components when they are exposed to the Australian environment.	Med
	13. Store and organise information on customer renewable energy deployments	A 'PV Module and System Fault Reporting Portal' has been developed to increase the understanding of the PV industry about the types of problems that are found with different system components when they are exposed to the Australian environment.	High

Approaches	Approach	Comments
	Interviews and Surveys	A web-based survey has been developed for anyone who owns, operates, installs or inspects a PV system and/or has detected fault/problem with whole or part of the system.

Results	Result	Comments
	No results yet	This project will provide a publicly available, high quality PV performance database containing location-specific technical, operational and performance data. Data will be collated from a variety of representative locations across Australia. Analysis of these data and project outputs will highlight technical aspects of PV systems that need improvement, inform development of standards and guidelines, and enable comparisons to be made of performance, reliability and economics in different climate zones.

Commercial & Industrial Demand Management (DM)

Project ID	313
Organisation	Energex
Organisation Type	Government, Network
Partners	
Story	Energex has experienced very high levels of load growth in its network, resulting in the need for significant capital investment. This growth occurred across all customer sectors including Commercial, Industrial and Residential. This project sought to establish commercial and industrial (C&I) demand management (DM) programs through development of a number of product offerings and a range of customer engagement strategies. Through this project, Energex aimed to create customer awareness of peak demand and its impacts. The project also aimed to develop a better understanding of C&I customers' abilities and desires to participate in demand management (DM) programs. The project was successful in achieving successful results on customer engagement. Standard product offerings and contracts for C&I customers were established. The project also found that the role-out of DM programs that are technically and economically viable, provide peak demand reductions and are mutually beneficial to customers and Energex.
Start Date	2007
End Date	Ongoing
Customer Segment	Industrial, Large commercial, Residential, SME
Customers Involved	This program is targeted to customers in specific areas of Energex's network,
Cost	
Funding Source	Regulator-Approved Spend, State Government
Network	Energex
Connection Point	Customer Connections, Distribution Feeders, Sub transmission Feeders, Zone
Location	Brisbane
State	QLD
Country	Australia
Future Plans	This project has grown and evolved from originally piloting and trialling DM technologies/ products and customer acceptance of the them, to now being an ongoing business-as-usual offering to customers in specific targeted areas of the network.
Contact Name	Greg Flynn
Contact Email	gregflynn@energex.com.au
Contact Phone	07 3664 5758
Contact Link	https://www.energex.com.au/residential-and-business/positive-payback
Background	During the early 2000's Energex experienced very high levels of load growth in its network, resulting in the need for significant capital investment. This growth occurred across all customer sectors including Commercial, Industrial and Residential. This project sought to establish C&I DM programs through development of a number of product offerings and a range of customer engagement strategies.

Areas of Relevance	Area	Comments	Relevance
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	The project aimed to create customer awareness of peak demand and its impacts. The project also aimed to develop a better understanding of C&I customers' abilities and desire to participate in DM programs. The project was successful in achieving successful results on customer engagement. Standard product offerings and contracts for C&I customers were established.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Establishment of appropriate DM product offerings and contractual arrangements for C&I customers were developed. Role-out of DM programs that are technically and economically viable, provide peak demand reductions and are mutually beneficial to customers and Energex.	Med
Approaches	**Approach**	**Comments**	
	Demand Side Incentives	The project initially trialled several different delivery models and approaches. The primary DM products which were utilised by customers included: demand response/embedded generation, power factor correction, building management system, air-conditioning, refrigeration and lighting system upgrades. As the project progressed the delivery model continued to be refined and the customers contracted for the program were specifically targeted towards areas of the network where future network investment is expected in the medium term.	
Results	**Result**	**Comments**	
	Customer engagement achieved	Customer engagement was very successful and standard product offerings and contracts for C&I customers were established.	
	Incentives helped consumers reduce consumption during peak demand	Project has moved to a business as usual delivery model and planned demand reduction targets being achieved.	

Consumer portal for Demand Side Management trial

Project ID	4
Organisation	Jemena
Organisation Type	Network
Partners	
Story	*No information on the web. The project may be published in a different name or is current confidential for public domain.*
Start Date	
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	
Network	
Connection Point	
Location	
State	
Country	Australia
Future Plans	
Contact Name	
Contact Email	
Contact Phone	
Contact Link	
Background	
Areas of Relevance	

Areas of Relevance	Area	Comments	Relevance

Approaches	Approach	Comments

Results	Result	Comments

Customer PV Voltage Control Project

Project ID	271
Organisation	Ergon Energy
Organisation Type	Network
Partners	
Story	Localised high concentrations of PV systems are causing significant and widespread voltage management problems on the network, adversely affecting Ergon Energy's customers and business operations. Operational tools to mitigate and manage this problem are currently effectively limited to restricting the size or number of PV systems around these concentrations. Enforcing PV system protection standards and customer funded network augmentation in some instances are also being utilised. Ergon Energy will modify the existing Solar PV systems by replacing the micro inverters with a single inverter for each system. The new inverters will allow Ergon Energy to test the ability of customer owned inverters to use automated voltage regulation through the absorption and injection of Reactive Power. This would also provide an opportunity to use inverters from multiple manufacturers and provide assessment of inverter interaction.
Start Date	01-08-2013
End Date	01-12-2014
Customer Segment	Residential
Customers Involved	8
Cost	AUD 230,000
Funding Source	Discretionary Spend
Network	Ergon Energy
Connection Point	Customer Connections
Location	Townsville
State	QLD
Country	Australia
Future Plans	Project is still running
Contact Name	Michelle Taylor
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Contact Phone	
Contact Link	
Background	Localised high concentrations of PV systems are causing significant and widespread voltage management problems on the network, adversely affecting our customers and our business operations. Operational tools to mitigate and manage this problem are currently effectively limited to restricting the size or number of PV systems or requiring customer funded network augmentation in some instances and enforcing PV system protection standards.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The project will modify the existing Solar PV systems by replacing the micro inverters with a single inverter for each system. This will help improve understanding to then feed into the development of Network Connection standard and provide considered feedback in the development of a national inverter standard.	High
	9. Strengthen the network to manage higher renewable energy penetration	Ergon Energy will modify the existing Solar PV systems by replacing the micro inverters with a single inverter for each system. The new inverters would allow Ergon Energy to test the ability of customer owned inverters to use automated voltage regulation through the absorption and injection of Reactive Power. This will also help test a Voltage Rise mitigation option and develop products for deployment.	Med

Approaches	Approach	Comments
	Improve Inverter Design	The existing Solar PV systems would be modified to replace the micro inverters with a single inverter for each system. The new inverters would allow Ergon to test the ability of customer owned inverters to use automated voltage regulation through the absorption and injection of Reactive Power. This would also provide an opportunity to use inverters from multiple manufacturers and provide assessment of inverter interaction.

Results	Result	Comments
	No results yet	Project is still running

Customer-Led Network Revolution

Project ID	170
Organisation	Northern Powergrid
Organisation Type	Network
Partners	British Gas, EA Technology
Story	The project's aim is to test and evaluate potential future solutions that will enable Distribution Network Operators to facilitate the low carbon future at the lowest cost for customers. This will be done by developing optimum solutions to accommodate the rise in intermittent renewable generation (PV and wind, etc) and the connection of low carbon technology loads (such as heat pumps and electric vehicles) as policy changes and incentives influence the decarbonisation of the heat and transport sectors. The project aims to test a range of customer-side interventions (innovative tariffs and load control incentives) in association with different low carbon technologies alone and in combination with network-side technology (including voltage control, real time thermal rating and storage).The aim is to provide five specific learning outcomes:--Learning Outcome 1: What are current, emerging and possible future customer load and generation characteristics? -Learning Outcome 2: To what extent are customers flexible in their load and generation, and what is the cost of this flexibility? Learning Outcome 3: To what extent is the network flexible and what is the cost of this flexibility? How can new technologies optimise the use of installed network capacity? -Learning Outcome 4: What is the optimum solution to resolve network constraints driven by the transition to a low carbon economy? -Learning Outcome 5: What are the most effective means to deliver optimal solutions between customer, supplier and distributor? The overall objective is to develop the network efficiently to accommodate future changes at least cost and to ensure prompt connection of these low carbon technologies.
Start Date	01-01-2011
End Date	01-12-2014
Customer Segment	Industrial, Large commercial, Residential, SME
Customers Involved	550
Cost	AUD 55M
Funding Source	Commercial Partner, Regulator-Approved Spend
Network	Other
Connection Point	
Location	
State	
Country	United Kingdom
Future Plans	The CLNR trials are likely to be followed by a trial of residential demand side response based upon community engagement .The voltage control, real-time thermal rating and demand side response elements of the trial will be adopted in the regulatory next price control (commencing 1 April 2015) and the cost savings from such techniques (i.e. avoided reinforcement costs) are already built into the Northern Powergrid 2015-23 business plan
Contact Name	Jim Cardwell
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Contact Link	http://www.networkrevolution.co.uk/
Background	The project's aim is to test and evaluate potential future solutions that will enable Distribution Network Operators facilitate the low carbon future at the lowest cost for customers by developing optimum solutions to accommodate the rise in intermittent renewable generation (PV and wind, etc.) and the connection of low carbon technology loads such as heat pumps and electric vehicles as policy changes and incentives influence the decarbonisation of the heat and transport sectors. The project aims to test a range of customer-side interventions (innovative tariffs and load control incentives) in association with different low carbon technologies alone and in combination with network-side technology (including voltage control, real time thermal rating and storage).

Areas of Relevance	Area	Comments	Relevance
	5. Engage customers to build their and the industry's understanding of distributed energy resources	The project aims to test a range of customer-side interventions such as innovative tariffs and load control incentives in association with different low carbon technologies alone and in combination with network-side technology (including voltage control, real time thermal rating and storage).	Med
	2. Support the transition to an alternative electricity pricing approach	The project is trialling alternative tariffs to incentivise customers to relocate load from periods of network constraint. Preliminary results are showing both a reduction in overall consumption as well as a reduction at peak times. Final results will be published in Q3 2014.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Creation of a prototype network planning and design decision support tool to enable designers to assess a range of smart solutions not previously adopted as "business as usual". Also developing a control system that can integrate a range of deployed solutions and control them in a way that deploys the optimum solution. Both of these pave the way towards new commercial arrangements with customers for flexibility services and also the transition towards a more actively managed network.	High
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The project will equip designers with a range of solutions (technical and commercial) that will enable the connection of renewable generation (and new low-carbon heating and transport loads) quicker and cheaper than conventional reinforcement techniques.	Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The project will deliver design tools, policies, standards, specifications, procedures and training materials.	Low
	8. Establish control over, or otherwise influence, intermittent generation sources	The flexible network solutions being trialled by CLNR, such as real-time thermal ratings, voltage control and storage, will assist the network to accommodate the intermittent nature of renewable generation but does not control the generation itself. The project is also trialling in-home balancing techniques to increase the amount of within premises consumption of power generated by solar PV panels. Other projects (including one Northern Powergrid project) are looking at methods of controlling generation output to address constraints.	High
	9. Strengthen the network to manage higher renewable energy penetration	The flexible network solutions being trialled by CLNR, such as real-time thermal ratings, voltage control and storage, together with commercial arrangements with the generators, will assist the network to accommodate the intermittent nature of renewable generation thereby deferring the need for the traditional reinforcement of the network.	Med

11. Alter local load profile to match a desired level	The CLNR project is trialling direct control techniques with residential customers and also DSR commercial arrangements with industrial and commercial customers. It is also developing a control system that will monitor network conditions and, if a constraint is predicted, will dispatch the most appropriate load smoothing response, whether this be the discharging of a local storage device or the automated call for a load reduction / increase in generation output.	High
12. Use distributed energy solutions to address network and system constraints	The CLNR project is investigating the use of reactive power capabilities of wind generation to provide network voltage support.	

Approaches	Approach	Comments
	Demand Side Incentives	Three different tariff approaches are being trialled – 1) time of use tariffs, 2) restricted hours tariffs (i.e. a lower tariff for certain appliances at certain hours), and 3) direct control tariffs. Trials have already been performed for the industrial and commercial customers over the 2011/12 and the 2013/14 winter periods.
	Load Monitoring & Analysis	Customers engaged in the baseline monitoring trials were asked if their smart meter data could be used for the trial and invited to opt out if they did not want to be included on the trials. No payments were made to these customers. A further group of customers with low carbon technologies were recruited to be monitored and these were incentivised with store vouchers at the start of the trial.
	Storage, Grid-Connected	The main network energy technology solutions being trialled are enhanced automatic voltage control, real time thermal rating devices, electrical energy storage and a state estimation control system. Devices are being trialled on the EHV, HV and LV systems and trials are being undertaken to determine the optimum configurations.
	Volt / VAR Control	The main network energy technology solutions being trialled are enhanced automatic voltage control, real time thermal rating devices, electrical energy storage and a state estimation control system. Devices are being trialled on the EHV, HV and LV systems and trials are being undertaken to determine the optimum configurations.
	Dynamic Equipment Rating	The main network energy technology solutions being trialled are enhanced automatic voltage control, real time thermal rating devices, electrical energy storage and a state estimation control system. Devices are being trialled on the EHV, HV and LV systems and trials are being undertaken to determine the optimum configurations.
	Network Monitoring & Analysis	The main network energy technology solutions being trialled are enhanced automatic voltage control, real time thermal rating devices, electrical energy storage and a state estimation control system. Devices are being trialled on the EHV, HV and LV systems and trials are being undertaken to determine the optimum configurations.

Results	Result	Comments
	No results yet	The project is still underway. The project is on target to deliver the learning outcomes as specified at the start of the project but these will be delivered one year later than planned (at end 2014). The impact on the completion of the project was due to a number of externalities impacting the project. These externalities ranged from a slower uptake of low carbon technologies than indicated in the DECC forecasts to a major equipment supplier filing for bankruptcy protection and being taken over. All issues were overcome and the project will be publishing the results of the Customer Flexibility Trials during Q3 2014 and the overall trial results by the end of 2014. The customer trials have been largely completed and the customer feedback surveys, data analysis and write-up are underway. All the network technology was installed as designed and the network flexibility trials are in currently progress, including the trial of the active network management system (the Grand Unified Scheme – GUS) designed by the project and implemented on a rural network, an urban network and the heat pump cluster network and the PV cluster network. Operational procedures, safety documentation and training materials has been created and approved by Northern Powergrid for the connection and operation of this equipment. Significant progress has been made with the development of the Network Planning and Design Decision Support tool, which is now taking in data from the network trials.

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Demand Management Storage Project (DMSP)

Project ID	356
Organisation	CitiPower & Powercor Australia
Organisation Type	Network
Partners	
Story	Energy storage both on a large scale and consumer level is attracting much attention, driven by a growing range of potential applications of the technology. Like many other distribution businesses, Powercor have identified energy storage as a technology that is increasingly becoming an important part of the evolving grid. Storage technology offers the capability to reduce energy at risk, defer traditional network capex, smooth renewable integration, provide voltage and frequency support and improve reliability. The project will create cost efficiency improvements for integrating storage into the network – a key technology to maximise and manage the output of intermittent renewable resources. The project will generate capability and learnings for the scope, procurement, design, integration and operation of energy storage assets. The project will build the networks capability to scope, install and operate large scale storage that could be used to manage the output of intermittent renewable resources. The project will be utilised to load shift the peak on the local feeder during times of high demand. The project will relieve congestion on two upstream locations, deferring the need to invest in new network feeders for 3-5 years. Project has already built capability to evaluate, scope, size, procure, and design grid energy storage systems. The energy storage system is still in the construction phase; therefore full project outcomes are not available.
Start Date	01/08/2015
End Date	01/04/2016
Customer Segment	Residential
Customers Involved	6400
Cost	$6m
Funding Source	Discretionary Spend, Regulator-Approved Spend
Network	Powercor
Connection Point	Distribution Feeders
Location	Ballarat/Buninyong
State	VIC
Country	Australia
Future Plans	Yes, the project is only in construction. The trial phase to test the capital deferral, voltage control, islanding and operations of the asset are still to be completed.
Contact Name	Leigh Chivers
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Contact Phone	03 9297 6066
Contact Link	
Background	Energy storage both on a large scale and consumer level is attracting much attention, driven by a growing range of potential applications of the technology. Like many other distribution businesses, Powercor have identified energy storage as a technology that is increasingly becoming an important part of the evolving grid. Storage technology offers the capability to reduce energy at risk, defer traditional network capex, smooth renewable integration, provide voltage and frequency support and improve reliability.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The project will create cost efficiency improvements for integrating storage into the network – a key technology to maximise and manage the output of intermittent renewable resources.	Low
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The project will generate capability and learnings for the scope, procurement, design, integration and operation of energy storage assets.	Low
	8. Establish control over, or otherwise influence, intermittent generation sources.	The project will build the networks capability to scope, install and operate large scale storage that could be used to manage the output of intermittent renewable resources.	Med
	9. Strengthen the network to manage higher renewable energy penetration	The project will build the networks capability to scope, install and operate large scale storage that could be used to manage the output of intermittent renewable resources.	Med
	10. Smooth out intermittent generation output	The project will build the networks capability to scope, install and operate large scale storage that could be used to manage the output of intermittent renewable resources.	Med
	11. Alter local load profile to match a desired level	The project will be utilised to load shift the desired level demand.	Med
	12. Use distributed energy solutions to address network and system constraints	The project will relieve congestion on two upstream locations, deferring the need to invest in new network feeders for 3-5 years.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	The project aims to provide and operate with multiple energy services, the most economic outcome fore an energy storage asset.	Low

Approaches	Approach	Comments
		Grid energy storage is known as the 'Swiss army knife' of the energy system, as it can provide multiple energy services including peak shaving (capital deferral), voltage control (VAR support) and improved reliability (STPIS avoidance). The highest value location on the network is where all energy services can be utilised. Grid energy storage was evaluated across Citipower and Powercor networks for all of the above services at a sub transmission, zone substation and feeder level. Through the analysis it was determined that unreliable remote sections of Powercor feeders provide the best opportunity to realise all of the above services.

Results	Result	Comments
		Project has already built capability to evaluate, scope, size, procure, and design grid energy storage systems. The energy storage system is still in the construction phase; therefore full project outcomes are not available.

Deployment of High Resolution Real-Time Distribution Level Metering on Maui

Project ID	233
Organisation	National Renewable Energy Laboratory
Organisation Type	Government
Partners	Maui Electric Company
Story	The ongoing Okinawa-Hawaii Smart Grid Demonstration project is preparing to install several different types of smart grid equipment into the distribution system in the Kihei area of Maui. This equipment includes advanced Distribution Management Systems, electric vehicles and chargers, and battery storage technology along with upcoming distributed PV installations. The goal of this project is to demonstrate all of these systems in concert on a real distribution network, and how they can improve efficiency and operation through advanced renewable integration and energy management and control systems. This includes advance real-time distribution level metering which has been developed at NREL. The distribution metering is focused at the low voltage points on the system and provides high-resolution power quality and phasor data in real time through an active Internet connection. Additionally NREL is collecting solar irradiance data to assess the available resource and the impact on PV generation in the Kihei area.
Start Date	
End Date	
Customer Segment	Residential, SME
Customers Involved	
Cost	
Funding Source	
Network	Maui Electric Company
Connection Point	Customer Connections, Distribution Feeders
Location	Maui
State	Hawaii
Country	United States
Future Plans	
Contact Name	
Contact Email	
Contact Link	http://www.nrel.gov/docs/fy13osti/56417.pdf
Background	The ongoing Okinawa-Hawaii Smart Grid Demonstration project is preparing to install several different types of smart grid equipment into the distribution system in the Kihei area of Maui where increasing PV is being installed. This equipment includes advanced Distribution Management Systems, electric vehicles and chargers, and battery storage technology along with upcoming distributed PV installations. The goal of this project is to demonstrate all of these systems in concert on a real distribution network, and how they can improve efficiency and operation through advanced renewable integration and energy management and control systems. Deploying advanced metering into the area in preparation of the upcoming base lining and experimental data collection needs. This includes advance real-time distribution level metering which has been developed at NREL. The distribution metering is focused at the low voltage points on the system and provides high-resolution power quality and phasor data in real time through an active Internet connection. Additionally NREL is collecting solar irradiance data to assess the available resource and the impact on PV generation in the Kihei area.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Improve control of distribution feeders by increasing metering and thus monitoring of the feeders, and also measuring solar irradiance to assess the impact on PV generation.	Med

Approaches	Approach	Comments
	Network Monitoring & Analysis	The transformer monitoring for this project is provided by NREL's real-time distribution monitoring network. This network is made up of remote metering devices which communicate to a set of data collection servers. The metering devices are built from off-the-shelf hardware with custom-developed software to handle data collection, processing, and communications. They implement phasor calculations similar to phasor measurement units and additionally include power quality calculations. Hereafter the distribution transformer meters are referred to as Distribution Monitoring Units (DMU). Design of the DMUs has been specifically targeted for installation at remote and disparate points within a distribution feeder. Ease of installation was a major requirement so that the DMU could be installed at any location—ranging from the service panel of a single home up to the distribution transformers and medium voltage locations (assuming proper potential transformers were added). In addition to the above electrical metering, NREL has also deployed a set of five irradiance sensors, located near current and future PV installations, in order to assess the available solar resource in the area.

Results	Result	Comments
	PV, if uncontrolled, can create voltage problems for the network	The data analysis stage has not yet begun in earnest with only a few preliminary assessments presented here. Some interesting features of the collected data sets have been presented including a case in which power was flowing toward the utility through a distribution transformer due the presence of PV and light loading conditions. Operation of voltage control devices within the distribution circuit can also be observed as step changes in voltage by this metering. As the modelling and simulation portion of this project begins, more accurate load models are becoming important. To achieve this, some preliminary assessment of load variability has been done based on robust variance statistics. This metric can be tuned to look at different time scales, and assess the time dependence of certain load characteristics including how particular switched loads behave. One type of loads has been identified that switched on and off at a rate of about ten minutes. The developed variability metric demonstrates this time dependence through a series of progressively larger time windows used as a base. The same metric was also applied to solar irradiance measurements to estimate the expected variability in PV generation sources and how PV generation relates to the observed load variability

DERINT - Large scale virtual power plant integration

Project ID	164
Organisation	DONG Energy
Organisation Type	Network
Partners	
Story	Increasing levels of wind and solar require increasing volumes of balancing services. The project involved the development of a virtual power plant named 'Power Hub', which is an IT system that can manage both small power generators (such as small hydro power plants, industrial combined heat and power plants (CHP) or emergency generation sets) and power consumers to provide balancing services. Power Hub's main task is to ensure that all units are used optimally for both the electrical system and the unit owner. For example, pumping water can be stopped or started in a matter of seconds if the power system needs it. Similarly a small hydroelectric plant could gain access through Power Hub to provide services which stabilise the frequency of the power system. The Power Hub team approached more than 100 owners and signed up 47. The demonstration was set up in Denmark on fully commercial terms, namely the VPP delivers services to the Danish power system based on the controlled units on a daily basis at market prices. The project has demonstrated how virtual power plant technology can help integrate an increased share of intermittent renewable energy to the European power system. DONG Energy has continued the VPP as a commercial activity and is now actively working on commercializing the technology developed in the Twenties project on a larger scale both in Denmark and in Britain.
Start Date	2010
End Date	2013
Customer Segment	Industrial, Large commercial, SME
Customers Involved	47 industrial units
Cost	Part of AUD 84M European Commission Twenties Project
Funding Source	European Commission
Network Connection Point	
Location	Multiple locations
State	
Country	Denmark
Future Plans	For the VPP solution developed on the Faroe Islands is already extended with additional industrial units on request of the local power company SEV, and they expect to extend the local solution further. The solution will help SEV keep a stable power supply on the Faroe Island when the Islands will go from 10% wind power to 25% wind power. DONG Energy and Schneider Electrics have made a partnership for development and global sales of the island solution. DONG Energy is in dialogue with some of the largest island operators in Europe on how the solution can help other islands make similar steps towards more renewables. The solution is also relevant in larger power systems with Island characteristics that have a high share of renewables like Ireland and Britain. EirGrid has followed the development on the Faroe Islands with interest, as they also consider inertia as a future issue when winds share of production rises in Ireland, and EirGrid will have to consider new solutions.
Contact Name	Mr. Anders Birke
Contact Email	andbi@dongenergy.dk
Contact Phone	+45 99 55 49 47
Contact Link	http://www.twenties-
Background	When an increasing share of energy is produced by renewable sources such as solar and wind, electricity production can fluctuate significantly. In the future there will be a need for services that can help balance power systems in excess of what conventional assets can provide. Virtual power plants (VPPs) are one of the most promising new technologies that can deliver the necessary stabilising services.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	This project aimed to develop the practical implementation of a Virtual Power Plant (VPP).	High
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The project explored the potential of aggregating small generating units and industrial demand side units to provide balancing services. A significant number of small generators and users of electricity participated in the project.	High
	8. Establish control over, or otherwise influence, intermittent generation sources	Establish control over, or otherwise influence, flexible industrial consumption units and small generation units, to deliver services that can help balance a future wind based power system. A significant number of generators and consumers participated on commercial terms.	High
	Other	Show the full potential of the VPP technology. The VPP project was successful and is being commercialised.	

Approaches	Approach	Comments
	Demonstration Project	The demonstration project involved the development of a virtual power plant named 'Power Hub', which is an IT system that can manage both small power generators (such as small hydro power plants, industrial combined heat and power plants (CHP) or emergency generation sets) and power consuming units (such as pumps in waste water treatment, grow light in greenhouses, cooling in cold storages). Most owners of distributed energy resources are not aware of the potential economic value of flexible power production and consumption. Mobilising flexibility often involves time consuming efforts to create the necessary awareness among them, explaining the potential economic value as well as the value of contributing to the greening of the energy system. The Power Hub team approached more than 100 owners and signed up 47.

Results	Result	Comments
	Other	The project showed both the availability of flexibility in distributed energy resources, as well as the feasibility of mobilising them for system support on commercial terms acting through existing energy and reserves markets. Power Hub integrated different energy producing and consuming technologies. Even a small portfolio of assets can be competitive to existing resources participating in existing reserves markets.
	Wind turbines can deliver all required balancing services	In addition to the common balancing services Power Hub has proven to be capable of delivering a broader portfolio of balancing services, including reactive power and fast frequency demand response, as well as other services not yet managed through markets. Power Hub has shown that wind turbines can deliver all required balancing services.

Direct Load Control of Pool Pump/AC

Project ID	293
Organisation	United Energy
Organisation Type	Network
Partners	
Story	The use of heavy air-conditioners during hot weather has led to high growth in peak demand. On the United Energy's distribution network, four 11kV feeders in the Bulleen/Lower Templestowe area will require upgrade in 2017/18. This trial aims to remotely control customer pool pumps and/or AC to reduce load during peak event periods. One of the main goals of this trial is to raise awareness in customers of their appliance use and the impact it has on the network through an engagement and education process. The trial also seeks to incentivise customers to allow United Energy to remotely control their pool pump and/or AC to reduce their peak demand and smooth the demand profile. The load reduction through direct load control is expected to reduce stress on the network during peak demand periods and help alleviate network constraints.
Start Date	TBA
End Date	TBA
Customer Segment	Residential
Customers Involved	TBA
Cost	
Funding Source	Regulator-Approved Spend
Network	United Energy
Connection Point	Customer Connections, Distribution Feeders, Zone Substations
Location	United Energy distribution area
State	VIC
Country	Australia
Future Plans	The project has not been implemented yet.
Contact Name	Sharon Tissai-Krishna
Contact Email	sharon.tissai-krishna@ue.com.au
Contact Phone	03 8846 9828
Contact Link	
Background	Heavy air conditioner use in hot weather has led to high growth in peak demand. Four 11kV feeders in the Bulleen/Lower Templestowe area will require upgrade in 2017/18. This trial aims to remotely control customer pool pumps and/or AC to reduce load during peak event periods.

Areas of Relevance	Area	Comments	Relevance
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	One of the goals of the trial is to raise awareness in customers of their appliance use and the impact on the network. Through this engagement and education process, it is expected that customers will understand the heavy impact on the network of pool pumps and AC at peak demand times. These customers are incentivised to allow UE to remotely operate their pool pump or AC to reduce their load.	Med
	11. Alter local load profile to match a desired level	Through awareness and education the trial seeks to incentivise customers to allow UE to remotely control their pool pump and/or AC to reduce their peak demand and smooth the demand profile.	Med
	12. Use distributed energy solutions to address network and system constraints	The load reduction through direct load control is expected to reduce stress on the network during peak demand periods and help alleviate network constraints.	Med

Approaches	Approach	Comments
	Direct load control	The trial seeks to understand if direct load control of pool pumps and/or AC on peak demand days can reshape the load profile on the distribution network and at the local premises.

Results	Result	Comments
	No results yet	The project has not been implemented yet.

Distribution Scale Energy Storage

Project ID	329
Organisation	Isentropic Ltd
Organisation Type	Other
Partners	Energy Technologies Institute, Western Power Distribution
Story	The Energy Technologies Institute (ETI) ran a competition for funding the development of a next-generation electricity storage technology. The aim was to provide solutions for the integration of renewable energy sources into the electricity grids of the future. Isentropic® PHES, the cycle which is being developed in this project, uses abundant metals to make its power equipment and uses crushed rock in highly efficient thermal stores as its energy storage medium to create a low-cost, highly-efficient, long-life answer to the electricity storage challenge. The system is based on a reversible heat pump, and when heat flows back it works like a reversible heat engine converting thermal energy to mechanical power.
Start Date	2011
End Date	
Customer Segment	
Customers Involved	
Cost	AUD 29 M
Funding Source	Discretionary Spend, Regulator-Approved Spend, State Government
Network	Western Power Distribution
Connection Point	Subtransmission Feeders
Location	Toton
State	Nottinghamshire
Country	United Kingdom
Future Plans	
Contact Name	James Macnaghten
Contact Email	james.macnaghten@isentropic.co.uk
Contact Phone	+44 1489 565 024
Contact Link	
Background	The Energy Technologies Institute (ETI) is a public-private partnership between global energy and engineering companies and the UK Government. Its role is to act as a conduit between academia, industry and the government to accelerate the development of low carbon technologies. It brings together engineering projects that develop affordable, secure and sustainable technologies to help the UK address its long term emissions reductions targets as well as delivering nearer term benefits. It does this by undertaking targeted commercial investments in nine technology programmes across heat, power, transport and the infrastructure that links them. ETI modelling demonstrates a requirement for large-scale distributed electricity storage to help the UK reach a low-carbon economy. This modelling has suggested that the ideal size was around 1 MW and located on primary substations. The project they have commissioned and funded is for: • Demonstration of grid scale energy storage technology on a Western Power Distribution network site • Technology developed by Hampshire SME Isentropic – using a combined heat pump/heat engine to generate electricity to create temperature difference for storage efficiency

- ETI equity investment to support development of the company and its technology to a level of scale

This project is demonstrating the feasibility of a revolutionary new approach to storing electricity at grid scale.

Isentropic have developed their own Pumped Heat Electricity Storage (PHES) technology for large-scale energy storage. It uses an innovative heat pump/engine which converts electrical energy to heat, stored in low cost gravel storage vessels. The process is reversible, with hot gas expanded in the engine to drive a generator with an achievable round trip efficiency of approximately 75%.

Using this technology, the project will develop and demonstrate a cost-effective 1.5MW/6MWh energy storage device that will operate on a Western Power Distribution network site.

The AUD 29 M project sees ETI become a minority equity shareholder in Isentropic to allow them to develop the business to meet the demands of the project specification. It is scheduled to complete in the summer of 2018.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Storage should make a significant contribution to integrating variable renewables.	Low
	8. Establish control over, or otherwise influence, intermittent generation sources	The power equipment at the heart of the Isentropic® PHES cycle has a one second response time and a rotating mass, meaning that it can help stabilise supply from intermittent renewable resources and minimise the backup supply required from conventional plant.	Med
	9. Strengthen the network to manage higher renewable energy penetration	The next stage in the project, the Field Test Article, will be placed on a substation, allowing the system operator to minimise network reinforcement required to meet demand peaks. The system should peak shave, thus reducing the need to reinforce the network.	Med
	10. Smooth out intermittent generation output	The ability to store electricity from intermittent generation sources smooths out the supply curve.	Med
	12. Use distributed energy solutions to address network and system constraints	The next stage in the project, the Field Test Article, will be placed on a substation, allowing the system operator to minimise network reinforcement required to meet demand peaks.	Low

Approaches	Approach	Comments
	Storage, Grid-Connected	This project is demonstrating the feasibility of a revolutionary new approach to storing electricity at grid scale. Isentropic have developed their own Pumped Heat Electricity Storage (PHES) technology for large-scale energy storage. The project is focussed mainly on technology development, aiming to maximise efficiency and performance and to minimise the cost of the technology. A highly-skilled engineering team has been assembled in order to achieve these objectives through the design and manufacture of bespoke components. It is the opinion of Isentropic Ltd that attempting to develop this technology using off-the-shelf components would not create a commercially attractive offering and would not solve any of the key technical challenges whilst maintaining flexibility in the manufacturing and maintenance process.

Results	Result	Comments
	No results yet	The project has not been implemented yet.

Distribution Transformer Low Voltage Circuit Monitoring

Project ID	315
Organisation	Energex
Organisation Type	Government, Network
Partners	
Story	The project aimed to conduct an evaluation of the analytics and tools for monitoring of the individual low voltage feeders from pad-mounted distribution transformers to determine the scope and scale of any additional benefits over that for the measurement of total output only. The project utilised advanced metering technology that the utility already had experience and systems deployed for commercial customers. The system leveraged existing communications and backend infrastructure to measure and collect data. The project deployment and data collection was successfully achieved on target and budget. The project data collection is underway providing a longitudinal data set for future analysis.
Start Date	28-05-2012
End Date	01-07-2015
Customer Segment	Residential
Customers Involved	3700
Cost	
Funding Source	Regulator-Approved Spend
Network	Energex
Connection Point	Customer Connections, Distribution Feeders
Location	Brisbane
State	QLD
Country	Australia
Future Plans	It is planned to continue collecting a longitudinal data set whilst commencing
analysis of existing data in 2015/16.	
Contact Name	Aidan Roberts
Contact Email	aidanroberts@energex.com.au
Contact Phone	07 3664 5792
Contact Link	
Background	To conduct an evaluation of the analytics and tools for monitoring of the individual low voltage feeders from pad mounted distribution transformers to determine the scope and scale of any additional benefits over that for the measurement of total output only.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	Understand low voltage distribution network, voltage and power flows with and without PV and to model the impact and assess remedial solutions that could support regulatory compliance in the light of high PV penetration.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	Understand low voltage distribution network, voltage and power flows with and without PV and to model the impact and assess remedial solutions that could support regulatory compliance in the light of high PV penetration.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	Utilisation of advanced metering technology that the utility already had experienced and systems deployed for commercial customers. The system leveraged existing communications and backend infrastructure to measure and collect data.	Med
	12. Use distributed energy solutions to address network and system constraints	The project supported other Smart Grid Project initiatives by assessing customer load and power quality measures. The project also aimed to develop new LV modelling capability to cater for newer load types and embedded generation from customers.	Med
Approaches	**Approach**	**Comments**	
	Smart Meters and In-Home Displays	The project utilised advanced metering technology that the utility already had experience and systems deployed for commercial customers. The system leveraged existing communications and backend infrastructure to measure and collect data. Analytics on the data is yet to be undertaken.	
Results	**Result**	**Comments**	
	No results yet	Initial evidence suggests that trialled circuit cables exceed rating & are unbalanced. Fusing is not in accordance with the rating of the cable. Monitoring would provide visibility of overloaded circuit cables.	

DOE Global Energy Storage Database

Project ID	297
Organisation	Scandia National Laboratories, Department of Energy
Organisation Type	Government
Partners	
Story	The DOE Global Energy Storage Database provides free, up-to-date information on grid-connected energy storage projects and relevant US state and federal policies. The aim of this database is that it will contribute to the rapid development and deployment of energy storage technologies. This database shows the impressive diversity of energy storage projects across the globe, as well as the broad services they provide. Anybody can create an account and add projects, and each project goes through a vetting process where database staff contact the project owner to verify data accuracy. The database has become an important tool as the main point of reference for energy storage professionals worldwide.
Start Date	
End Date	Ongoing
Customer Segment	
Customers Involved	
Cost	
Funding Source	Federal Government
Network	
Connection Point	
Location	
State	
Country	United States
Future Plans	Ongoing
Contact Name	
Contact Email	storage.exchange@strategen.com
Contact Phone	
Contact Link	http://www.energystorageexchange.org/
Background	The DOE Global Energy Storage Database provides free, up-to-date information on grid-connected energy storage projects and relevant state and federal policies. More than 50 energy storage technologies are represented worldwide, including multiple battery technologies, compressed air energy storage, flywheels, gravel energy storage, hydrogen energy storage, pumped hydroelectric, superconducting magnetic energy storage, and thermal energy storage. The policy section of the database shows 18 federal and state policies addressing grid-connected energy storage, from rules and regulations to tariffs and other financial incentives.

Areas of Relevance	Area	Comments	Relevance
	13. Store and organise information on customer renewable energy deployments	The DOE Global Energy Storage Database provides free, up-to-date information on grid-connected energy storage projects and relevant state and federal policies. The hope is that this site will contribute to the rapid development and deployment of energy storage technologies.	High
	4. Inform the regulatory environment for renewable energy.	This database provides projects on more than 50 energy storage technologies represented worldwide. Additionally, the policy section of the database shows 18 federal and state policies across US addressing grid-connected energy storage, from rules and regulations to tariffs and other financial incentives.	Med
Approaches	**Approach**	**Comments**	
	Interviews and Surveys	Anybody can create an account and add projects, and each project goes through a vetting process where database staff contact the project owner to verify data accuracy. All data can be exported to Excel or PDF.	
Results	**Result**	**Comments**	
	Produced information resources	As of October 2013, the DOE Global Energy Storage Database has logged 420 energy storage projects worldwide. The database has become an important tool as the main point of reference for energy storage professionals worldwide.	

Doomadgee Solar Farm

Project ID	137
Organisation	Ergon Energy
Organisation Type	Network
Partners	
Story	Ergon Energy designed a solar system in the off-grid town of Doomadgee which maximised economic renewable energy penetration into a diesel mini-grid, without causing stability issues associated with solar intermittency. The solar system is capable of achieving 50% instantaneous penetration, suppling 8% of the town's annual energy use. The project utilised Ergon Energy's advanced knowledge of diesel engines, diesel power station control systems and solar design to scope and cost an innovative high level design for the solar system. The project developed advanced control algorithms to maximise system efficiency whilst ensuring adequate spinning reserve. The project has successfully removed risk and costs associated with transition from diesel only to diesel solar hybrid systems. The solution designed can be transferred across other Ergon Energy's Isolated Systems.
Start Date	1-08-2011
End Date	1-12-2013
Customer Segment	
Customers Involved	
Cost	
Funding Source	Discretionary Spend
Network	Ergon Energy
Connection Point	Distribution Feeders
Location	Doomadgee
State	QLD
Country	Australia
Future Plans	The Doomadgee Solar Farm has a design life of 20 years.
Contact Name	Jenny Gannon
Contact Email	Jennifer.gannon@ergon.com.au
Contact Phone	
Contact Link	
Background	Ergon Energy designed a solar system which maximised economic renewable energy penetration into a diesel mini-grid, without causing stability issues associated with solar intermittency. The solar system is capable of achieving 50% instantaneous penetration, suppling 8% of the town's annual energy use.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	System models were developed to demonstrate maintenance of system stability within technical limits during transient events including sudden loss of solar farm output. The project developed advanced control algorithms to maximise system efficiency whilst ensuring adequate spinning reserve. Solution designed for repeatability across Ergon Energy's Isolated Systems.	Med
Approaches	**Approach**	**Comments**	
	Large Scale Renewable Plant	The project utilised Ergon Energy's advanced knowledge of diesel engines, diesel power station control systems and solar design to scope and cost an innovative high level design for the solar system. Ergon Energy awarded a design and construct tender for the solar farm to RFI Solar. Integration was completed in-house in order to obtain learnings to enable solution repeatability across other Isolated Systems.	
	Electrical System Modelling	Ergon Energy worked with ABB to undertake comprehensive modelling of the system to confirm theoretical maximum limitations.	
Results	**Result**	**Comments**	
	Reduced reliance on diesel fuels	The system has a payback period of 10 years. Increasing costs of diesel fuel, reduced costs of solar and avoided costs of design will result in future 8% solar solutions having a reduced payback period vs diesel. The successful project has removed risk and costs associated with transition from diesel only to diesel solar hybrid systems.	

E.ON Smart Grid Control Center

Project ID	318
Organisation	Ventyx
Organisation Type	Proponent
Partners	
Story	Ventyx is working with E.ON to create the "next-generation" control centre for the Smart Grid. The control centre in Malmo, Sweden, is expected to be operational in early 2014. The project scope is ambitious and reflective of the scenarios confronting utilities around the globe. Today's control centres were designed for a different set of assumptions about electricity generation and consumption. Power system environments are becoming more complex as new sources of generation are added into the distribution grid, and as Demand Response programs can scale up to include greater numbers of intelligent devices that can modulate their electricity consumption. The solution embodies what is often described as the convergence of OT (operations technology) with IT (information technology) to deliver more granular remote monitoring and control of grid operations as well as improved power flow models that address grid congestion before it becomes a problem. In other words, there needs to be much more hands-on management with planning and forecasting of generation and consumption that share the characteristic of increased variability. These are key requirements for a successful transition to grids that support Transactive Energy concepts.
Start Date	2013
End Date	2014
Customer Segment	Industrial
Customers Involved	1 million of E.ON Elnät's customers
Cost	
Funding Source	Commercial Partner
Network	E.ON Elnät, Sverige AB
Connection Point	Zone Substations
Location	Malmö
State	
Country	Sweden
Future Plans	
Contact Name	Therese Hornstedt
Contact Email	therese.hornstedt@ventyx.abb.com
Contact Phone	
Contact Link	
Background	Representing the next step in a strategic research and development initiative between E.ON and ABB to define next-generation smart grid solutions, the new control centre will provide a best-practices model for global utilities to ensure greater operational efficiency in the face of increasingly complex power networks worldwide. The main objectives are: Prevent instability issues Minimize grid losses Reduce operator stress. The control centre in Malmö, Sweden, is evaluated in 2014. The project scope is ambitious and reflective of the scenarios confronting utilities around the globe. Today's control centres were designed for a different set of assumptions about electricity generation and consumption. Power system environments are becoming more complex as new sources of generation are added into the distribution and transmission grid.

Areas of Relevance	Area	Comments	Relevance
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	Easier and less stressful for the operators when it is possible to predict what will happen in the system in the near future. Through establishing the control centre, the project aims to improve internal practices. The establishment of the control centre will be customized for E.ON's network condition and operational needs in Sweden. However, the entire process and concept of IT and OT integration could be a reference to Australia.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources	More accurate monitoring and control of power flows between the transmission and distribution systems through load control/demand response. Technology-wise, it is quite relevant to the objective of managing distributed energy resources. Especially, this project embodies the concept of IT and OT convergence and integration.	Med
	12. Use distributed energy solutions to address network and system constraints	Optimal use of the system when predictions for the near future is available. The project has a clear focus on making distributed energy resource a solution to the network constraints.	Med
	14. Improve techniques for forecasting renewable energy output	Greater awareness of the state of the network through improved forecasting using real-time and near-real time operational data, weather data and neural network algorithms. The project uses real-time forecasting approach, which is a key to better control and management of renewables.	Med

Approaches	Approach	Comments
	Other	In a joint R&D effort, the project looked at how to forecast and predict the impact of renewable energy in the transmission and distribution networks. The project is performed in three different states. • Pre-Study including work statement • Implementation phase • Evaluation phase
	Interviews and Surveys	The pre-study phase contained a number of workshops in order to really understand the scenarios to be solved. During the workshops the scope of the delivery was defined along with design of the user interface.
	Electrical System Modelling	During the implementation phase the work was divided between the two parties. The Customer was in charge of data and data quality, hardware and data transfer between the systems. The vendor worked with both existing software and with development. The system was installed at site in an early stage and then updated with more functionality as the data and functionality were available.
	Network Monitoring & Analysis	The third phase is the evaluation phase. During the evaluation the customer is running the system and evaluates the forecasts made towards the real time values. During all three phases it has been crucial that the project teams from both the Customer and the vendor has worked together very closely and that it has been an open and honest relationship.

Results	Result	Comments
	No results yet	Results will be available on completion of the project.

ECOGRID EU

Project ID	227
Organisation	Energinet.dk
Organisation Type	Proponent
Partners	Sintef
Story	The objective of the EcoGrid EU project is to illustrate that modern information and communication technology and innovative market solutions can enable the operation of a power system with more than 50% renewable energy sources (RES) such as wind, biomass and photovoltaic. The project demonstrates a real-time market concept in a large-scale field test on the Danish island Bornholm. The development of a real-time electricity market is considered one of the most efficient ways to meet the challenges in operating a power system with an increasing shares of renewable sources:- - The real-time market has the fine resolution of five minutes, which improves the capability to manage large amounts of rapidly fluctuating RES - The market price is set at the very last minute, so that very accurate forecasts of wind power and demand can be utilised when determining it. All households have a smart electricity meter which measures the power consumption of the device(s) every five minutes, which can be used in advanced demand forecast models of electricity and settlement that is based on 5 minute intervals. The test of the industry/commercial buildings focuses on new control and scheduling systems on different types of large electricity consuming units and energy storage capabilities which enables the customers to take part in the real-time market.
Start Date	01-03-2011
End Date	01-08-2015
Customer Segment	Residential, SME
Customers Involved	1900 residential and approximately 50 business entities
Cost	
Funding Source	Commercial Partner, European Commission
Network	
Connection Point	Customer Connections
Location	Bornholm Island
State	
Country	Denmark
Future Plans	
Contact Name	Preben Nyeng
Contact Email	pny@energinet.dk
Contact Phone	+4551 380 706
Contact Link	http://www.eu-ecogrid.net/
Background	The objective of the EcoGrid EU project is to illustrate that modern information and communication technology and innovative market solutions can enable the operation of a power system with more than 50% renewable energy sources (RES) such as wind, biomass and photovoltaic. (The current level of wind in Denmark is 30% of total electricity consumption; the government's target for 2020 is 50%).

Areas of Relevance	Area	Comments	Relevance
	5. Engage customers to build their and the industry's understanding of distributed energy resources	The core of the EcoGrid project is development, installation and full-scale demonstration of a close to real-time market with the capability of moving load away from the classical peak load by five-minute varying price signals only.	Med
	2. Support the transition to an alternative electricity pricing approach	The EcoGrid market will extend the current electricity markets closer to real-time and are considered as an extension/modernization rather than a replacement of the current electricity market design(s).	Low
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Potential business model considered will be a part of the (coming) deployment plan/EcoGrid road map.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	One of the objects is to remove existing barriers that has been complicating introduction of DER /small scale end-users into the electricity market, including the balancing market, e.g. barriers related to size, administrative burdens related to the market bidding process.	Med
	11. Alter local load profile to match a desired level	Flexible resources, like electric heating and heat pumps, adapting their behaviour to the real-time prices will contribute to maintaining the balance of supply and demand in the power system. The price signal is created by e.g. the TSO, by continuously monitoring the power system and adjusting the price signal to correct the balance of the system. To do so, it is necessary to create reliable forecasts of the expected response to price changes. These will be utilized when computing the marginal price change required to trigger a response of the right size, leading to a proper rebalancing of the system.	Med

Approaches	Approach	Comments
	Demand Side Incentives	The development of a real-time electricity market is considered one of the most efficient ways to meet the challenges in operating a power system with an increasing share of renewable sources. The real-time market concept is designed based on the NordPool power exchange and balancing market, but to avoid interfering with them the Ecogrid EU demonstration is operated as an isolated entity as a market mock-up. The issue to be tested is whether and how five-minute varying real-time price signals and related forecasts can influence the demand of electricity customers.
	Smart Meters and In-Home Displays	All households have a smart electricity meter which measures the power consumption of the device(s) every five minutes, which can be used in advanced demand forecast models of electricity and settlement that is based on 5 minute intervals. The measured power consumption data is uploaded to the historical metering data repository once every 10 minutes. The aim is to exploit flexibility in electricity consumption associated with heat pumps and electric heating. To this end the house must be 'smart'. It must have the capability of acting on external input to vary consumption. The house must also have direct and online customer feedback systems to communicate current consumption data and electricity prices in real-time.
	Smart Meters and In-Home Displays	The households are divided into three groups: statistical control group, manual control group and automatic control group. The automatic control group is divided into so- called IBM houses and Siemens houses that use different technologies to implement and test the real-time prices responsiveness of the customers. The automatic control group will in addition to manual assistance have equipment installed in their homes to optimize the operation of their electric heating or heat pump. The test of the industry/commercial buildings focuses on new control and scheduling systems on different types of large electricity consuming units and energy storage capabilities which enables the customers to take part in the real-time market.

Results	Result	Comments
	No results yet	The core of the EcoGrid project is development, installation and full-scale demonstration of a close to real-time market with the capability of moving load away from the classical peak load by five-minute varying price signals only. The outcome will depend on the response of the different test groups of selected for the EcoGrid project. The project has 1200 automated test households with a smart meter (five-minute readings) and one to two appliances in active control. Finally the field test includes 500 houses with manual control. In addition to a smart meter, this manual control group has no smart appliances installed. Finally, the test includes industrial/SME commercial customers with e.g. building automation installations.

E-DeMa Project

Project ID	220
Organisation	RWE Deutschland AGE
Organisation Type	Network
Partners	Siemens AG, SWK, Miele, Ruhr University Bochum, Dortmund University of Applied Sciences and Arts, Technical University Dortmund, University of Duisburg-Essen
Story	In the western Rhine-Ruhr area, the E-DeMa project is testing a smart grid in a region that has both rural and urban areas and therefore poses particular technological challenges for efficient power generation. E-DeMa wants to turn the electricity consumer into a "prosumer".The E-DeMa project investigates intelligent consumption management and the near-time capture and provision of consumption data. The regional E-DeMa energy marketplace functions as a central data hub both for consumption and contract data. Together, the project partners develop practical solutions for Renewable Energy Production and Consumption management of household, grid and market applications. The focus is placed on the cost-based application of decentralised small producers, such as power and heat co-generators and electric home appliances. E-DeMa has so far also been able to improve business operations in classic energy supply, for example, switching suppliers now carried out automatically via the marketplace has been shortened from several weeks to two days. Electricity products provided by the marketplace can shift ten per cent of consumption to off-peak times and reduce peak loads. This consumer flexibility can be put to use for the internal adjustment of balancing groups at distribution grid level.
Start Date	2008
End Date	2013
Customer Segment	Large commercial, Residential, SME
Customers Involved	1,500 households and businesses
Cost	AUD 31.85M (EUR 22M)
Funding Source	Commercial Partner, Local Government
Network	
Connection Point	
Location	
State	Rhine Ruhr region
Country	Germany
Future Plans	The result is under evaluation
Contact Name	Dr. Michael Laskowski
Contact Email	michael.laskowski@rwe.com
Contact Phone	
Contact Link	
Background	E-DeMa is a joint project between SWK, RWE, Siemens, Miele, ProSyst, the universities of Bochum, Duisburg/Essen and Dortmund and the University of Applied Sciences and Arts, Dortmund. These groups are working to develop and demonstrate an e-energy, locally networked "energy marketplace of the future" using cutting-edge information and communication technology. As part of this project, the municipal utility of Krefeld, SWK, is running a pilot program with the purpose of creating a sustainable model for utility companies to employ, which would allow consumers to become active participants in the market by controlling their consumption. Krefeld was selected as a model region - as it offers an excellent variety of housing - to provide a representative cross-section of the entire population structure. SWK wanted to determine how best to motivate its customers to care about energy and changing their energy usage habits. A solution was needed that would deliver immediate water, gas and electricity consumption and pricing information to the residential customers participating in the project. Furthermore, this information needed to be presented to the customer in a simple visualization that would enable them to understand, actively manage and control their consumption.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The E-DeMa marketplace enables prosumers to assess their consumption and costs at any time and switch to a cheaper rate. It also facilitates the best placement of electric power from these CHP stations on the market. This gives rise to completely new business models. Now, the electricity customer - represented by an agent or aggregator, as he cannot participate on the market himself as a rule - can offer his own generated electricity or his flexible consumption on the marketplace. The project fits more into the German context. However, the innovativeness of the concept can be a reference to Australia.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources	One of major objectives of E-DeMa is to determine how to best motivate energy customers to care about energy and changing their energy usage habits, which also includes the understanding of renewables and distributed energy resources.	Med
	12. Use distributed energy solutions to address network and system constraints	Block-type thermal power stations and ICT Gateway: As part of E-DeMa, 14 micro CHPs (combined heat and power) are being intelligently integrated into the distribution grid. Power consumers thus function as producers at the same time. Its technological relevance to Australia needs to be evaluated.	Low

Approaches	Approach	Comments
	Load Monitoring & Analysis	The consortium includes RWE Energy AG and Siemens AG and is developing an intelligent power consumption control system which ensures the real-time collection and provision of consumption data. The project also aims to optimize network operation management in decentralized distribution networks. It will allow consumers to regulate their energy consumption from their living rooms based on real-time information on when peak periods are over and the price of power is at its lowest. In E-DeMa, 14 micro block type thermal power stations (µKWK) were installed for the field trial, which can be connected when needed as decentralized small producers and aggregated via the marketplace to tradeable outputs. In addition, over 1,500 households and commercial enterprises were equipped with ICT gateways that enable consumers to take active part in the E-DeMa marketplace. Besides outputs, shiftable loads can also be aggregated as flexibilities and sold on the marketplace. The classic roles of energy consumer and producer in the Rhine Ruhr region have thus been merged into the 'prosumer', who does not just consume energy but also participates on the market as a producer and provider of flexibilities

Results	Result	Comments
	No results yet	The results are under evaluation

Education Queensland

Project ID	273
Organisation	Ergon Energy
Organisation Type	Network
Partners	
Story	Customers (whether connected to an isolated or non-isolated grid) are being denied the right to connect PV systems to the network. This is limiting the ability of PV to reduce diesel costs and reducing customer choice. Ergon has provided Education Queensland with technical support for finding a solution which will allow connection of the Windorah State School 2kW PV system to the network. The proposed solution involves the supply two 2kW rated systems which will include modification of existing inverters and a Maximum Power Point Tracker (MPPT). Additionally, lithium iron phosphate batteries will be installed to store electricity and allow customised control of the inverter output to limit the ramp rate to 100%-0% in 10 minutes. This project is developing a customer solution to support renewable connection in remote areas that will enable customer's choice as well as potentially resolving isolated grid issues.
Start Date	1-10-2011
End Date	1-07-2014
Customer Segment	
Customers Involved	2
Cost	
Funding Source	
Network	Ergon Energy
Connection Point	Customer Connections
Location	Windorah
State	QLD
Country	Australia
Future Plans	
Contact Name	Michelle Taylor
Contact Email	michelle.taylor@ergon.com.au
Contact Phone	
Contact Link	
Background	Education Queensland has asked Ergon to provide technical support for finding a solution which will allow connection of the Windorah State School 2kW PV system to the network. Developing a customer solution to support renewable connection in remote areas will enable customer's choice.

Areas of Relevance	Area	Comments	Relevance
	10. Smooth out intermittent generation output	Lithium iron phosphate batteries were used to store electricity and allow customised control of the inverter output to limit the ramp rate to 100%-0% in 10 minutes.	Med
	12. Use distributed energy solutions to address network and system constraints	Customers (whether connected to an isolated or non-isolated grid) are being denied the right to connect PV systems to the network. This is limiting the ability of PV to reduce diesel costs and reducing customer choice. This project provides a possible solution to Education Queensland's problem as well as the development of a potential solution for other customers faced with this situation, as well as potentially resolving isolated grid issues.	Med
Approaches	**Approach**	**Comments**	
	Improve Inverter Design	The proposed solution involves a partnership with Magellan Power to supply two 2kW rated systems for a customer-side solution. Each system will include modification of an existing inverter, a Maximum Power Point Tracker (MPPT), lithium iron phosphate batteries to store electricity and allow customised control of the inverter output to limit the ramp rate to 100%-0% in 10 minutes. The systems will be hosted by Education Queensland.	
	Storage, Customer-Connected	Lithium iron phosphate batteries were used to store electricity and allow customised control of the inverter output to limit the ramp rate to 100%-0% in 10 minutes. The systems will be hosted by Education Queensland.	
Results	**Result**	**Comments**	
	No results yet	The project contact is happy to be contacted and will discuss and share information as relevant.	

Effect of Small Solar PV System on Peak Demand

Project ID	299
Organisation	Ausgrid
Organisation Type	Network
Partners	
Story	As part of the NSW Independent Pricing and Regulatory Tribunal (IPART) review in 2011 into a fair and reasonable solar feed-in-tariff for New South Wales, AusGrid provided data to IPART and an analysis on the potential contribution of solar PV in reducing network peak demand. The project investigated the potential benefits for small solar PV systems in reducing network peak demand at various levels of the network (System-wide, Zone Substation and 11kV Distribution Feeders) by matching actual customer solar generation profiles from interval meter data on peak demand days to network asset load profiles for the same peak demand days. The findings of this study found that solar photovoltaic systems appear to have only a small effect on reducing summer peak demand on the electricity network. The study found that at the time of AusGrid system summer peak between 4:30 to 5pm (Australian Eastern Daylight Savings Time) that the average generation for the 26,000 solar systems was 30% of the peak rated solar capacity. The detailed analysis of zone and feeder load profiles found that the amount of peak demand reduction was not significant enough to contribute to any potential deferral of network investment.
Start Date	01-09-2011
End Date	11-10-2011
Customer Segment	Residential, SME
Customers Involved	Analysis of the effect of small solar systems on network peak demand. At the time
Cost	
Funding Source	
Network	Ausgrid
Connection Point	Customer Connections, Distribution Feeders, Zone Substations
Location	Ausgrid network (eastern Sydney, Central Coast and Hunter region)
State	NSW
Country	Australia
Future Plans	
Contact Name	Paul Myors
Contact Email	pmyors@ausgrid.com.au
Contact Phone	02 9269 7316
Contact Link	Ausgrid's PV peak analysis paper http://www.ausgrid.com.au/Common/About-us/Newsroom/Discussions/Solar-panels-and-peak-demand-research.aspx NSW IPART Review of solar feed-in tariffs (2011 to 2012) http://www.ipart.nsw.gov.au/Home/Industries/Electricity/Rev
Background	As part of the NSW Independent Pricing and Regulatory Tribunal (IPART) review in 2011 into a fair and reasonable solar feed-in-tariff for New South Wales, AusGrid provided data to IPART and an analysis on the potential contribution of solar PV in Integrating Renewables into the Grid reducing network peak demand. The analysis of the contribution of solar in reducing network peak demand attempted to quantify any potential network benefits from Solar Photovoltaic systems.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	The project investigated the potential benefits for small solar PV systems in reducing network peak demand at various levels of the network (System-wide, Zone Substation and 11kV Distribution Feeders) by matching actual customer solar generation profiles from interval meter data on peak demand days to network asset load profiles for the same peak demand days.	Med
	4. Inform the regulatory environment for renewable energy.	The analysis project was primarily to help inform the regulatory environment about the potential for network benefits in reducing peak demand from photovoltaic systems.	High
	14. Improve techniques for forecasting renewable energy output.	The analysis project has led to the improvement of forecasting techniques for spatial demand forecasting, where solar PV effects can be incorporated into spatial demand forecasts as post-modelling adjustments	Med

Approaches	Approach	Comments
	Electrical System Modelling	The analysis project involved analysing 30-minute interval data from gross metered solar customers on peak demand days predominantly over the Summer 2010-11 period. Solar generation profiles were matched and correlated to network asset load profiles using connection data to determine the effectiveness of solar photovoltaic systems in reducing load on individual zone substations and 11kV distribution feeders. Network assets (zone substation and 11kV feeders) with the highest penetration of photovoltaics were analysed in more detail to explore the potential benefits of solar PV in reducing peak demand and thereby contributing to deferring or avoiding capital expenditure on the network.

Results	Result	Comments
	PV alone does not reduce peak demand	The findings of this study found that solar photovoltaic systems appear to have only a small effect on reducing summer peak demand on the electricity network. The study found that at the time of AusGrid system summer peak between 4:30 to 5pm (Australian Eastern Daylight Savings Time) that the average generation for the 26,000 solar systems was 30% of the peak rated solar capacity. The detailed analysis of zone and feeder load profiles found that the amount of peak demand reduction was not significant enough to contribute to any potential deferral of network investment.

Effects of PV and CFLs on the Grid

Project ID	311
Organisation	Ergon Energy
Organisation Type	Network
Partners	
Story	This project aimed to understand how the network would respond to PV and CFL installations. To do this, the project obtained and analysed data on the voltage, current and voltage and current harmonics from key transformer sites on Magnetic Island, where there is a high penetration of PV systems, number of residential customers and existing voltage issues. This will lead to better planning by being able to better anticipate future network performance.
Start Date	01-03-2008
End Date	01-06-2011
Customer Segment	Residential
Customers Involved	
Cost	AUD 167,000
Funding Source	
Network	Ergon Energy
Connection Point	Customer Connections
Location	Magnetic Island
State	QLD
Country	Australia
Future Plans	
Contact Name	Michelle Taylor
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Contact Phone	
Contact Link	
Background	This project will allow better understanding of the network, and how it responds to PV and CFL installations. This will lead to better planning by being able to better anticipate future network performance.

Areas of Relevance	Area	Comments	Relevance
	12. Use distributed energy solutions to address network and system constraints	This project will allow better understanding of the network, and how it responds to PV and CFL installations. This will lead to better planning by being able to better anticipate future network performance. The project provided a basic simulation model at LV level.	Low

Approaches	Approach	Comments
	Literature Review	Review information already available in the public domain in term of studies, experiences from other utilities, technical papers, presentations at conferences, etc. in the form of a desktop study.
	Network Monitoring & Analysis	Obtain and analyse data on the voltage, current and voltage and current harmonics from key transformer sites on Magnetic Island where there is a high penetration of PV systems, number of residential customers and existing voltage issues

Results	Result	Comments
	Confidential information	Limited sites were examined; results are site specific and no general conclusions are publishable.

E-harbours Project

Project ID	287
Organisation	Municipality of Zaanstad
Organisation Type	Government
Partners	Research: Hamburg University of Applied Sciences, VITO, Robert Gordon University,
Story	Large industrial cities and harbour areas, with a dense variety of production and consumption processes, are a perfect testing ground for smart energy concepts. The aim of e-harbours is to explore the possibilities for large scale implementation of smart energy networks, specifically through four pillars of energy optimization. The project focused on the following key areas: 1. Optimising capacity in the system for additional renewable energy, intermittent by nature 2. A strong improvement in energy efficiency, supporting savings 3. The integration of electric mobility, reducing fossil fuels and possibly adding a buffer to the grid 4. Enhanced stability for the energy network, and greater energy-security
Start Date	01-09-2010
End Date	01-03-2014
Customer Segment	Industrial, Residential, SME
Customers Involved	At point of departure, the project aimed at industry. Over 20 industrial end users
Cost	EUR 4.8 Million (AUD 6.96 Million)
Funding Source	Discretionary Spend, Local Government
Network	A number of DSO's networks in EU
Connection Point	Customer Connections, Distribution Feeders, Zone Substations
Location	Amsterdam, Antwerp, Hamburg, Malmo, Zaanstad, Shetland Islands
State	
Country	The Netherlands, Belgium, Germany, Sweden, United Kingdom
Future Plans	Yes.
Contact Name	Jan Schreuder
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Contact Phone	0031629027834
Contact Link	
Background	The European Union has agreed upon ambitious targets to address climate change, energy security and economic competitiveness. By 2020 primary energy consumption must be cut by 20% across Europe and the share of renewable energy must be increased to 20%. Without smart demand management, the grid will physically not be able to cope with a substantial increase in decentralized and intermittent renewables. In some parts of Europe, this is already a reality. The e-harbours project aims at stimulating renewable energy for power and transport by optimizing energy usage and production." The project runs from 2010 to 2014 and is supported by EU Interreg IVB North Sea Regions Programme. The e-harbours project has been endorsed by the European Commission's Sustainable Energy Europe Campaign as an Official Partner.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	This has been executed in several showcases, audits and implemented. The e-harbours project identifies six different ways to make flexibility profitable. For individual households and small business, normally the only options available are shifting energy consumption to cheaper off-peak tariff hours or reduction of the peak power. Large consumers and producers of energy have more options, like buying electricity on the wholesale market or selling flexibility to parties that are responsible for keeping the power grid stable. Energy markets, regulation and legislation differ greatly from country to country. What works in The Netherlands might not work in Germany or the UK. Energy markets misdirected by uncoordinated policies (taxes, levies, juridical barriers) can produce suboptimal results. We need standardisation and coordination of policy.	Med
	2. Support the transition to an alternative electricity pricing approach	The objective to support the transition to an alternative electricity pricing approach has been addressed by this project. However, its applicability in the Australia requires further evaluation.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	This has been executed in several showcases of the project. The project tests several potential business models. Although these models' applicability in Australia requires further investigation, it shows a very clear initiative on developing commercial viable business models for the future.	Med
	4. Inform the regulatory environment for renewable energy	Legal and Social aspects: Although some cases look nice from an economic point of view, quite an additional number of barriers have to be overcome, foremost practical, social and legal issues. Although some business cases look nice from an economic point of view, there are still a great number of barriers to be overcome, foremost practical, social and legal issues. Therefore, the finding of the project should be further evaluated with Australian social and legal contexts.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources	Social barriers: In the sludge processing plant in the Antwerp harbour, a limited amount of staff is needed to keep operations going. A sound business case for flexibility in this company depends on the introduction of a night shift and weekend work, a social issue that should not be underestimated. The project takes a very practical approach to understand the outcome and implication of customer engagement, which gives quite good first-hand experience on dealing with potential barriers on customer uptake.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	This is the main focus of the project: aiming for a business case for large end consumers. This has been executed in the showcases. Since the project has a strong focus on researching commercialization and business cases, the economic and cost-efficiency aspects of the finding can be a good reference to Australia.	Med

7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	An organisational issue was one of the four main themes this project aimed to address. Its practice might be applicable in Australian context.	Med
8. Establish control over, or otherwise influence, intermittent generation sources	The project aimed to enhance stability for the energy network, and greater energy-security.	Med
9. Strengthen the network to manage higher renewable energy penetration	Optimising capacity in the system for additional renewable energy, intermittent by nature. The detailed technical approach need to be further evaluated for its transferability in Australia	Low
10. Smooth out intermittent generation output	The project addressed large Scale introduction of Demand Side Management, Energy Buffering, Process Alignment. The project addresses the integration of distributed generation for industrial customers, which is an important energy customer groups in the energy market.	Med
12. Use distributed energy solutions to address network and system constraints	The project addressed the integration of electric mobility, reducing fossil fuels and possibly adding a buffer to the grid. The project introduces the concept of electricity mobility, which is quite innovative. However, it is applicability in Australia need to be further discussed.	Med
13. Store and organise information on customer renewable energy deployments	Smart Grid Technology: ICT connecting to Energy system is a general approach adopted by projects in other regions of the world.	Med
14. Improve techniques for forecasting renewable energy output	Smart Grid Technology: ICT connecting to Energy system, with the best example: REloadIT in Zaanstad - small scale smart grid. This is a common research scheme across a number of international projects.	

Approaches	Approach	Comments
	Demonstration Project	The e-harbours project comprised seven 'showcase' locations in the EU-member states. These showcases had different approaches: some were searching for flexibility among industrial consumers, while others created awareness by practical application of a smart grid, the development of energy labelling or business case benchmarking. The project focussed on four issues: Technical, Economical, Legal and Organisational.

Results	Result	Comments
	No results yet	Contact the project lead for further information

Embedded Generation Project

Project ID	363
Organisation	Energy Networks Association
Organisation Type	Association
Partners	CSIRO
Story	• investigate and assess the technical, regulatory and commercial impacts of continued growth in EG on Australian distribution and transmission networks • identify potential policy and regulatory options that the ENA and its members should consider in response to these impacts, to ensure the safe, reliable, affordable and efficient operation of the electricity network in the long-term interests of customers • develop a high-level commercial framework to value EG and assess the commercial opportunities for NSPs.
Start Date	
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	
Network	
Connection Point	
Location	
State	
Country	Australia
Future Plans	
Contact Name	Stuart Johnston
Contact Email	sjohnston@ena.asn.au
Contact Phone	62721513
Contact Link	
Background	

Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach		Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources		Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources		Med
	8. Establish control over, or otherwise influence, intermittent generation sources		Low
	12. Use distributed energy solutions to address network and system constraints		Low

Approaches	Approach	Comments

Results	Result	Comments

Emerging challenges in wind energy forecasting for Australia

Project ID	146
Organisation	Centre for Energy and Environmental Markets (CEEM)
Organisation Type	Research
Partners	
Story	Non-storable energy sources (such as wind energy) present a significant issue – how to maintain continuity of supply in the event of possible disturbances to power production. If disturbances can be accurately forecast, their impact can be minimised by ensuring that alternative sources are available to make up any power shortfalls. This paper aims to produce an accurate, local scale, wind-focused forecast for wind farm sites that push the boundaries of current weather prediction techniques. To do this, this paper compared the accuracy of various wind prediction models using Woolnorth wind farm in Tasmania as a case study. It was found in the study that a larger number of possibly less accurate, turbine-mounted anemometers are more effective than a smaller number of more accurate met towers located local to the wind farm for producing high-quality measurement data for wind energy forecasting.
Start Date	
End Date	01-02-2009
Customer Segment	None
Customers Involved	
Cost	
Funding Source	Federal Government Australian Greenhouse Office
Network	None
Connection Point	
Location	Woolnorth Wind Farm
State	TAS
Country	Australia
Future Plans	
Contact Name	Merlinde J. Kay, Nicholas Cutler, Adam Micolich, Iain MacGill and Hugh Outhred
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Contact Phone	+61 2 93854031
Contact Link	
Background	Non-storable energy sources (such as wind energy) present a significant issue – how to maintain continuity of supply in the event of possible disturbances to power production. If disturbances can be accurately forecast, their impact can be minimised by ensuring that alternative sources are available to make up any power shortfalls.

Areas of Relevance	Area	Comments	Relevance
	8. Establish control over, or otherwise influence, intermittent generation sources	Produce accurate, local scale, wind-focused forecasts for wind farm sites that push the boundaries of current weather prediction techniques.	Med
	14. Improve techniques for forecasting renewable energy output.	Produce accurate, local scale, wind-focused forecasts for wind farm sites that push the boundaries of current weather prediction techniques.	Med

Approaches	Approach	Comments
	Case Study	This paper compared the accuracy of various wind prediction models using Woolnorth wind farm in Tasmania as a case study

Results	Result	Comments
	Quantity and placement of wind measurement devices is more important than accuracy	It was found in the study that a larger number of possibly less accurate, turbine-mounted anemometers are more effective than a smaller number of more accurate met towers located local to the wind farm for producing high-quality measurement data for wind energy forecasting.

Enel Info+ Project

Project ID	221
Organisation	Enel Distribuzione
Organisation Type	Network
Partners	
Story	Enel Info+ is a large scale trial of the Enel smart info device that will involve a representative sample of families served by the Carpinone primary sub-station. The scope of the project is to demonstrate whether giving to end users a feedback on their energy consumption can address more efficient energy behaviours. The consumers participating to the project will thus receive an energy monitoring kit including Enel smart info and dedicated interfaces that they will use for one year to view how much electricity is currently being used in their household and to process their historical consumptions. A full colour, touch screen in-house display (Smart Info Display), and two software applications (Smart Info Manager and Smart Info Mobile, for personal computers and smart-phones respectively) have thus been conceived to monitor, collect and analyse energy data. "Prosumers", consumers who are also producers of renewable energy (by photovoltaic or mini-eolic plants), will receive an additional Enel smart info in order to manage both production and consumption metering data. The Enel Info+ kit and the related monitoring solutions are modular and foresee three levels of analysis. In Enel Info+, Enel's customers can collect their consumption and production data through a software that allows their PC to communicate with the smart info and help them to analyse their consumption putting in comparison production with consumption data. Indeed, it is a very useful tool that help pilot participants to be more awareness about their production and consumption. According to Enel, it could only be considered as one component of a entire renewable integration system
Start Date	2013
End Date	2014
Customer Segment	Residential
Customers Involved	8,000
Cost	
Funding Source	Regulator-Approved Spend
Network	ENEL Distribuzione
Connection Point	Customer Connections
Location	Isernia
State	
Country	Italy
Future Plans	The project is on-going
Contact Name	Lorenzo Pizzoferro
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Contact Phone	
Contact Link	
Background	Enel Info+ is a large scale trial of the Enel Smart Info® device that has been designed by Enel Distribuzione to allow end users to have certified information on electricity data managed by their electronic smart meter. Enel Info+ involves a representative sample of low voltage households and small commercial consumers served by the Carpinone primary sub-station in some municipalities in the area of Isernia, the potential universe of participants includes about 8,000 low voltage households.

Areas of Relevance	Area	Comments	Relevance
	5. Engage customers to build their and the industry's understanding of distributed energy resources	The project's primary goal is to provide energy information to energy consumers and prosumers. By changing their behaviour, the project helps to achieve the balancing of DER and renewable into the distribution network from the demand side. The project provides energy consumption feedback to the customers to help them better understand and adjust their energy usage.	Med
	13. Store and organise information on customer renewable energy deployments	Consumers are involved in “Enel Info+”, a project that sets out to increase understanding and control of their own usage of energy as a first step towards “Active Demand”: providing electricity consumers with information on their consumption and the ability to actively manage it in line with the network conditions, such that modifications in consumer demand become a viable option for addressing challenges of electricity systems like the increase of efficiency and reliability, infrastructure planning and investments deferral.	Med

Approaches	Approach	Comments
	Load Monitoring & Analysis	The Enel Info+ kit and the related monitoring solutions are modular and foresee three levels of analysis. The first one is based on the use of Smart Info Display, a full colour, touch screen in-house display, that lets the consumers keep an eye on their household energy consumption pattern easily. Smart Info Display provides both close to real time and historical information on energy consumption, which are shown in bar graphs and pie charts to highlight their mean value and how they split in tariff time bands for different periods of time (a single day, one week, one month, a bi-month, one year). The actual power and tariff time band are displayed, together with the date and time of tariff time band switching. Moreover additional feedback contents are given such as alarms at pre-defined, modifiable thresholds and when the contractual power is exceeded, DSO's announcements and contractual data. The second monitoring solution is based on Smart Info Manager, a software application that allows the consumers to examine their consumption data in depth on their personal computers and the energy prosumers to compare production and consumption data. The third monitoring solution is based on the smartphone App Smart Info Mobile that enables the consumers/prosumers remote access to their own energy data. Prosumers - the consumers who are also producers of renewable energy (by photovoltaic), receive an additional Enel smart info in order to manage both production and consumption metering data. Moreover all participants receive a quarterly feedback report helping them to get awareness of their behaviour, any changes they make and how their peers are behaving. The consumption patterns of the families living in municipalities included in the project have been observed by Enel Distribuzione.

Results	Result	Comments
	No results yet	Interim project result: A telephonic survey one month after the delivery of the Enel Info+ kit among a sample of participants in the "pre-trial" test (about 62.5%) revealed that 80% of the experimenters gave a positive judgment ("Very much" or "Sufficiently") of the kit in terms of satisfaction and usefulness in addressing more efficient energy behaviours, against the 20% who gave a negative judgment. ("Little" or "At all").34% of the interviewed experimenters declared they acquired a better understanding of their consumptions and they are more careful in the use of electricity. 6% discovered unexpected consumptions due to their appliances. 12% believe the kit is a good means to shift their peaks of consumption in the lower tariff time bands. 17% still needed some time to explore the functionalities of the kit. 31% declared themselves as "advanced" energy users, and believe the "Examine" solution is the most effective for them to improve their level of knowledge and understanding (such a percentage is related to the particular recruitment criterion adopted for the "pre-trial" test, involving some Utility employees). Smart Info Display has been used by 80% of the experimenters "Regularly" or "Sometimes", Smart Info Manager by 20% and Smart Info Mobile by 3% (8% of all those having a smart phone). The interviewed experimenters stated that the "Monitor" solution gives them a quick access to data with minimum effort and thus they use it more often. Moreover one of the main reasons behind the lower percentage of adoption of Smart Info Manager was the number of steps experimenters had to go through for the installation of the software.

EPIC-HUB (Energy Positive Neighbourhoods Infrastructure Middleware based on Energy-Hub Concept)

Project ID	289
Organisation	D'Appolonia SpA
Organisation Type	Other
Partners	Thales Italia, ETH - Swiss Federal Institute of Technology in Zurich, Institute Mihailo Pupin, Acciona Infrastructures, IK4 Tekniker, Honeywell, Panoramic Power, Terminal San Giorgio, EnerGrid, Bilbao Exhibition Centre
Story	EPIC-HUB fully exploits the Energy Hub Model: the couplings and interactions between different input energy carriers are identified and optimized in satisfying the electricity and heating/cooling demand at the output. Its approach aim to enable: Integration of the Analysis and Management of the Energy Carriers Optimization of the Energy Flows in aggregated way- Simulating and Planning the Energy Behaviour for Neighbourhood Planning.
Start Date	01-10-2012
End Date	30-04-2016
Customer Segment	Industrial, Large commercial, Residential
Customers Involved	3
Cost	EUR 6,720,937 (Approximately AUD 9.74 Million)
Funding Source	Commercial Partner, Federal Government
Network	Genova – Italy, Belgrad - Serbia Bilbao - Spain
Connection Point	Customer Connections, Sub transmission Feeders, Zone Substations
Location	Genova, Belgrad, Bilbao
State	
Country	Italy, Serbia, Spain
Future Plans	
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Contact Phone	+39 0103628148
Contact Link	http://www.agl.com.au/about-agl/how-we-source-energy/renewable-energy/broken-hill-solar-plant
Background	The focus of EPIC-HUB project is to combine the Energy-Hub approach with the development of a fully-interoperable Middleware solution. Such approach will allow Facility and Neighbourhood Managers to tackle energy efficiency, self-generation, emissions reduction, and exploit the excess energy generated and the unused /unshared storage potential often available at the neighbourhood community level.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	In Energy-Hub approach renewable energy sources are a fundamental energy carrier to bring energy positive neighbourhoods. The project takes a new angle to look at renewable and measure the integration's benefit and cost, which could add value to researches conducted in Australia.	Med
	2. Support the transition to an alternative electricity pricing approach	EPIC-HUB approach shall enable neighbourhoods' aggregator and new business models for energy retailers. The project adopts new business model, thus pricing is a key component. However, the specific setting of the pricing might not be highly applicable in Australia.	low
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	An E-Trading Platform was developed to manage local energy sources as well as Innovative Energy design and management decision support tool. The project adopts a new business model of Energy Hub, which could be a potential area for Australia to explore. It would facilitate the convergence of ICT and energy industry and create synergy.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources	Large Customers are directly involved in the project, as fundamental enabler of EPIC-HUB business models. The customer engagement is more focused on large energy users. Although traditional engagement researches target residential customers, however, large energy users' engagement should not be overlooked due to their importance in energy market.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources	This project focussed on Energy Planning and Energy Management Services. The projects spent more resources in the planning and managing the distributed renewable resource. It is strategically important for nearly every country around the world.	Med
	14. Improve techniques for forecasting renewable energy output	Cloud-based service enabling real-time analytics of consumption data. Cloud application is a general trend, and it is quite relevant to an Australian context when dealing with smart management of renewables.	Med

Approaches	Approach	Comments
	Improve IT Systems	EPIC-HUB project's key approach is to fully adopt an Energy Hub Model. Its Middleware aims to define a technological solution for different markets demands. In fact EPIC-HUB focuses on the integration and interoperability of the existing ICT systems overcoming the problems related to different formats of data, reporting schedules, communication protocols, etc. Through the energy-hub model, EPIC-HUB middleware enables the development of dedicated services for the integration of multi-domain and multi-energy carrier resources in a neighbourhood environment featuring:- Energy Planning and Energy Management Services- E-Trading Platform to manage local energy sources- Cloud-based service enabling real-time analytics of consumption data

Results	Result	Comment
	No results yet	Project is currently underway.

EPM FOA Frequency Regulation

Project ID	214
Organisation	Ecoult/East Penn Manufacturing
Organisation Type	Proponent
Partners	USA Department of Energy
Story	With renewable portfolio standards coming into effect, the large-scale integration of intermittent wind and solar generation will affect the physical operation of the modern grid, resulting in an increasing need for regulation services. Regulation services are necessary to provide fine tuning in real time for the network to match supply and demand and thus keep a constant frequency. The project objective was to demonstrate the capability of energy storage solutions (in this case UltraBattery (invented by CSIRO)) to provide regulation services in a cost effective manner. The energy storage implemented for the project responds to a signal provided from the market operator, PJM. PJM operates an open market for Ancillary Services (including Regulation Services). The energy storage resource competes in this market against incumbent gas peakers. The fast-responding UltraBattery technology can manage regulation services more efficiently than fossil fuel generation methods, and shows a positive commercial return.
Start Date	01-07-2010
End Date	Ongoing
Customer Segment	Large commercial
Customers Involved	
Cost	AUD 5.2M
Funding Source	Commercial Partner, Federal Government
Network	
Connection Point	Customer Connections, Distribution Feeders, Subtransmission Feeders, Zone
Location	Lyon Station
State	Pennsylvannia
Country	United States
Future Plans	Absolutely. Ecoult and EPM are implementing three extensions of the project now. The first is a higher rate system using the new UB devices. The other two both provide capability for combined regulation services and UPS backup. One of these is also designed to also provide peak demand management with the power and energy available separately specifiable. These systems enjoy a 40-50% IRR ad full return of capital invested within 2-3 years
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Background	With renewable portfolio standards coming into effect, the large-scale integration of intermittent wind and solar generation will affect the physical operation of the modern grid, resulting in an increasing need for regulation services. Regulation services are necessary to provide fine tuning in real time for the network to match supply and demand and thus keep a constant frequency.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The project demonstrated both the technical operation and the viability for the profitable provision of ancillary services in open markets (in competition with generating assets by using energy storage assets.	med
	4. Inform the regulatory environment for renewable energy	Renewable Energy introduces additional variability and need for ancillary service to address this into the grid management equation. The introduction of energy storage assets with their ability to respond more quickly to the grid operators needs led to regulatory change in the USA toward structuring payment for performance. In turn this regulatory change has led to a more competitive market that provides the service at a lower total price to the network.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The total cost of management of the variability on the PJM grid through regulation services has been reduced by facilitating the introduction of Energy Storage to compete with peaking gas turbines. As more renewable resource is integrated into the grid more regulation services are needed. Ipso Facto the project has made the process of integrating renewable energy into the grid more cost effective.	Med
	10. Smooth out intermittent generation output	The project supports control over the effect of intermittent resources on the grid	Med
	9. Strengthen the network to manage higher renewable energy penetration	The project strengthens the network to manage higher renewable energy penetration	Med
	11. Alter local load profile to match a desired level	The project is implemented behind the meter of a large commercial enterprise (East Penn Manufacturing) and has delivered demand management to the local network.	Med

Approaches	Approach	Comments
	Storage, Customer-Connected	The project was implemented both in a building and in a containerized format to demonstrate flexibility in approach for prospective adopters. The project uses four strings of UltraBattery® cells and connects to the grid from inside the EastPenn Manufacturing site in Lyon Station, Pennsylvania. The project provides continuous frequency regulation services bidding into the open market on PJM. The system is responding to PJM's fast response signal.

Results	Result	Comment
	Storage can provide frequency regulation to support high penetrations of distributed energy resources	The project provides continuous frequency regulation services bidding into the open market on PJM. The system is responding to PJM's fast response signal.
	Storage can be commercially viable with the right value stacking arrangements	The project earns in the order of $750K to $1M per year from the provision of regulation services to PJM. Lessons from the project combined with continuing development of UltraBattery has advanced our solution engineering to where we can now turnkey full regulation service solutions for less than $1.2M per MW of capability. This matched up against the income being derived gives a project IRR for new standalone projects in the order of 15-20%.

eStorage Project

Project ID	168
Organisation	Alstom
Organisation Type	Proponent
Partners	EDF, ELIA, Imperial College, Algoé, DNV GL
Story	Currently the pumped storage facilities in Europe are fixed speed and can only provide power regulation in generation mode. Adding variable speed technology to pumped storage power plants increases plant flexibility by allowing power regulation in both turbine and pumping mode. Coupled with improved IT systems, variable speed technology would facilitate better management of real-time balancing of supply and demand. The aim of the eStorage project is to develop cost-effective solutions for the widespread deployment of flexible, reliable, GWh-scale variable speed pumped hydro storage plants (PSP) across the EU and to enhance grid management systems, in order to improve energy management and to advance the cost-effective integration of large amounts of renewable generation, thereby facilitating the achievement of the 2020 targets and the 2050 vision of the Energy Policy for Europe. The project involves retrofitting an old 250MW fixed speed pump storage unit with a variable speed machine. Then assuming that is successful, technology solutions allowing the upgrade of 75% of European pumped hydro storage to variable speed would be developed and their value assessed.
Start Date	1-12-2012
End Date	
Customer Segment	Industrial
Customers Involved	
Cost	AUD 34M
Funding Source	European Commission
Network	
Connection Point	
Location	Le Cheylas
State	
Country	France
Future Plans	
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Background	Currently the pumped storage facilities in Europe are fixed speed and can only provide power regulation in generation mode. Adding variable speed technology to pumped hydro storage power plants increases plant flexibility by allowing power regulation in both turbine and pumping mode. Coupled with improved IT systems, variable speed technology would facilitate grid management for better real-time balancing of supply and demand. 75% of European fixed speed units creating about 96W of additional power regulation capacity at night.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Evaluate the system value of pumped storage and variable speed pumped storage to propose relevant changes to the market and regulatory frameworks, to support energy resources appropriate business models for flexible energy storage in the EU.	Med
	4. Inform the regulatory environment for renewable energy	The project proposed changes to the market and regulatory frameworks, to support appropriate business models for flexible energy storage in the EU. These changes may not be highly relevant to an Australian context.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The eStorage project aims to develop an efficient carbon free regulation capacity.	Low
	8. Establish control over, or otherwise influence, intermittent generation sources.	The project aims to facilitate integration of intermittent renewable energy.	Low
	9. Strengthen the network to manage higher renewable energy penetration	The project aims to develop adequate network management tools.	Low
	10. Smooth out intermittent generation output	Develop and assess technology solutions allowing the upgrade of 75% of European Pumped hydro storage to variable speed to obtain additional capacity for flexible balancing.	Low

Approaches	Approach	Comments
	Electrical System Modelling	The project will investigate the feasibility of upgrading a conventional 250MW PSP to variable speed and assess the benefit to the intermittent generation integration.
	Demonstration Project	The project will develop and demonstrate the capability of IT systems to facilitate flexible balancing capabilities of energy storage by looking at closer to real-time market systems.
	Economic Modelling	The project will quantify the benefits of an EU-wide rollout of flexible variable speed-based retrofit of PSP schemes, and propose changes to market and regulatory frameworks to support appropriate business models for flexible energy storage.
	Demonstration Project	The project will evaluate the deployment potential of new PSP and of PSP upgrade into variable speed and provide a technical cost benchmark on PSP sites in Europe.

Results	Result	Comment
	No results yet	Project still underway. Too early to tell.

eTelligence Project

Project ID	325
Organisation	EWE AG
Organisation Type	Other
Partners	EWE AG, Fraunhofer Energy Alliance, BTC AG, OFFIS e.V., Öko-Institut, energy & meteo systems GmbH
Story	Through the eTelligence Project, the model region Cuxhaven showed how the regional balance between generation and consumption can contribute to security of supply and how ICT, in combination with existing structures of the energy industry, can enable the optimisation of supply. The core component of eTelligence was a regional electricity marketplace that brought together fluctuating producers, consumers with shiftable loads, energy service providers and grid operators. As well as improving supply security from renewable energies, this also enhanced economic efficiency.
Start Date	2008
End Date	2012
Customer Segment	Residential
Customers Involved	650
Cost	
Funding Source	Federal Government
Network	Cuxhaven Region's 400 VA / 20 KVA network
Connection Point	Customer Connections, Distribution Feeders
Location	Cuxhaven Region
State	Lower Saxony
Country	Germany
Future Plans	
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Contact Phone	
Contact Link	
Background	Germany's aim to obtain 50% of its energy from renewables by the year 2030 was already a reality in Cuxhaven back in 2008, where the sense of urgency to look for new solutions is already evident. The core message was: "The energy supply of the future is intrinsically linked with the convergence of energy and communication networks, and intelligent solutions regarding information technologies are key to ensuring the secure and sustainable supply of renewable energies." EWE has set the course for the future with its eTelligence lighthouse project in Cuxhaven by linking large and small-scale consumers and producers via modern information and communication technologies (ICT) within an intelligent system.

Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach.	Making electricity more visible as a limited resource through the use of dynamic tariffs and transparent feedback systems. The project took a unique angle to signify the importance of transition to dynamic tariffs by making the fact of energy scarcity more transparent to the end consumers. At the same time, renewables and distributed energy resources may gain more attention by the consumers.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	One instant result of these efforts is the "intelligent load manager" function designed by EWE, which creates an economically viable ideal scenario using power plants' inherent flexibility. The "Intelligent load manager" is designed within the project, which could be a new service or business model to support the increasing integration of renewables to the network.	Med
	4. Inform the regulatory environment for renewable energy	The project entered into a dialogue with people from the world of science and politics to examine the existing political and legal frameworks, highlighting any potential hindrances or areas for improvement and suggesting potential approaches for future policy formulation. The project used an open approach to actively address the importance of regulatory environment with the involvement of different stakeholders, which can be a good reference to Australia.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	The savings potential and load shift potential in private energy use were investigated in 650 households in a one year trial. The most important instruments for this were customer specific tariff incentives and the use of intelligent metering technology (smart meters), as well as the depiction of electricity consumption in real time. On average, electricity consumption was reduced by 11% with the real-time visualisation, which corresponds to lower costs and lower CO_2 emissions. The project used dynamic pricing and real-time feedback as consumer engagement practices, and achieved excellent result.	Med

6. Make the process of integrating renewable energy into the grid more cost-efficient	The digital energy marketplace enabled small and medium-sized power-generating systems, as well as medium to large electricity consumers, to trade energy products in a fully automated way. In a one year field trial plant operators did not need any extra knowhow or extra time to participate in the electricity market and they were still able to achieve excellent prices when generation and consumption by the plants followed the requirements of the overall energy system. The market participants were two cold storage depots, a wind park, the Cuxhaven municipal swimming pool, a treatment plant and a block type thermal power station. The creation of digital energy market is another innovative concept tested in the project, which worth exploring its applicability in Australia.	Med
7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	Cogeneration plants and major consumers were equipped with measurement and control technology in order to enable optimised operations and to facilitate their participation in the energy market. The direct marketing of renewables plays a major role in this regard. Cogeneration plant and large energy consumers are taken into consideration and designed an effective process to increase their active participation in the energy market.	Med
8. Establish control over, or otherwise influence, intermittent generation sources.	As part of a field test, eTelligence developed a virtual power plant, which it then operated continuously for one year. The virtual power plant can manage both generation and consumption systems online via a common control room. The main generating systems included wind farms, photovoltaics and biogas systems, while the consumers were refrigerated warehouses. The aim is to coordinate the operations of decentralised systems and to participate in the energy market just as reliably with this pool of systems as is possible with a conventional power station. One of the project's focus was on the development of a suitable sales solution and the technical implementation in real pilot plants linked to the eTelligence marketplace. The efficiency of the technical solutions and the accessible power flexibility potential of small- and medium-output decentralised cogeneration units (50-500 kW) were proven during the field test phase. The project uses a holistic approach to not only control the distributed energy resources but also integrating them into the virtual energy market. However, it fits better in German context.	Med

9. Strengthen the network to manage higher renewable energy penetration	In order to understand the network behaviour of the model region, grid measurement data (active and reactive power, voltages, currents, frequency) was collected from 100 substations in the distribution network, saved and exported on request. The data was recorded for the participation of the network in the regional marketplace. The installation of sensor and feedback technologies is essential in order to overcome infrastructural challenges within electricity grids. If the successful integration of renewable energies is to continue, we will require technologies that are able to make the grid transparent and thus controllable. An intelligent approach helps to avoid the random expansion of the electricity grid, helps to support the integration of renewable energies and offers the location a major economic advantage, namely the stability of the energy system and supply security. The project's approach is to strengthen the network by combing OT (substation infrastructure) and IT (data and network behaviour modelling).	Med
10. Smooth out intermittent generation output	Overall, the project contributes to the smoothing of distributed generation, showing how the regional balance between generation and consumption can contribute to increased supply security.	Med

Approaches	Approach	Comments
	Demand Side Incentives	By making electricity more visible as a limited resource through the use of dynamic tariffs and transparent feedback systems, eTelligence shows how individual households can help to increase energy efficiency.
	Other	eTelligence shows how the regional balance between generation and consumption can contribute to increased supply security. In this way, even small regional wind farms or refrigerated warehouses can support the security of the entire system. The project also shows how renewables and decentralised cogeneration plants can be best integrated into the existing energy system.
	Case Study	eTelligence examines how flexibility can be increased across Germany in a range of different future scenarios with regard to the integration of renewables to reduce costs and reduce CO2 emissions.
	Policy advocacy	eTelligence has entered into a dialogue with people from the world of science and politics to examine the existing political and legal frameworks, highlighting any potential hindrances or areas for improvement and suggesting potential approaches for future policy formulation.

Results	Result	Comment
	Incentives helped consumers reduce consumption during peak demand	The following results are of particular note: Electricity consumption, costs and CO2 emissions were made transparent for all participants in the eTelligence field test. With the aid of the innovative Mengen-Tariff, households were able to save an average of €100 during the 12-month test phase. In the time-variable Event-Tariff, it was possible to achieve load transfers of up to 30% and electricity was primarily used when sufficient energy from renewables was available. As major consumers, the refrigerated warehouses in the region were able to save more than 6% on their usual electricity costs. Innovative technologies such as digital electricity meters, the eTelligence app and a special online portal for analysing consumption were all proven in practical scenarios.
	Other	The standards that were developed and implemented as a result of eTelligence, including the common information model (CIM) and the IEC 61850 standard, enabled the straightforward integration of various decentralised power-generating systems, the implementation of new market processes and the processing of large amounts of data. The scenario analysis shows how the benefits of eTelligence's flexibility are set to increase significantly for the electricity system of the future.

Evaluating the benefits of implementing existing storage technologies with residential PV rooftop systems

Project ID	6
Organisation	University of New South Wales, School of Photovoltaics and Renewable Energy
Organisation Type	Research
Partners	
Story	Most residential working consumers use the bulk of their electricity during evening hours. As such, installing solar systems on these consumers' rooftops has little to no value for them; most of the electric power generated is exported to the electricity grid during the day for a small Feed in Tariff (FiT). One potential solution for effectively utilising the generated solar energy is the implementation of distributed storage systems. This research project aims to analyse the financial and technological benefits of adding electricity storage to existing rooftop distributed PV systems for residential households in Sydney, Australia. The end user data for residential households and network load data for Sydney were analysed and the impact of the type and size of a storage system on electricity consumption and network load were quantified. Three different scenarios namely base case scenario (no PV or battery storage), PV only scenario and PV with storage scenario were considered. It was found that increased self-consumption and reduced evening peak consumption can be achieved through battery storage. A reduction of approximately 17% in peak demand was observed with installation of electricity storage. Network augmentation due to peak load management can be deferred.
Start Date	
End Date	
Customer Segment	Residential
Customers Involved	
Cost	
Funding Source	Federal Government
Network	None
Connection Point	None
Location	Sydney
State	NSW
Country	Australia
Future Plans	
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Background	On weekdays in Sydney, most residential working consumers use the bulk of their electricity during evening hours. As such, installing solar systems on these consumers' rooftops has little to no value for them; most of the electric power generated is exported to the electricity grid during the day for a small Feed in Tariff (FiT). One potential solution for effectively utilising the generated solar energy is the implementation of distributed storage systems.

Areas of Relevance	**Area**	**Comments**	**Relevance**
	10. Smooth out intermittent generation output	This research project aims to study the benefits, both financial and technological, of adding storage to existing rooftop distributed PV systems on residential households in Sydney and estimate the required amount of storage for a given PV system size for a typical household, to make more financial sense and make PV a major and more dispatchable electricity source. The study also analyses the impact of installing storage in customer households on evening peak electricity load.	Med

Approaches	**Approach**	**Comments**
	Economic Modelling	The end user data for residential households and network load data for Sydney were examined and the impact of the type and size of a storage system on electricity consumption and network load was quantified. A mathematical model was constructed using MATLAB to analyse and manipulate the available data. Three different scenarios were analysed: base case scenario (no PV or battery storage), PV only scenario and PV with storage scenario .

Results	**Result**	**Comment**
	PV alone does not reduce peak demand	With PV systems installed without battery storage, it can be seen that there was no effect in reducing the network peak load. No significant reduction in evening peak grid electricity consumption was observed when compared to the base case scenario.
	Storage can combine with PV to reduce peak demand	With installation of storage batteries in individual households, a reduction of approximately 17% in peak demand was observed. Increased self consumption and reduced evening peak consumption can also be achieved through battery storage. Energy storage can provide an effective way of solving some of the issues with the network. Network augmentation due to peak load management can be deferred.

Expanding the Value Proposition for Building Integrated Photovoltaics (BIPV): Thin Film Building Integrated Photovoltaic Thermal (BIPVT) Retrofitting of Buildings

Project ID	244
Organisation	BlueScope Steel Limited
Organisation Type	Other
Partners	Institute for Solar Energy Systems, ISE; Sustainable Buildings Research Centre, University of Wollongong
Story	This project aims to increase the use of building integrated photovoltaics (BIPV) by developing a tool that assists in designing the best BIPV-thermal (BIPV-T) configurations for building retrofits. Key to the commercial success of Thin Film Building Integrated Photovoltaic Thermal (BIPV-T) is ensuring that it is affordable in the absence of Government incentives. To achieve this, BlueScope Steel Limited along with its partners is developing the Decision Support tool to provide quantitative information around the expected outcomes from installing BIPV-T on existing Australian buildings. The tool will assist a range of users in various ways: building owners to understand the performance/cost savings from installing a BIPV-T system- designers, builders and installers to identify the ideal design configurations of BIPV-T systems to ensure the best performance/cost savings for a wide range of climatic conditions and existing building types- project partners to determine if BIPV-T systems offer a viable opportunity for further BIPV enhancements and cost reductions in retrofit circumstances.
Start Date	01-09-2012
End Date	01-09-2014
Customer Segment	
Customers Involved	
Cost	AUD 577,320
Funding Source	Commercial Partner, Federal Government
Network	None
Connection Point	
Location	
State	
Country	Australia
Future Plans	Please contact the project lead for more information
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Background	BlueScope Steel plans to work with its channel partners to commercialise BIPV systems using thin film PV technologies. Key to the commercial success of BIPVT is ensuring that it is affordable in the absence of Government incentives. This requires a longer-term roadmap for performance improvements and cost reductions, other than those that can be attained through component improvements (cost and technical) alone. This project will expand the financial value proposition for BIPV by both improving product performance and identifying how to maximise value via optimised application of the other potential functionality of a BIPV system (i.e. thermal management of a building) to suit installation on existing buildings. BlueScope Steel considers that BIPVT will be a key driver for distributed solar market uptake in the future. Uniquely, the focus will be on the retrofit market as only 1 to 2% of the existing building stock is added to or replaced by new-build per annum in Australia.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	The project assesses and quantifies the payback periods and economic feasibilities of installation of BIPVT systems in residential buildings in climatic conditions of major Australian cities.	Med
	11. Alter local load profile to match a desired level	The project investigated the benefits of integrating BIPVT with phase change materials (PCMs) as thermal energy storage systems for load shifting and reduction.	Med
	14. Improve techniques for forecasting renewable energy output.	The project developed a detailed dynamic model which can be used to reliably estimate the electrical and thermal energy generation of BIPVT systems. It also developed a decision support system for design of cost effective BIPVT systems for Australia.	Med

Approaches	Approach	Comments
	Electrical System Modelling	This project objectives were/will be achieved by five steps: 1) Development of a dynamic simulator for BIPVT retrofit systems. 2) Investigation of the dynamic characteristics and effects of key parameters on the overall operating efficiency of BIPVT retrofit systems under changing operating conditions. 3) Development of a systematic approach and methodology to optimise the design configuration and sizing of BIPVT retrofit systems by using a genetic algorithm (GA) optimisation method. 4) Testing and validation of the performance of the dynamic model and actual BIPVT retrofit systems through an experimental program of work. 5) Development of a software tool and design guidelines to support the design and sizing optimisation of BIPVT retrofit systems. This software will be used by BlueScope Steel as a key component of its BIPV product offering.

Results	Result	Comment
	Produced information resources	The resultant commercial outcome will be a decision support tool that can assist builders/installers to identify the ideal design configuration of BIPVT systems for integration with existing building/roof types to ensure optimal performance/cost savings.
	Produced information resources	The resultant commercial outcome will be a decision support tool that can assist the partners (and other research groups working in this area) to determine if BIPVT-PCM systems offer a viable opportunity for further BIPV enhancements and cost reductions in retrofit circumstances.
	Adding thermal systems to building integrated PV(BIPV) increases efficiency	This project will deliver the front-end interface for determining ideal design and quantifying cost benefits (through the decision support system) and the back-end evidence that is required to develop a reliable advisory and evaluation product. Compared to BIPV, the overall efficiency of BIPVT can increase dramatically. The thermal efficiency of the BIPVT can reach to about 20% in cold climates.

Facilitating Local Network Charges and Virtual Net Metering (VNM)

Project ID	361
Organisation	Institute for Sustainable Futures (ISF)
Organisation Type	Research
Partners	Australian Renewable Energy Agency (ARENA), AGL, Byron Shire Council, City of Sydney, Ergon Energy, Moira Council, Swan Hill Council, NSW Renewable Energy Advocate, Powercor, Total Environment Centre, Wannon Water, Willoughby
Story	Building on previous theoretical work, the project aims to work through Local Network Charges and VNM methodologies with NSPs, electricity retailers, and project proponents. This research aims to ensure that the project can learn from existing instances of Local Network Charges and VNM. ISF undertook a limited literature review on the international examples of local network charge methodologies for the Consumer Advocacy Panel . ISF will supplement that review to capture additional relevant examples that may offer lessons and precedents. The research will also build on the literature review undertaken as part of the ARENA funded Clean Energy Council project Future Proofing in Australia's Distribution Industry (FPDI) project on valuing embedded generation. ISF's previous review will be expanded to include VNM, identify whether there are any examples of Virtual Power Stations (VPS) in the many-to-one configuration, in which a large user buys from multiple small generators. The review will further attempt to identify a community project(s) where electricity is netted off at member premises. Five customer trials will be conducted in NSW QLD and VIC on particular projects that may benefit from local energy trading and local generation network credits. Potential benefits of Distributed energy accruing to networks are not incentivised or price-signalled in a manner leading to economically efficient outcomes. As such some customers generation projects which would be feasible with local energy transfer either do no occur or occur with duplication of network infrastructure (private wires) Jurisdictions overseas, particularly the US have developed mechanisms to address these benefits. This project seeks to trial mechanism in local generation network credits and virtual net metering with a view to recommending mechanism for the Australian context. The project is in progress.
Start Date	28/05/2015
End Date	31/08/2016
Customer Segment	Large commercial, Residential, SME
Customers Involved	6
Cost	$705,950
Funding Source	Commercial Partner, Local Government
Network	Powercor, Ergon Energy, Ausgrid, Essential Energy
Connection Point	Customer Connections, Distribution Feeders
Location	Wannon water, Moira/Swan Hill
State	VIC, NSW, QLD
Country	Australia

Future Plans	ISF will continue to support the rule change request process of introduction local generation network credits initialised by City of Sydney, the Property Council and the Total Environment Centre and (if required) a subsequent rule change request regarding virtual net metering.
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Background	Potential benefits of Distributed energy accruing to networks are not incentivised or price-signalled in a manner leading to economically efficient outcomes. As such some customers generation projects which would be feasible with local energy transfer either do no occur or occur with duplication of network infrastructure (private wires) Jurisdictions overseas, particularly the US have developed mechanisms to address these benefits. This project seeks to trial mechanism in local generation network credits and virtual net metering with a view to recommending mechanism for the Australian context

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	most benefits will be considered relative to the status quo, Microeconomic 'customer level' inputs such as the calculated Local Network Charges/VNM charges, transaction costs and electricity prices, will be used to estimate levels of end-user participation and subsequent NEM wide macro outputs (cost/benefits), such as: •Potentially avoided network costs • Changes to power prices and average household bills • Emissions reduction • Installed distributed energy capacity • Ratio of all generation from distributed sources	Med
	2. Support the transition to an alternative electricity pricing approach	An alternative pricing approach for locally generated electricity is proposed via • a methodology for Local Generation Network Charges • a local energy trading (virtual net metering) mechanism to allow customer participation in a market of local generation and consumption	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The business models enabled by local generation network changes and virtual net metering (local energy trading) provide incentives for DER to remain on grid and assist in reducing strain on network infrastructure.	Low
	4. Inform the regulatory environment for renewable energy	ISF will use the research to support a rule change request to the AEMC for a Local Generation Network Credit methodology to extent the cost reflective pricing reforms to apply to exports as well as imports. ISF will disseminate the findings and promote the suggested rule changes through targeted industry and stakeholder presentations at conferences, workshops and forums. Similarly, targeted articles will reach stakeholders through industry magazines and newsletters, targeted for sectors who are likely to consider DG, and whose projects could benefit from Local Network Charges and VNM. This would include, for example, the Property Council and commercial building managers, local government, the food and beverage industry, farm associations, as well as the participant stakeholders, namely NSPs, electricity retailers and MDSPs. Broader energy audiences will be reached through energy newsletters such as Climate Spectator, Renew Economy, the Conversation or the ATA's Renew magazine.	High

5. Engage customers to build their and the industry's understanding of distributed energy resources	Customers with distributed energy resources will be encouraged to operate those resources in a way which provides maximum benefit to the grid in terms of peak reduction, loss avoidance and augmentation avoidance	Low
6. Make the process of integrating renewable energy into the grid more cost-efficient	The aim is to identify a draft methodology, and gain insight on the actual costs and benefits of the creation of Local Generation Network Credit. As the credit will be based on Long Run Marginal Cost of the surrounding network it will lead to efficient outcomes in terms of distributed energy deployment, operation and network augmentation	Med
7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	To enable broad stakeholder input to the development of a Local Network Charge calculation methodology and the introduction of VNM in Australia. To broaden and deepen understanding among key stakeholders (including network owners and managers, regulators, policy makers and proponents and developers of renewable energy and decentralised energy resources) about the relationship between electricity networks and renewable energy and decentralised energy resources, and how these resources can be more effectively integrated for mutual benefit and for the benefit of consumers and the nation.	Med
8. Establish control over, or otherwise influence, intermittent generation sources	Intermittent generation sources are sought to be influenced through a market mechanism (price signal) incentivising their availability and generation at peak times, thus providing impetus for technical solutions to be offered by the market place to lead to greater control and responsiveness through storage or other technology	Low
12. Use distributed energy solutions to address network and system constraints	The Local Generation Network Credit is designed as a price signal linked to the Long Run Marginal Cost (LRMC) of system constraints.	Low

Approaches	Approach	Comments
	Literature Review	Building on previous theoretical work, the project aims to work through Local Network Charges and VNM methodologies with NSPs, electricity retailers, and project proponents. This research aims to ensure that the project can learn from existing instances of Local Network Charges and VNM. ISF undertook a limited literature review on the international examples of local network charge methodologies for the Consumer Advocacy Panel . ISF will supplement that review to capture additional relevant examples that may offer lessons and precedents. The research will also build on the literature review undertaken as part of the ARENA funded Clean Energy Council project Future Proofing in Australia's Distribution Industry (FPDI) project on valuing embedded generation. ISF's previous review will be expanded to include VNM, identify whether there are any examples of Virtual Power Stations (VPS) in the many-to-one configuration, in which a large user buys from multiple small generators. The review will further attempt to identify a community project(s) where electricity is netted off at member premises. Five customer trials will be conducted in NSW QLD and VIC on particular projects that may benefit from local energy trading and local generation network credits.

Results	Result	Comment
	No results yet	The project is in progress.

FLEXGRID – Improving the flexibility of the grid

Project ID	163
Organisation	Red Eléctrica de España
Organisation Type	Network
Partners	ABB Spain
Story	Not all wind power can be integrated, leading to curtailment, which sometimes happens when the nominal static ratings (the maximum power that can be transmitted) of the lines are exceeded, making it unsafe to operate the line. FLEXGRID demonstrated alternatives to help optimise the infrastructure and maximise the integration of renewable generation. Firstly, power lines can be monitored in order to assess their maximum capacity in real time (dynamic line rating) and estimating capacity in future. Secondly, power flows can be controlled in overload lines, redirecting flows from these overload lines to close lines with spare capacity by using OLC. Two technologies were developed: a dynamic line rating based on RTTR (Real-time thermal monitoring) and the Overhead Line Controller (OLC). For the RTTR, the power line conditions were monitored to assess their maximum capacity in real time based on their 'dynamic line rating'. A special kind of conductor called an 'Optical Phase Conductor' is used. This is a conventional conductor in which one of the wires has been replaced by a beam of fibre optics; and a distributed temperature sensor, which monitors the temperature along the entire line. The temperatures and weather conditions stored in a PC are used to estimate the line ampacity using algorithms. OLC is made up of three reactors of different impedances arranged in series, driven via individual switches which are parallel to each of the reactors. Through the optimised and controlled action of these reactors, it is possible to achieve staggered limitation of the desired power flow, allowing for the overload of the affected line to be controlled in a steady and a contingency state. The project was successful: - Average additional wind power integrated: 40% higher - Maximum redispatch generation avoided: 24 GWh/year - Generation redispatch savings: Au$760,000/year - Avoided CO2 emissions cost: Au$90,000/year
Start Date	2010
End Date	2013
Customer Segment	None
Customers Involved	
Cost	
Funding Source	Commercial Partner, Discretionary Spend, European Commission, Regulator- Network
Connection Point	Zone Substations
Location	Magallon Substation / Magallón
State	
Country	Spain
Future Plans	Yes. 1) DLR model is being optimised and the results are being analysed. 2) These technologies are been managed to be integrated in the planning of the transmission system in future.
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Background	Not all wind power can be integrated, leading to curtailment, which sometimes happens when the nominal static ratings (the maximum power that can be transmitted) of the lines are exceeded, making it unsafe to operate the line. FLEXGRID demonstrated alternatives to help optimise the infrastructure and maximise the integration of renewable generation. Firstly, power lines can be monitored in order to assess their maximum capacity in real time (dynamic line rating) and estimating capacity in future. Secondly, power flows can be controlled in overload lines, redirecting flows from these overload lines to close lines with spare capacity by using OLC

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The objective is addressed with a cost-benefit analysis of this new technology versus conventional solution (building new power lines) to solve the problem. Simulations about the savings achieved (redispatched energy avoided, CO2 emissions avoided) by the new technology were undertaken.	Low
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	With these devices, new processes for operating the transmission system have been implemented with the aim of integrating more wind energy by avoiding curtailments, which is cheaper than redispatching generation. As a result, average additional wind power integrated is 40% higher and 24 GWh/year of redispatch generation can be avoided as maximum.	Low
	10. Smooth out intermittent generation output	Combining dynamic line ratings and power flow control to provide more flexibility to the transmission system.	Low

Approaches	Approach	Comments
	Controllers	To address the project's approach, two technologies have been developed: a dynamic line rating based on RTTR (Real-time thermal monitoring) and the Overhead Line Controller (OLC). OLC: it is made up of three reactors of different impedances mechanically arranged in series, driven via individual switches which are parallel to each of the reactors. Through the optimised and controlled action of these reactors, it is possible to achieve staggered limitation of the desired power flow, allowing for the overload of the affected line to be controlled in a steady and a contingency state.
	Dynamic Equipment Rating	RTTR: The power line conditions were monitored to assess their maximum capacity in real time based on their 'dynamic line rating' rather than using static seasonal ratings. To achieve this, a special kind of conductor called an 'Optical Phase Conductor' is used. This is a conventional conductor in which one of the wires has been replaced by a beam of fibre optics; and a distributed temperature sensor, which monitors the temperature along the entire line. The temperatures, in addition to weather conditions, are stored in a PC and are used to estimate the line ampacity using algorithms.
Results	**Result**	**Comments**
	Technology easily portable to other locations	Regarding to OLC technology: - One of the most innovative goals achieved is the advanced control that has been adapted to this device. - It is an economic solution compared to other FACTS topologies. - It is easily portable to other locations and easily scalable in terms of size and number of steps.
	Increasing the reliability of Dynamic Line Rating (DLR) solutions	Regarding RTTR technology: - It is a continuous monitoring system for power lines (increasing the reliability of DLR solutions) - Most days the dynamic rating was 15% higher than the static rating. - There is a correlation between wind production and the increase of transmission capacity in lines affected by local weather conditions.

Other	The project was successful and the results from combining both technologies (RTTR and OLC) have been even better that expected. The most significant results are: - Average additional wind power integrated: 40% higher - Maximum redispatch generation avoided: 24 GWh/year - Generation redispatch savings: Au$760,000/year - Avoided CO2 emissions cost: Au$90,000/year

FPDI: Analysis of Demand-Side Management Opportunities

Project ID	253
Organisation	Clean Energy Council
Organisation Type	Association
Partners	ARENA
Story	A transition to a more 'cost-reflective' network charging regime is underway in many Australian states. New charging options are being considered that are designed to provide price signals which are anticipated to more closely reflect the costs of providing electricity. In doing so there is an expectation that SME customers may become exposed to significant cost increases if their peak consumption is not managed accordingly. DSM options can shield businesses from exposure to high price events. These same options can also assist DNSPs in managing their networks if utilised effectively. However, there is not a coherent link between the expectations of DNSPs for demand management, and that of SME customers who may adopt demand management. The purpose of this task is to build an understanding of the opportunities for the uptake of DSM options for Small-Medium Enterprises (SME). It will analyse available technologies and identify and demonstrate available DSM options by considering consumption patterns and tariff structures. This analysis will produce reference material that will enable SME customers to take advantage of opportunities which may be available to them. This will also inform Distribution Network Service Providers (DNSP) on how to engage SME customers to take advantage of DSM opportunities.
Start Date	1-06-2014
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	Federal Government ARENA
Network	
Connection Point	
Location	
State	
Country	Australia
Future Plans	
Contact Name	Tom Butler
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Contact Phone	03 9929 4142
Contact Link	
Background	A transition to a more 'cost-reflective' network charging regime is underway in many Australian states. New charging options are being considered that are designed to provide price signals which are anticipated to more closely reflect the costs of providing electricity. In doing so there is an expectation that SME customers may become exposed to significant cost increases if their peak consumption is not managed accordingly. DSM options can shield businesses from exposure to high price events. These same options can also assist DNSPs in managing their networks if utilised effectively. However, there is not a coherent link between the expectations of DNSPs for demand management, and that of SME customers who may adopt demand management. DSM options for commercial premises include embedded generation such as solar PV, battery storage, load shifting and integrated energy management systems. As technology costs decline and energy costs increase businesses are increasingly motivated to incorporate DSM options. For some SMEs there may already be benefits of taking up DSM. However, many customers are generally not well informed on the most appropriate DSM options to consider and may not be well placed to explore those available to them. Similarly, DNSPs may not be well informed of the best options for their business customers and are therefore unable to engage effectively to fully understand solutions available. Opportunities in the installation of DSM measures depend on a range of factors, including the business' location, consumption profile, load switching capability

and tariff structures.
Analysis of DSM opportunities for SME customers will also assist DNSPs in creating tariff structures which incentivise efficient customer responses. The outcome will mean more efficient levels of network investment consistent with a long term benefit to consumers broadly.

Areas of Relevance	Area	Comments	Relevance
	5. Engage customers to build their and the industry's understanding of distributed energy resources	This analysis will produce reference material that will enable SME customers to take advantage of opportunities which may be available to them. This will also inform Distribution Network Service Providers (DNSP) on how to engage SME customers to take advantage of DSM opportunities.	Med
	13. Store and organise information on customer renewable energy deployments	The purpose of this task is to build an understanding of the opportunities for the uptake of Demand-Side Management (DSM) options for Small-Medium Enterprises (SME). It will analyse available technologies and identify and demonstrate available DSM options by considering consumption patterns and tariff structures.	Med
	1. Measure or quantify the benefits and costs of renewable energy	This task will model electricity tariffs, pricing regimes and anticipated future scenarios for commercial consumers. It will also consider the characteristics of electricity consumption in various commercial business types and the DSM options which may be available for these businesses. Finally, it will demonstrate the value of incorporating those options.	Med

Approaches	Approach	Comments
	Literature Review	This task proposes to prepare an informative guide for potential investors in commercial-scale DSM technologies such as solar PV, storage and/or load control, accompanied by a technical report designed to inform DNSPs and other more technically informed stakeholders. These two documents are expected to focus on the business case for various DSM options and provide enough information for the relevant businesses to gain an understanding of the opportunities and benefits of implementing DSM measures based on their individual requirements. In addition they should inform potential providers of DSM technologies to prepare well-rounded solutions for their customers.

Results	Result	Comments
	No Results yet	

FPDI: Demand Side Management Technology Testing

Project ID	256
Organisation	Clean Energy Council
Organisation Type	Association
Partners	ARENA
Story	To date the applicable standards for solar PV, commercial-scale embedded generation and DSM options have made an assumption of low penetration which has led to simplistic operating characteristics becoming the norm. Although equipment generally has to meet the relevant Australian Standards, DNSPs have a lack of confidence in quality control frameworks. Building industry confidence in new technologies and ensuring quality control will be a fundamental underpinning of flexible and resilient distribution systems. This task proposes to canvas current perceptions of the performance of inverter-based energy and DSM systems against the technical requirements of the network, and evaluate the need for a domestic quality management framework. Based on the outcomes of this assessment it will assess the feasibility of and design principles for such a framework, within the context of Australia's electricity markets. This task will survey DNSPs regarding their perceptions and concerns about the technical performance of inverters and DSM equipment. It will concurrently survey equipment suppliers to understand equipment capability and whether there is a willingness to embrace available functionality. Following these surveys the task will analyse potential options for addressing concerns raised through a testing and compliance framework. It will also gather an understanding of international standards and practices and their application within a domestic setting.
Start Date	1-06-2014
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	Federal Government - ARENA
Network	
Connection Point	
Location	
State	
Country	Australia
Future Plans	
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Background	To date approximately 1.2 million households have installed over 3 GW of solar PV demonstrating that embedded generators are playing an increasingly important role in our energy mix. Increased electricity costs, changes to charging structures and declining technology costs are also increasing the competitiveness of commercial-scale embedded generation and DSM options. The efficient integration of new technologies into distribution networks requires a level of confidence in the behaviour of these technologies. In order to do so laboratory-based analysis of plant performance under a range of specific network conditions is likely to be required. To date the applicable standards have made an assumption of low penetration which has led to simplistic operating characteristics becoming the norm. As demonstrated by the revised AS 4777 standard, future standards should be more pragmatic about the behaviour of these technologies. Although equipment generally has to meet the relevant Australian Standards, DNSPs have a lack of confidence in quality control frameworks. While current standards specify baseline performance, this does not necessarily provide adequate information about performance under different network conditions. In regional areas where there are greater operational constraints and 'weaker' networks, a lack of performance information can lead to onerous technical solutions for grid connection. Building industry confidence in new technologies and ensuring quality control will be a fundamental underpinning of flexible and resilient distribution systems. There is an expectation that inverter-based energy systems and DSM solutions could be used to support the network as penetration increases. Modern inverters can provide enhanced solutions to "traditional" generation systems, with the technical capabilities already in place. However, in order for the solutions offered by these new technologies to be properly integrated, DNSPs will be expected to accept new operating characteristics with which they have limited experience and therefore confidence. Contributing further to this uncertainty is the increasing need for confidence in equipment reliability and ongoing maintenance as penetration of these new technologies increases.

Areas of Relevance	**Area**	**Comments**	**Relevance**
	4. Inform the regulatory environment for renewable energy	This task proposes to canvas current perceptions of the performance of inverter-based energy and DSM systems against the technical requirements of the network, and evaluate the need for a domestic quality management framework. Based on the outcomes of this assessment it will assess the feasibility of and design principles for such a framework, within the context of Australia's electricity markets. This may have flow-on implications for distributed renewable energy integration.	Low

Approaches	Approach	Comments
	Interviews and Surveys	This task will survey DNSPs regarding their perceptions and concerns about the technical performance of inverters and DSM equipment. It will concurrently survey equipment suppliers to understand equipment capability and whether there is a willingness to embrace available functionality.
	Literature Review	Following these surveys the task will analyse potential options for addressing concerns raised through a testing and compliance framework. It will also gather an understanding of international standards and practices and their application within a domestic setting.

Results	Result	Comments
	No Results yet	

FPDI: Review of Policies and Incentives

Project ID	254
Organisation	Clean Energy Council
Organisation Type	Association
Partners	ARENA and Marchment Hill Consulting
Story	Small-scale distributed electrical generation, demand-side management (DSM) and storage are playing an increasingly important role in our energy mix. Their proliferation within the incumbent system is changing the context of current policy settings, and may be leading to significant lost opportunities. The purpose of the task is to undertake a review of current market conditions in Australia and why they may be problematic to increasing the uptake of renewable energy and emerging technologies. The review report will provide a critique of current policy settings, while outlining recommendations on how they may be adjusted. Its purpose will be to provide an information resource on options for policy makers and recommendations for priority policy and regulatory development.
Start Date	1-06-2014
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	Federal Government ARENA
Network	
Connection Point	
Location	
State	
Country	Australia
Future Plans	
Contact Name	Tom Butler
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Contact Phone	03 9929 4142
Contact Link	
Background	Small-scale distributed electrical generation, demand-side management (DSM) and storage are playing an increasingly important role in our energy mix. To date approximately 1.2 million households have installed over 3 GW of solar PV. Declining storage costs are also signalling a rapid uptake of this technology in the medium term. Increased electricity costs, changes to charging structures and declining technology costs are also increasing the competitiveness of commercial-scale embedded generation and DSM options. These new technologies represent a new future for distribution networks, and the broader electricity industry. Their proliferation within the incumbent system is changing the context of current policy settings, and may be leading to significant lost opportunities. A review and critical evaluation of Australian policies and incentives is important to determine how best to address challenges ahead. Without an assessment of existing and alternative settings, there is a risk that policy frameworks intended to set incentives for embedded generation and/or DSM will not efficiently reveal benefits. While immediate challenges are easily identifiable, they can manifest in the market in several ways and it is crucial to define their origins in order to begin to address them. In some instances, the rules already in place may be able to provide solutions but an evaluation of their effectiveness may be required.

Areas of Relevance	Area	Comments	Relevance
	4. Inform the regulatory environment for renewable energy	The purpose of the task is to undertake a review of current market conditions in Australia and why they may be problematic to increasing the uptake of renewable energy and emerging technologies (embedded generation and demand side management, DSM, broadly). This will include the development of case studies based on overseas markets, with the intent to inform policy decisions around the increased penetration of embedded generation and DSM domestically. The review report will provide a critique of current policy settings, while outlining recommendations on how they may be adjusted. Its purpose will be to provide an information resource on options for policy makers and recommendations for priority policy and regulatory development.	High

Approaches	Approach	Comments
	Literature Review	The task will produce a comprehensively researched report which will consider current market conditions in Australia and offer a critique of why they may be problematic to increasing use of embedded generation and DSM. Additional information will be gathered from overseas markets and presented in a “case study” format in order to articulate how other markets are enabling the deployment of embedded generation and DSM. The report is also to include recommendations for policy and/or regulatory development, based on the research, evaluation and case studies.

Results	Result	Comments
	No Results yet	

FPDI: Review of work undertaken to date

Project ID	272
Organisation	Clean Energy Council
Organisation Type	Association
Partners	ARENA
Story	The continued integration of renewable energy into Australian distribution networks represents one of the largest economic, regulatory and technical challenges that the industry has faced to date. The extent of this reform brings with it risks and opportunities. The CEC has an understanding of key priority actions that are required in this space. We will look to complement this work by performing a thorough analysis of what has already been undertaken, what is planned by other organisations, and further identify potential synergies with this roadmap. The report produced by this work will be publicly available and disseminated to key stakeholders. It will potentially be a useful tool for bureaucrats and regulators to assist in making informed decisions on policy and review processes. It will also provide a useful framework and evidence bank of the prevailing drivers and issues surrounding grid integration of renewable energy technologies.
Start Date	1-04-2014
End Date	1-08-2014
Customer Segment	
Customers Involved	
Cost	
Funding Source	Federal Government ARENA
Network	
Connection Point	
Location	
State	
Country	Australia
Future Plans	The report produced by this work will be publicly available and disseminated to key stakeholders. It will potentially be a useful tool for bureaucrats and regulators to assist in making informed decisions on policy and review processes. It will also provide a useful framework and evidence bank of the prevailing drivers and issues surrounding grid integration of renewable energy technologies.
Contact Name	Tom Butler
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Background	The continued integration of renewable energy into Australian distribution networks represents one of the largest economic, regulatory and technical challenges that the industry has faced to date. The extent of this reform brings with it risks and opportunities. The CEC, in conjunction with its members and other key stakeholders, has scoped a comprehensive program of work that will begin to address some of these challenges. With the objective of enhancing the flexibility and resilience of Australia's electricity distribution systems and the installations connected to them the CEC-led Future Proofing in Australia's Distribution Industry (FPDI) project will analyse existing and emerging issues while identifying potential future roadblocks to the adaptation of these systems to consumer expectations. Much of the work undertaken in this space to date has had a longer-term focus or provides a series of recommendations in the absence of a coordinated implementation plan. The intention of this task is to utilise this extensive foundation to inform the project scope and tasks in their short-medium term objectives.

Areas of Relevance	Area	Comments	Relevance
	4. Inform the regulatory environment for renewable energy	The project will focus on a comprehensive synthesis of regulatory reviews, research reports, policy analysis and other analytical studies as agreed with the project steering committee, including but not be exclusive to: - A consolidated understanding of recent activities of reform and additional opportunities for renewable energy, storage and DSM; - Reviews by AEMC and the Productivity Commission; - Proposed and current rule changes; - Studies conducted by organisations such as APVA, Grattan Institute, CSIRO, UTS, etc…, and; - The CSIRO Future Grid Forum	High

Approaches	Approach	Comments
	Literature Review	The CEC has an understanding of key priority actions that are required in this space. We will look to complement this work by performing a thorough analysis of what has already been undertaken, what is planned by other organisations, and further identify potential synergies with this roadmap. This analysis will focus on dissecting the outcomes and recommendations of other studies as relevant to this project. It will also seek to set the scene for the overall project and consider the implications of potential future scenarios. Additional synergies within ARENA's funding programs will also be explored to ensure these objectives are complementary.

Results	Result	Comments
	No Results yet	

FPDI: Value of Small Scale Embedded Generation and Storage

Project ID	255
Organisation	Clean Energy Council
Organisation Type	Association
Partners	ARENA
Story	During recent reviews and legislative changes across Australia, many independent regulators have made clear statements that embedded generation provides a network benefit due to the alleviation of demand on networks. These same regulators were unable to determine an appropriate value for it due to the diversity in network characteristics. At the same time, some stakeholders claim that networks are bearing increased costs related to adjusting network settings. This task proposes to establish a reasonable methodology for quantifying the cost/benefit added by embedded generation technologies under a variety of real world conditions. The objective of this methodology will be to enable policy makers to appropriately reward (where relevant) these actors for their contribution to investment needs in networks. This task will also consider the role of the retail market in dealing with the cost/benefit issue and how future policy direction could coordinate the needs of this stakeholder group. These studies will be conducted through consultation with Distribution Network Service Providers.
Start Date	1-06-2014
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	Federal Government - ARENA
Network	
Connection Point	
Location	
State	
Country	Australia
Future Plans	
Contact Name	Tom Butler
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Background	Small scale distributed electrical generators and storage (embedded generation broadly) are playing an increasingly important role in our energy mix. To date approximately 1.2 million households have installed over 3 GW of solar PV and declining storage costs are also signalling a rapid uptake of this technology in the short term. Combined, these and other embedded generation technologies are driving significant changes to distribution network expansion and investment signals. Embedded generation can add value and create costs depending on locational characteristics and electricity consumption patterns. During recent reviews and legislative changes across Australia, many independent regulators have made clear statements that embedded generation provides a network benefit due to the alleviation of demand on networks. These same regulators were unable to determine an appropriate value for it due to the diversity in network characteristics. At the same time, some stakeholders claim that networks are bearing increased costs related to adjusting network settings. In remote off-grid applications, embedded generation can offset both network investment and the need for high cost fuels (usually gas or diesel which is subject to high transport costs). In fringe off-grid situations the savings can be remarkable due to the high capital / low consumption nature of these assets. Similarly, penetration levels in urban distribution networks are creating significant changes to network investment signals. The value of the contribution of small scale embedded generation and storage to networks is currently an unknown. The continued lack of this background information is likely to lead to a significant lost opportunity in the future as the penetration of embedded generation increases. There is now a growing need to make a technical assessment of the expected value (be it positive or negative) to ensure that it can be recognised and considered in future policy reforms, and appropriately addressed within regulatory frameworks.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	This task proposes to establish a reasonable methodology for quantifying the cost/benefit added by embedded generation technologies under a variety of real world conditions.	High
	4. Inform the regulatory environment for renewable energy	The objective of this methodology will be to enable policy makers to appropriately reward (where relevant) these actors for their contribution to investment needs in networks. This task will also consider the role of the retail market in dealing with the cost/benefit issue and how future policy direction could coordinate the needs of this stakeholder group.	Med

Approaches	Approach	Comments
	Interviews and Surveys	This task will seek to address the following questions: • Under different distribution network types and scenarios, what would be a typical value add to the network from embedded generation technologies? • Under what conditions could the benefit be negative and how could this cost be managed efficiently? • What does a reasonable methodology for considering this value in the future look like? • What is the role of retailers in addressing the changed economic conditions brought about by changing generation and consumption patterns? • How do current regulatory and policy settings apportion this value? • Given the recent uptake of embedded generation over the last 5 years what policy changes could have produced more efficient outcomes? These studies will be conducted through consultation with Distribution Network Service Providers.

Results	Result	Comments
	No Results yet	

Fringe of Grid / Stand Alone RAPS Project

Project ID	336
Organisation	Horizon Power
Organisation Type	Network
Partners	
Story	Details of this project available on request.
Start Date	
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	
Network	Horizon Power
Connection Point	
Location	
State	WA
Country	Australia
Future Plans	
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Background	

Areas of Relevance	Area	Comments	Relevance

Approaches	Approach	Comments

Results	Result	Comments

Future Grid Forum

Project ID	245
Organisation	CSIRO
Organisation Type	Government, Research
Partners	Various distribution companies and government agencies
Story	Australia's electricity system is at a significant crossroads. Historically high retail electricity prices, widespread deployment of solar panels, greenhouse gas emissions abatement, and declining aggregate peak demand and consumption in most states are some of the major issues that have put it at this crossroads, and there are several potential future directions. Each direction has far-reaching implications for the future electricity supply chain and would alter the electricity model in this country. Recognising the extraordinary circumstances of this time in the electricity sector's history, in 2012 CSIRO convened the Future Grid Forum, unique in composition (bringing together more than 120 representatives of every segment of the electricity industry, as well as government and community) and in approach (undertaking extensive whole-of-system quantitative modelling and customer social dimensions research to support its deliberations and findings). Through the forum, four scenarios were explored and discussed: set and forget; rise of the prosumer, leaving the grid and renewables thrive. The four scenarios represent potential new directions for the development of the electricity sector as well as other information describing their impact and possible response options. The result is Australia’s first extensive whole-of-system evaluation that encompasses the entire energy chain from generation through to consumption.
Start Date	01-08-2012
End Date	13-12-2013
Customer Segment	
Customers Involved	
Cost	AUD 1.022M
Funding Source	Commercial Partner, Discretionary Spend
Network	
Connection Point	Customer Connections
Location	All
State	
Country	Australia
Future Plans	CSIRO has existing and developing projects which seek to address the challenges identified by the Future Grid Forum. At a high level this includes research into control systems, storage, solar air conditioning, social attitudes to distributed resources and cost-reflective pricing and other stakeholder engagement processes to further develop the sector's roadmap over the next decade.
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Contact Link	http://www.csiro.au/Organisation-Structure/Flagships/Energy-Flagship/Future-Grid-Forum-brochure.aspx
Background	Australia's electricity system is at a significant crossroads. Historically high retail electricity prices, widespread deployment of solar panels, greenhouse gas emissions abatement, and declining aggregate peak demand and consumption in most states are some of the major issues that have put it at this crossroads, and there are several potential future directions. Each direction has far-reaching implications for the future electricity supply chain and would alter the electricity model in this country. While many of these challenges also confront electricity supply in other parts of the world, Australia has its own set of unique strengths and vulnerabilities around which it will need to tailor effective solutions. Recognising the extraordinary circumstances of this time in the electricity sector's history, in 2012 CSIRO convened the Future Grid Forum, unique in composition (bringing together more than 120 representatives of every segment of the electricity industry, as well as government and community) and in approach (undertaking extensive whole-of-system quantitative modelling and customer social dimensions research to support its deliberations and findings).

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The Future Grid Forum explored a scenario called 'Renewables Thrive' which quantified the outcomes of a very high renewable penetration grid by 2050. The project calculates the greenhouse gas emissions, technology mix, wholesale electricity prices, retail electricity prices and share of onsite, versus grid supplied electricity for that scenarios and describes a plausible narrative for reaching the outcome.	High
	2. Support the transition to an alternative electricity pricing approach	The Future Grid Forum describes the reason why the current pricing approaches has lead to some undesirable outcomes and provides detailed scenarios for how improved pricing approaches might lead to different outcomes (although not always positive for all stakeholders) as well as another scenario which describes how consumers are encouraged to be 'Leaving the grid' if pricing approaches are not changed	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Through scenario analysis the Future Grid Forum described several different electricity systems which will require alternative business models to cope with growth in on-site generation of between 20 and 50 percent across the scenarios together with smart meters, demand management and other distributed energy resources	High
	4. Inform the regulatory environment for renewable energy	The Future Grid Forum explored the impact of alternative electricity pricing approaches and alternative carbon pricing levels. It also discussed consumer safety nets and the need to review the resilience of current network regulation given the current and potential impact of solar panels and other distributed energy resources.	High
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The deep engagement of the participating organisation in the Future Grid Forum has meant that those organisations are more informed and strong ownership of the distributed energy scenarios and concepts that were explored and their implications.	High
	8. Establish control over, or otherwise influence, intermittent generation sources	The Future Grid Forum explores a high renewable scenario and explains one way of managing intermittent generation to achieve the reliability standards using storage	Med
	9. Strengthen the network to manage higher renewable energy penetration	The Future Grid Forum explores a high renewable scenario and explains how the transmission network would need to be expanded to accommodate high renewable energy penetration.	Med
	10. Smooth out intermittent generation output	The Future Grid Forum explores scenarios which include use of storage at customer and grid scale to smooth out intermittent generation output.	Med
	11. Alter local load profile to match a desired level	The Future Grid Forum explores scenario which include use of storage, industrial demand management, commercial and residential air conditioning control and managed electric vehicle charging to alter local loads.	Med

	12. Use distributed energy solutions to address network and system constraints	The Future Grid Forum explores the impact of on-site generation storage, industrial demand management, commercial and residential air conditioning control and managed electric vehicle charging on growth in peak demand and subsequent costs or savings for expenditure on networks	Med
	Other	Build consensus within the Australian electricity industry and its stakeholders on the potential ways in which the system might evolve, providing objective quantification of the impacts of those alternative outcomes and the options for responding to those outcomes.	
Approaches	**Approach**	**Comments**	
	Interviews and Surveys	The project uses a Forum process which involves bringing together all relevant stakeholders to work together to explore the issues. The participants represent a diversity of views including those that would benefit and or be disadvantaged from change. The process also uses quantitative modelling to bring a degree of objectivity to the Forum discussions. Unlike other stakeholder engagement processes the participants review all materials many times over an 18 month process, actively contributing content, participating in working groups and signing-off on the final report and other communication materials as well as acting as spokespeople for the project. The diversity and deep engagement of the forum ensures that the outputs manage the balance of innovatively exploring the potential for change but also being grounded. Consequently the outputs and ideas of the Forum are seen as credible and more rapidly adopted by both the internal and external stakeholders to the project.	

Results	Result	Comments
	Inform the public discussion on the future of the electricity industry	The forum's journey was summarised by delivery of various reports and communication activities in December 2013. Those materials describe 4 scenarios which represent potential new directions for the development of the electricity sector as well as other information describing their impact and possible response options. Given the industry media attention the material has received, it has achieved its goal of informing the public discussion on the future of the sector and the various issues it faces.

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Gansu Dunhuang Photovoltaic Grid-Connected Power Generation Project

Project ID	349
Organisation	CGNPC Group
Organisation Type	Government
Partners	Enfinity NV Group
Story	Gansu Dunhuang 10 MW photovoltaic grid-connected generation project is China's first photovoltaic (PV) grid integration demonstration project with the participation of private companies. The project is led by CGNPC group (State-owned corporation), the solar company under CGNPC's holding and Belgium Enfinity NV Group. One of the main objectives of the project is to bring Solar PV generation and integration to a lower level than the existing offerings, through facilitating the cooperation between state-own corporations and private companies.
Start Date	01-08-2009
End Date	
Customer Segment	Industrial, Large commercial, Residential, SME
Customers Involved	
Cost	
Funding Source	Commercial Partner, Regulator-Approved Spend
Network	Network in Dunhuang, Gansu
Connection Point	Customer Connections
Location	Dunhuang
State	Gansu Province
Country	China
Future Plans	This demonstration project will help to set the standards and best practices for the future Solar PV generation and integration projects in China.
Contact Name	Confidential information
Contact Email	
Contact Phone	
Contact Link	
Background	China is developing record levels of renewable energy generation. Over 5GW of wind power and 100MW of solar power has been installed in Gansu province alone. To manage power fluctuations from this critical energy resource, intelligent Solar PV generation and integration methodologies are required.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The aim of the project is to quantify the cost / benefit and reduce the costs associated with the rollout of Solar PV and network integration at a broader scale. The development of the project's construction provides valuable experience for China's push for large-scale integration of Solar PV grid-connected power generation project. Keeping Solar PV's generation and integration cost at a significantly low level is very important to achieve the economic benefit and encourage the future cooperation between China's government and private companies.	Med

Approaches	Approach	Comments
	Demonstration Project	Gansu Dunhuang 10 MW photovoltaic grid-connected generation project is China's first photovoltaic (PV) grid integration demonstration project with the participation of private companies. The main approaches of the project include:- Enable the renewable energy generation facilities to export full generation capacity into the grid - Remove the need for spinning reserve - Improve the power quality- Enable solar energy to be stored when it is generated for use at night. The project also aims to establish an important exemplary role in China on promoting the integration of solar power at a broader scale that beyond pilot projects.

Results	Result	Comments
	No results yet	The project is on-going.

Golden Sun Demonstration Project

Project ID	274
Organisation	Ministry of Science and Technology (MOST)
Organisation Type	Government
Partners	Ministry of Finance (MOF) and National Development and Reform Commission
Story	"Golden Sun demonstration project" was introduced in 2009 to support the domestic photovoltaic industry to advance technology, increase the scale and development of production and implement a policy to foster this emerging industry. Another objective was to spend up PV industry development and assist China in achieving a cleaner energy mix. The project used policy which laid out comprehensive fiscal subsidies, innovation support and a focused push to speed up the industrialization and large-scale development of the domestic photovoltaic power generation. Documented project results included 490 MW of solar installation during 2010 alone. However, this project was driven through policy and incentive programs which may not be applicable in an Australian context.
Start Date	2009
End Date	2013
Customer Segment	Residential
Customers Involved	Broad based program involving investors, PV developers, installation, distribution
Cost	
Funding Source	Federal Government, State Government
Network	China State Grid
Connection Point	Customer Connections
Location	National Program
State	National Program
Country	China
Future Plans	Following the closure of this project the Chinese Government has announced it will start to purchase power with the purpose of enhancing the effectiveness of solar power systems. They plan to invest mainly in distributed systems and western large-scale power plants in 2013
Contact Name	
Contact Email	
Contact Phone	
Contact Link	
Background	"Golden Sun demonstration project" was introduced in 2009 to support the domestic photovoltaic industry to advance technology, increase the scale and development of production and implement a policy to foster this emerging industry. Another objective was to spend up PV industry development and assist China in achieving a cleaner energy mix.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	Identified a method to promote distributed energy resources although through a political/ regulatory environment far different from that in Australia.	Low
	4. Inform the regulatory environment for renewable energy.	Highlights governments role in influencing renewable energies competitiveness when competing with the establish black energy providers.	Low
Approaches	**Approach**	**Comments**	
	Subsidy	- Subsidies for both the sale and installation of PV. These subsidies consisted of half the value of purchased equipment and a per watt subsidy for construction of PV panels- Subsidize for investment into solar power projects as well as relevant power transmission and distribution systems that connect PV to grid	
	Feed-in Tariff	- Network companies are required to buy all surplus electricity output from solar power projects that generate primarily for the onsite usage, at similar rates to the benchmark of on-grid tariffs set for coal-fired power generators	
	Large Scale Renewable Plant	- Requirements that project must have a generating capacity of at least 300 kilowatt peak, while construction will have to be completed in one year and operations will have to last for at least 20 years- Focused support the in the deployment of up to 500-600 MW of large-scale solar PV in both on-grid and off-grid	
Results	**Result**	**Comments**	
	Deployment of distributed generation	Documented project results included 490 MW of solar installation during 2010 alone.	

Greenough River Solar Farm

Project ID	246
Organisation	Greenough River Solar Farm (joint venture between Synergy and GE Energy
Organisation Type	Proponent
Partners	First Solar
Story	Greenough River Solar Farm project is the largest commissioned PV system in Australia, and is connected to the South Western Interconnected Network of WA. The project was built to supply power to the Water Corporation (WA) via a Power Purchasing Agreement (PPA). The utility scale plant is designed to meet a different set of generation or network standards than small scale PV. Utility scale PV plants are controllable and can be set-up to react more pro-actively to grid disturbances more in line with conventional generation than small-scale PV anti-islanding measures. These plants are designed to meet maximum capacity requirements, but curtailed daytime peaks can be used to smooth out cloud events due to:: 1) clouds only affecting parts of the plant at a time 2) allowing curtailed inverters to export more energy to compensate for cloud-impacted inverters. The project was successfully constructed, being commissioned in September 2012. It is currently in its second year of active operation.
Start Date	01-08-2011
End Date	01-10-2012
Customer Segment	
Customers Involved	1
Cost	AUD 50M
Funding Source	Commercial Partner, State Government
Network	
Connection Point	Subtransmission Feeders
Location	Geraldton
State	WA
Country	Australia
Future Plans	First Solar is contracted to supply the Operations and Maintenance services for the Greenough River Solar Farm for 15 years from the date of commissioning
Contact Name	Nicole Ghiotto
Contact Email	nicole.ghiotto@firstsolar.com
Contact Phone	
Contact Link	http://www.greenoughsolarfarm.com.au/
Background	Project is the largest commissioned PV system in Australia, and was connected to the South Western Interconnected Network of WA. The project was built to supply power to the Water Corporation (WA) via a PPA.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	This project is the first to connect a utility-scale system to a network. The experience can be relevant to other similar projects being undertaken in Australia.	High
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Building utility-scale plants develops localised capacity and expertise to build further plants in future - subsequent plants are already sold at lower cost thanks to in-country supply chain and suppliers.	Low
	8. Establish control over, or otherwise influence, intermittent generation sources.	The utility scale plant is designed to meet a different set of generation or network standards than small scale PV - utility scale PV plants are controllable and can be set-up to react more pro-actively to grid disturbances more in line with conventional generation than small-scale PV anti-islanding measures.	Med
	10. Smooth out intermittent generation output	As per 8. above, plants are designed to meet maximum capacity requirements, but curtailed daytime peaks can be used to smooth out cloud events due a) to clouds only affecting parts of the plant at a time, and b) to allowing curtailed inverters to export more energy to compensate for cloud-impacted inverters.	Med

Approaches	Approach	Comments
	Power Purchase Agreement	The project was built to supply power to the Water Corporation (WA) via a PPA.
	Large Scale Renewable Plant	This project is the first to connect a utility-scale system to a network. The project was important to prove that utility-scale system projects can be developed and implemented, and addressed various first time mover barriers such as developing investor understanding and removing potential investor risk; negotiating utility-scale network connection agreements and so on.

Results	Result	Comments
	No results yet	The project was successfully constructed, being commissioned in September 2012. It is currently in its second year of active operation.

Grid Interactive Inverter program

Project ID	185
Organisation	Essential Energy
Organisation Type	Network
Partners	Surtek Pty Ltd, Statcom Solutions Pty Ltd
Story	The network's capacity to deliver load or absorb generation at any point can be constrained either by the current rating of elements in the supply path or by unacceptable voltage conditions for customers e.g. voltage rise often seen with high penetrations of renewable generation. The purpose of this project was to enable the development of a small scale four quadrants (i.e. positive and negative, real and reactive power) inverter capable of responding to voltage fluctuations. This technology would be able to respond quickly to changes in voltage and adjust power flows accordingly, thereby significantly improving the voltages, currents and losses on the existing infrastructure as an alternative to network augmentation. A systematic three phase approach was used to address the project objectives: prototype units were developed and installed where they could be closely monitored; then field trials were conducted where production units were installed and evaluated prior to approval for general use; and finally the four quadrant inverters were deployed as a generic supply quality improvement technology on the Essential Energy's distribution network. Key results from the grid interactive inverter program can be summarised as follows: 1) The project identified that a small scale four quadrants inverter is a low cost solution for voltage fluctuations caused by either embedded generation or network loading. 2) It was proven that a four quadrant inverter is capable of controlling the power flow on the network in response to voltage through the use of energy storage and/or reactive power. 3) Voltage at the point of connection can be controlled with sub cycle response times.
Start Date	2008
End Date	2016
Customer Segment	
Customers Involved	
Cost	
Funding Source	Regulator-Approved Spend DMIA
Network	Essential Energy
Connection Point	Customer Connections
Location	Queanbeyan, Pappinbarra, Tathra, Kalaru
State	NSW
Country	Australia
Future Plans	Essential Energy plans to follow on with the grid interactive program through a number of streams, these may include; - Monitoring and evaluating the existing installations to evaluate the longevity of the product for use in whole of life cost analysis - Evaluation of the potential means to incentivise inverters with more beneficial control structures (such as the grid interactive inverter) - Engaging with appropriate stakeholders to determine how to fit these beneficial control structures into the particular standards required.
Contact Name	Cory Urquhart
Contact Email	cory.urquhart@essentialenergy.com.au
Contact Phone	02 65886512
Contact Link	www.statcomsolutions.com.au

Background

The network's capacity to deliver load or absorb generation at any point can be constrained either by the current rating of elements in the supply path or by unacceptable voltage conditions for customers e.g. voltage rise often seen with high penetrations of renewable generation.The voltage in an electrical network is defined by the real and reactive characteristics of the network and the real and reactive power flows within the network, therefore we can use energy storage or controlled reactive power flows to precisely counteract voltage rise caused by generation systems injecting real power or voltage dips caused by customers demands. One potential solution is a small scale inverter capable of operating in four quadrants (i.e. positive and negative, real and reactive power), this technology would be able to respond quickly to changes in voltage and adjust power flows accordingly, thereby significantly improving the voltages, currents and losses on the existing infrastructure as an alternative to network augmentation. The added benefit of using a small scale inverter as the solution, is that these type of inverters are also part of the system causing the voltage rise problem, and hence using appropriate incentives and standards to incorporate voltage responsive four quadrant control into generation systems, may offer a low cost solution in the longer term. The purpose of this project was to enable the development of a small scale four quadrant inverter capable of responding to voltage fluctuations, which, if required would be suitable for use with existing generation sources and then confirm the theory and benefits of the technology.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	As higher penetrations of renewables create issues on the network, the network owner must respond by augmenting the network at a cost to the individual customer or by spreading the cost across all customers. The grid interactive inverter program looked to provide a low cost solution to the problem of voltage issues, and confirm the theory and technical benefits.	Low
	8. Establish control over, or otherwise influence, intermittent generation sources	The grid interactive inverter will control the power flow on the network in response to voltage, in doing so the output of the generation source may be stored, or the impact of generation on the network may be mitigated using reactive power.	Med
	9. Strengthen the network to manage higher renewable energy penetration	The grid interactive inverter will be available for network support either as part of a generation system, or as a stand alone unit without direct connection to generation.	Med
	10. Smooth out intermittent generation output	The grid interactive inverter will control the power flow on the network in response to voltage, in doing so the output of the generation source may be stored, or the impact of generation on the network may be mitigated using reactive power.	Low
	12. Use distributed energy solutions to address network and system constraints	The grid interactive inverter should be available for network support either as part of a generation system, or as a stand alone unit without direct connection to generation	High

Approaches	Approach	Comments
	Demonstration Project	The project was broken into three distinct stages. In the first stage (knowledge acquisition stage), prototype units were developed and installed in an environment where they could be closely monitored and design improvements checked for inclusion in the production version. During the 10/11 financial year proof of concept had been achieved with the prototype units installed at Queanbeyan and design modifications required for the production unit were agreed.
	Customer Acceptance Testing	In the second stage (field trial phase), the first run production units were installed and their performance evaluated prior to approval for general use. At the close of the 11/12 financial year substantial field trials and development towards a product suitable for general deployment were underway with final refinement work in progress in order to move the devices into the business as usual phase. During the 12/13 and 13/14 financial years further monitoring and modification had been made to the units to prepare them for general deployment use.
	Low Voltage Regulation	In the third stage (general deployment phase), the utilisation of four quadrant inverters as a generic supply quality improvement technology on Essential Energy's distribution network which may include development of incentive schemes to leverage spare network support capacity from suitable renewable energy connection equipment.

Results	Result	Comments
	PV voltage problems can be resolved	Identified a low cost solution for voltage fluctuations caused by either embedded generation or network loading. Enabled the development of a solution which can be used for network support either as part of a generation system or as a stand alone unit without direct connection to generation.
	Energy storage and reactive power can help control voltage	Proven, using a number of test installations the capabilities of a four quadrant inverter in controlling the power flow on the network in response to voltage through the use of energy storage and/or reactive power.
	Sub cycle response times can control voltage fluctuations	Confirmed the modelled theory on the amount of support required for a given change in voltage and the technical benefits. Specifically that the voltage at the point of connection is able to be controlled with sub cycle response times.

Grid Utility Support System (GUSS)

Project ID	327
Organisation	Ergon Energy
Organisation Type	
Partners	
Story	The Single Wire Earth Return (SWER) network is facing issues of capacity, reliability and quality of supply, which requires considerable network capital investment for only a minority of the customers. Traditionally, Ergon Energy has dealt with these issues by augmenting the SWER line by re-conducting power lines, installing voltage regulators and upgrading isolation transformers, often to satisfy a short peak demand. These are expensive solutions which yield very poor investment returns because asset utilisation is often low. To resolve these issues, Ergon Energy has worked with customers to test a new battery and control technology that connects directly to its electricity network, called the Grid Utility Support System (GUSS). GUSS works by charging batteries overnight when electricity use is at its lowest and discharging them during the day when energy use peaks. The primary purpose is to improve the quality of supply while reducing investment and operating costs on Ergon Energy's extensive rural electricity networks. The trial has shown a clear effectiveness of GUSS to reduce the demand on the SWER by using battery storage. The capability to shift load from one time to another is a key step in unlocking the potential solution of energy storage for the network. Although there were issues through the trial, the battery technology and inverter system has shown to be reliable with both systems cycling daily consecutively for over 1 year.
Start Date	01-11-2011
End Date	01-04-2013
Customer Segment	
Customers Involved	
Cost	$982,000
Funding Source	Discretionary Spend
Network	Ergon Energy
Connection Point	Distribution Feeders
Location	Atherton Tableland
State	QLD
Country	Australia
Future Plans	Yes more units are being purchased and deployed on to the network.
Contact Name	Michelle Taylor
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Contact Phone	
Contact Link	
Background	The SWER network is facing issues of capacity, reliability and quality of supply, which requires considerable network capital investment for only a minority of the customers. Traditionally Ergon Energy has dealt with these problems by augmenting the SWER line by re-conducting power lines, installing voltage regulators and upgrading isolation transformers, often to satisfy a short peak demand. These are expensive solutions which yield very poor investment returns because asset utilisation is often low. Energy storage systems have attracted the interest of many power utilities around the world; hence considerable investment has been placed in the research and development of new storage technologies. Rather than employing typically expensive network augmentation solutions, an alternative solution using inverter and energy storage technologies is being investigated. This aims to solve network issues relating to peak demand on SWER networks and help defer costs of augmentation or negate the need. Although SWER networks are mainly targeted by this project, the fundamental concept will allow it to be deployed at any single phase LV customer connection point.

Areas of Relevance	Area	Comments	Relevance
	12. Use distributed energy solutions to address network and system constraints	The trial has shown a clear effectiveness of GUSS to reduce the demand on the SWER by using battery storage. The capability to shift load from one time to another is a key step in unlocking the potential solution of energy storage for the network. Although there were issues through the trial, the battery technology and inverter system has shown to be reliable with both systems cycling daily consecutively for over 1 year.	Med

Approaches	Approach	Comments
	Storage, Grid-Connected	The primary intent of the GUSS unit is to supply the site during times of peak loading (as pre-set using time of day clocks) using the GUSS unit or reduce the site load significantly by supplying the site with supply only from the GUSS batteries. These batteries would then be recharged during low load times (as pre-set using time of day clocks).

Results	Result	Comments
	Battery storage can reduce the demand on the Single Wire Earth Return(SWER)	The trial has shown a clear effectiveness of GUSS to reduce the demand on the SWER by using battery storage. The capability to shift load from one time to another is a key step in unlocking the potential solution of energy storage for the network. Although there were issues through the trial, the battery technology and inverter system has shown to be reliable with both systems cycling daily consecutively for over 1 year.

Hampton Wind Farm

Project ID	215
Organisation	Ecoult
Organisation Type	Proponent
Partners	CSIRO
Story	An immediate solution to wind integration challenges is to control the ramp rate of wind output. The project objective is to demonstrate and optimize methods of applying UltraBattery storage to constrain the 5-minute ramp rate of renewable output from the Hampton Wind Farm before presenting it to the grid. The impact objective is to achieve higher penetration of wind and renewable energy in grid systems.
Start Date	01-07-2008
End Date	01-07-2014
Customer Segment	Industrial
Customers Involved	
Cost	AUD 5M
Funding Source	Commercial Partner, Federal Government, State Government
Network	
Connection Point	Distribution Feeders
Location	Hampton
State	NSW
Country	Australia
Future Plans	The project has been completed but as the capital equipment (including the UltraBatteries) were all still in very good shape we have redeployed the assets into two new projects. CSIRO is using part of the original system in microgrid control research at their Newcastle facility and we have recently reached agreement to shift the high power part of the solution to a remote power system to continue to test diesel/renewable/UltraBattery hybrid models.
Contact Name	John Wood
Contact Email	info@ecoult.com
Contact Phone	+61 2 9241 3001
Contact Link	http://www.ecoult.com/case-studies/hampton-wind-farm-australia-wind-smoothing/
Background	Wind power cannot be controlled. Wind farms exhibit greater uncertainty and variability in their output compared to conventional generation. In power systems, which already manage a large degree of uncertainty due to the need for generation and loads to be equal, demand is constantly matched with generation to maintain system frequency. The variability and uncertainty of wind power further increases uncertainty in the system, affecting its physical operations. Further challenges with supporting increased penetration of intermittent resources are related to congestion issues in the transmission and distribution system as well as the mismatch between wind availability and prevailing demand. Often, local networks are constrained, with renewable energy being forced to be curtailed. An immediate solution to wind integration challenges is to control the ramp rate of wind output. The project objective is to demonstrate and optimize methods of applying UltraBattery storage to constrain the 5-minute ramp rate of renewable output from the Hampton Wind Farm before presenting it to the grid. The impact objective is to achieve higher penetration of wind and renewable energy in grid systems.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The project delivered the practical control of the ramp rate of the wind farm to limit it to 10% of what it otherwise would be and focussed on how to do this with the minimum amount of energy storage	Low
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Similar approaches are now being formally adopted in Puerto Rico. Any new renewable facility needs to limit ramp rate and provide regulation services to the grid.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The use of the combination of ramp rate control and frequency regulation support is being considered in many international networks now. The extension is where this technique is applied to micro-grids and island grids to improve diesel efficiency	Low
	9. Strengthen the network to manage higher renewable energy penetration	Provided renewables are distributed across the grid a percentage of variability cancels itself out but if the ramp rate at the site of renewable generation is controlled this effect is significantly increased. Adding a contribution to frequency regulation such as in the Puerto Rico regulations again continues this strengthening.	Low
	10. Smooth out intermittent generation output	The wind output is controlled to 10% of its original rate utilizing a relatively small amount of storage	Med
	14. Improve techniques for forecasting renewable energy output	Working with CSIRO we are combining forecasting with preparation of for example of the state of charge of the energy storage asset to best support predicted needs.	Low

Approaches	Approach	Comments
	Storage, Grid-Connected	Ecoult provided and integrated a MW scale smoothing system using UltraBattery® technology. CSIRO subcontracted to Ecoult to provide sophisticated algorithms to achieve the smoothing objectives
Results	**Result**	**Comments**
	Storage can help control the ramp rate in a system with high renewable penetration	Ecoult has been able to demonstrate the ability to limit the 5-minute ramp rate to 1/10 of the raw output while applying storage with a usable capacity (in kWh) 1/10 the rated output of the farm (in kW).

Hervey Bay Hospital Solar

Project ID	352
Organisation	Queensland Health
Organisation Type	Government
Partners	
Story	Queensland Government sought to demonstrate the benefits and costs of solar PV within the commercial and industrial sectors with its Hervey Bay solar projects. The Hervey Bay hospital is one of the first hospitals in Australia to operate a large renewable energy generation facility on its rooftop. The project designed, supplied and installed a 265 kilowatt roof-mounted solar panel system for Hervey Bay Hospital. The local utility (Ergon Energy) was consulted during the design phase so the installation would meet their safety and grid protection requirements. The project met these by implementing a single point of isolation which makes it possible for the hospital to isolate the solar system in an emergency, either from the building management system or from a push-button station located in the main electrical room. The project is an on-going demonstration of the benefits of solar PV at the commercial scale. All electricity generated by the solar PV is used by the hospital internally, hence saving on electricity costs.
Start Date	2009
End Date	2012
Customer Segment	
Customers Involved	1
Cost	AUD 1.3 M
Funding Source	State Government
Network	Ergon Energy
Connection Point	Customer Connections
Location	Hervey Bay
State	QLD
Country	Australia
Future Plans	
Contact Name	Tim Quirey
Contact Email	tim.quirey@dews.qld.gov.au
Contact Phone	
Contact Link	http://www.abbaustralia.com.au/cawp/seitp202/0e4bca3d5795a9f948257b260029b477.aspx
Background	In 2009 distributed PV was still largely an emerging technology solution, particularly as an option for the commercial and industrial sectors. Government sought to demonstrate the benefits and costs of solar PV within this sector with its Hervey Bay solar projects. Learnings from the installations were also to be made available to support business in installing PV as a cost reduction measure.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The project aimed to understand and share commercial scale solar PV installation costs with the private sector to encourage uptake.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The Hervey Bay hospital is one of the first hospitals in Australia to operate a large renewable energy generation facility on its rooftop. This business model can be replicated by other entities across Australia. The hospital uses all the energy it generates from the solar panel, hence saving on electricity costs.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources	The Hervey Bay solar projects received extensive publicity showcasing the benefits of PV at a commercial scale.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Working with the Distributor from the concept phase helps to reduce timeframes and costs by ensuring necessary technical and grid protection measures are in place, with the solutions proposed satisfactory to both parties.	Med
Approaches	**Approach**	**Comments**	
	Distributed Energy Solutions	The project designed, supplied and installed a 265 kilowatt roof-mounted solar panel system for Hervey Bay Hospital. The local utility (Ergon Energy) was consulted during the design phase so the installation would meet their safety and grid protection requirements. The project met these by implementing a single point of isolation which makes it possible for the hospital to isolate the solar system in an emergency, either from the building management system or from a push-button station located in the main electrical room.	
Results	**Result**	**Comments**	
	Distributed energy solutions reduce energy consumed from the network	The project is an on-going demonstration of the benefits of solar PV at the commercial scale. All electricity generated by the solar PV is used by the hospital internally, hence saving on electricity costs.	

Other	One of the main results of this project was the learnings from working with the distributor on the connection process. By working together an economical solution was determined.

High Penetration Photovoltaic Case Study Report

Project ID	230
Organisation	National Renewable Energy Laboratory
Organisation Type	Government
Partners	Xcel Energy, Sun Edison, Colorado State University, Public Service of Colorado, Kapa'a Solar LLC, Kaua'i Island Cooperative, REC Solar Inc., Southern California
Story	The report examines the technical problems arising from four large solar generation facilities, three of which provided electricity for public service and one primarily for a dedicated customer, a university. The capacities of the projects ranged from 1.2-10MW. The projects required different technical solutions ranging from adding re-closers; controlling a small island system; modifying capacitor bank controller settings; planning a range of mitigation measures (voltage regulators, configure inverters, install an additional power factor controller) if high voltages became a problem. In the event the results of the studies were successful in that the PV was incorporated with no problems.
Start Date	2011
End Date	2013
Customer Segment	
Customers Involved	
Cost	
Funding Source	
Network	Xcel Energy, Kaua'i Island Cooperative, Southern California Edison
Connection Point	Distribution Feeders, Subtransmission Feeders
Location	Carlsbad, Fort Collins, Kaua'i, Fontana
State	New Mexico, Colorado, Hawel, California
Country	United States
Future Plans	
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Background	The report examines the technical problems arising from four large solar generation facilities, three of which provided electricity for public service and one primarily for a dedicated customer, a university. The four facilities were:- - 10 MW DC plant near Carlsbad, New Mexico - 5.2MW AC plant at Colorado State University Foothills Campus, Fort Collins, Colorado - Kapa's 1.2MW DC solar project, Dlohena Road, Kawa'i, Hawaii - 2MW plant on a warehouse rooftop in Fontana, California

Areas of Relevance	Area	Comments	Relevance
	9. Strengthen the network to manage higher renewable energy penetration	The projects included are intended to demonstrate success stories with integration of large PV plants at the distribution level as well as some of the solutions used by the utility to ensure safe, reliable operation of both the PV system and the distribution network. The project is a technical study, focusing on the integration of large PV plants to the distribution level network.	Med

Approaches	Approach	Comments
	Distribution system upgrades	For the Carlsbad plant, in anticipation of the new PV system, two reclosers were added to the distribution feeder. The utility also installed 0.75 miles of 336ACSR conductor to provide a primary distribution feeder from the substation out to the PV system.
	Changing System / Protection Settings	For the Kapa's project, one of KIUC's primary concerns is with the IEEE Std 1547 over-frequency set point of 60.5 Hz. As a small island system with a peak load of 70 MW, when system faults are cleared by the substation circuit breakers under load, frequency regularly exceeds 60.5 Hz. When faults occur during daylight hours, large PV systems as well as the aggregate of smaller residential systems will trip off-line.
	Distribution system upgrades	For the SCE's plant in Fontana, no major distribution circuit upgrades were made during the interconnection process of the Fontana PV system. Although unconfirmed, it is likely that the capacitor bank controller settings were modified in order to mitigate some of the effects of variable generation caused by the interconnected PV plant. The capacitor time delay settings, after capacitor operation, were likely reduced from a standard setting of 2 minutes to 30 seconds
	Distributed Energy Solutions	For the Colorado State University project, Xcel Energy's primary concern with the installation of this PV system is maintaining voltage levels within ANSI C84.1 (range A). The PV system was built in two phases. After completion of Phase I, a 2 MW installation, there were no measured voltage or power quality aberrations. Phase II added 3.2 MW of additional PV, and the voltage and power quality parameters remained within acceptable levels.
	Distribution system upgrades	For the Colorado State University project, Xcel Energy is primarily concerned about system voltage fluctuations on any large PV installation, including flicker and high or low voltage levels and excessive regulator and load tap changer (LTC) operations. Tools to address voltage aberrations include:- - LTC at substation transformer for voltage regulation - Capacitor bank (with remote controllability) - Inverters having power factor control capability

Results	Result	Comments
	PV voltage problems can be resolved	One of the potential problems identified by these impact studies was that high voltages may occur during periods of light feeder loads and high PV system production. If high voltage becomes a problem, Xcel Energy has planned a four-step mitigation approach which progresses through mitigation options until the problem is rectified. 1. Adjust the voltage regulators to stabilize the voltage levels. 2. The inverters (10 total) will be configured to absorb 100 kVAr each. 3. The inverter configurations will be changed so they will absorb 150 kVAr each. 4. Xcel Energy will notify the system operator to disconnect all or part of the PV system and install an additional power factor controller or dynamic VAR compensator.
	PV installation did not cause significant effects on the network	The Carlsbad plant's results from this system and other 10W-scale PV plants in west Texas and New Mexico have helped to guide Xcel Energy in performing impact studies and approval of interconnection requests.
	PV installation did not cause significant effects on the network	The installation of the PV on the Colorada State University plant's circuit has not had any significant effects on the day-to-day operation of this system. All power quality issues including flicker, harmonics, sags, and swells have been within acceptable ranges and, for the most part, unnoticeable.
	PV installation did not cause significant effects on the network	The initial results of the Kapa's project looks very positive. According to KIUC, the monitored results on the distribution feeder on sunny days and cloudy days, with the PV system turned on and the PV system turned off, are showing very little difference in the voltage levels, harmonics, and overall power quality between the different scenarios.
	PV installation did not cause significant effects on the network	SCE engineers investigated to see if the PV system resulted in reverse power flow conditions at the substation. Data, collected via the utility SCADA system, was collected and confirmed that no reverse power flow conditions were present at the substation.

PV voltage problems can be resolved	As part of the SCE High-Penetration PV Integration Project, the circuit has been instrumented with high speed voltage and current sensing data acquisition devices. This data will be used to quantify the impact of the installed PV systems on the circuit. Based on the impacts found the installed PV inverters will be modified to enable some form of advanced inverter control (volt/VAR control, curtailment, etc.) in order to reduce the impacts of PV system interconnection on the distribution circuit.

High performance thermal energy storage systems with high temperature phase change material

Project ID	267
Organisation	University of South Australia
Organisation Type	Research
Partners	
Story	Thermal energy storage technology allows improved dispatch-ability of power output from the concentrated solar power plant and increases the plant's annual capacity factor. However, until now, there is no available cost-effective compact storage technology. Most existing thermal energy storage systems currently use sensible heat storage in molten salts or oil. It requires expensive, unwieldy tanks and large volumes of storage materials. In this project, phase change materials (PCMs) are proposed to be utilised to store energy. This project aims to develop a phase change thermal storage system with superior heat transfer characteristics. A high performing thermal storage system will reduce the cost of the storage system and thus reduce the levelised cost of energy. It is estimated that by using a phase change storage system in a concentrated solar thermal power plant, the cost of thermal storage will be reduced by over 30% and the cost of electricity will be decreased by 5-8%.
Start Date	01-01-2010
End Date	31-12-2014
Customer Segment	
Customers Involved	
Cost	AUD 278,136
Funding Source	Federal Government
Network	
Connection Point	
Location	
State	
Country	Australia
Future Plans	The project is continuing in ASTRI projects.
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Background	Thermal energy storage technology allows improved dispatch-ability of power output from the concentrated solar power plant and increases the plant's annual capacity factor. However, until now, there is no available cost-effective compact storage technology. Most existing thermal energy storage systems currently use sensible heat storage in molten salts or oil. It requires expensive, unwieldy tanks and large volumes of storage materials. In this project, phase change materials (PCMs) are proposed to be utilized to store energy. Compared to sensible heat storage, PCMs allow large amounts of energy to be stored in relatively small volumes, resulting in some of the lowest storage media costs of any storage concepts. Several heat transfer enhancement technologies will be investigated in this project to increase the charging and discharging rates of the phase change thermal storage unit.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	This project aims to develop a phase change thermal storage system with superior heat transfer characteristics. A high performing thermal storage system will reduce the cost of the storage system and thus reduce the levelised cost of energy. It is estimated that by using a phase change storage system in a concentrated solar thermal power plant, the cost of thermal storage will be reduced by over 30% and the cost of electricity will be decreased by 5-8%.	Med
	10. Smooth out intermittent generation output	Thermal energy storage technology allows improved dispatch-ability of the concentrated solar power plant and increases the plant's annual capacity factor.	Med

Approaches	Approach	Comments
	Improve storage design	A few candidate PCMs with appropriate operating temperature range were selected and tested for their melting/freezing temperatures, latent energy, reliability and other thermo-physical properties. The heat transfer in five shell-and-tube heat exchangers was modelled using a computational fluid dynamics software (ANSYS). A design has been selected and a laboratory-scale prototype phase change thermal storage system is being constructed. The prototype system will be tested in the laboratory at the University of South Australia. The results from this work and other work will be used to develop guidelines and a methodology for designing high temperature phase change thermal storage systems.

Results	Result	Comments
	No results yet	Based on the experimental and modelling work, a stable candidate PCM was chosen for further testing and a shell-and-tube heat exchanger (without fins) was selected for prototype development. The project is still on-going.

Hybrid concentrating solar thermal systems for large scale applications

Project ID	264
Organisation	CSIRO
Organisation Type	Government, Research
Partners	Stockland Group, NEP solar
Story	In commercial buildings, cooling related electricity consumption is about 40 – 50%. The aim of the project is to demonstrate a high efficiency cooling system that can reduce grid electricity consumption using solar heat or waste heat available at the site. Demonstration of this system in a commercial rooftop will help quantify benefits of such systems in reducing carbon emissions and electricity usage. To achieve these objectives, the project uses an innovative (patent pending) desiccant based cooling system that can deliver higher cooling output for a given heat input. This is achieved by using heat that would otherwise be rejected to atmosphere in a conventional system. The main energy source for driving the cooling system is provided by rooftop solar collectors. These generate high temperature heat during the heat of the day when high levels of cooling are required. The system can also be hybridised with other sources of heat.The project is still underway and has already provided very useful insights about having a rooftop solar energy generation system.
Start Date	01-07-2012
End Date	01-09-2015
Customer Segment	
Customers Involved	
Cost	AUD 1,070,582
Funding Source	Commercial Partner, Federal Government
Network	None
Connection Point	
Location	Stockland Shopping Mall, Wendouree
State	VIC
Country	Australia
Future Plans	Many commercial sites could benefit from high efficiency solar air conditioning technology capable of also supplying domestic hot water. Before the project closure period, options for applying this technology to other sites and sectors will be explored.
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Contact Phone	02 49 606000
Contact Link	http://arena.gov.au/project/hybrid-concentrating-solar-thermal-systems-for-
Background	In commercial buildings, cooling related electricity consumption is about 40 – 50%.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	The aim of the project is to demonstrate a high efficiency cooling system that can reduce grid electricity consumption using solar heat or waste heat available at the site. Demonstration of this system in a commercial rooftop will help quantify benefits of such systems in reducing carbon emissions and electricity usage. This demonstration will also help accelerate implementation of such systems in other commercial rooftops. The benefits of this project will be known by June 2015.	High
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	The project has already provided very useful insights about having a rooftop solar energy generation system for Stockland group. In addition to cooling, the heat generated by the solar collectors will be used for space heating and domestic hot water, thus providing all year benefit to the customer.	High
	12. Use distributed energy solutions to address network and system constraints	The project uses rooftop solar energy to reduce the grid electricity consumption thus reducing the dependence on grid during peak periods.	Med
	Other	The project also demonstrates a high efficiency cooling generation system using heat as input energy.	

Approaches	Approach	Comments
	Improve Generation Plant Design	The project uses an innovative (patent pending) desiccant based cooling system that can deliver higher cooling output for a given heat input. This is achieved by using heat that would otherwise be rejected to atmosphere in a conventional system.
	Distributed Energy Solutions	The main energy source for driving the cooling system is provided by rooftop solar collectors. These generate high temperature heat during the heat of the day when high levels of cooling are required. The system can also be hybridised with other sources of heat.

Results	Result	Comments
	No results yet	The project is progressing according to agreed timelines and the solar collectors have been installed at the site for heat generation. The heat generated by the collectors will be used for space heating purposes during this winter thus providing cost savings for the customer. The novel cooling generation system is currently under design and will be commissioned at the site during the summer of 2015.

Hybrid PV / Diesel at Marble Bar and Nullagine

Project ID	330
Organisation	Horizon. Power
Organisation Type	Network
Partners	
Story	Details of this project available on request.
Start Date	
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	

Network	Horizon Power
Connection Point	
Location	
State	WA
Country	Australia
Future Plans	
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Contact Link	
Background	

Areas of Relevance	Area	Comments	Relevance

Approaches	Approach	Comments

IGREENGrid PRICE Project

Project ID	222
Organisation	Iberdrola and Gas Natural Fenosa
Organisation Type	Network, Retailer
Partners	Total 21 partners, including suppliers of industrial and information technology, research centers and universities, as well as Red Eléctrica Española (REE), the TSO (Transmission System Operator) of the Spanish electricity system.
Story	GREENGrid (IntegratinG Renewables in the EuropEaN Electricity Grid) project is a collaborative project co-founded by the European Commission in the Energy area. IGREENGrid project focuses on increasing the hosting capacity for Distributed Renewable Energy Sources (DRES) in power distribution grids without compromising the reliability or jeopardizing the quality of supply. The core of IGREENGrid is to promote the best practices identifying potential solutions for the effective integration of DRES in the different Demo Projects in LV and MV grids participating to the project and validating them via simulation in other environments to assess the scalability and reliability at EU level.
Start Date	01-01-2013
End Date	31-12-2015
Customer Segment	Industrial, Residential, SME
Customers Involved	300,000 customers
Cost	Total EUR 6.6 M (excluding meters cost) (AUD 9.65 M)
Funding Source	Federal Government
Network	6 Different European Demo Projects. Deployed each one of them in different
Connection Point	Customer Connections, Distribution Feeders, Subtransmission Feeders
Location	
State	
Country	Spain, France, Austria, Germany, Italy and Greece.
Future Plans	The project is on-going
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Contact Link	
Background	The European Union (EU) has established very ambitious objectives for 2020: 20% of consumption from renewable energy generation, 20% of CO2 emissions reduction and an increase of 20% in energy efficiency. A key issue to achieve these targets is to have an effective integration of the distributed renewable generation, particularly Solar Photovoltaic (PV), Wind, Biomass and Small Hydro power, into our current and future electricity distribution grids: not only new and innovative technical solutions are required, but also new suitable regulatory and economic schemes at European scale IGREENGrid (IntegratinG Renewables in the EuropEaN Electricity Grid) project is a collaborative project co-founded by the European Commission under the 7th Framework Programme in the Energy area. IGREENGrid project focuses on increasing the hosting capacity for Distributed Renewable Energy Sources (DRES) in power distribution grids without compromising the reliability or jeopardizing the quality of supply. The core of IGREENGrid is to promote the best practices identifying potential solutions for the effective integration of DRES in the different Demo Projects in LV and MV grids participating to the project and validating them via simulation in other environments to assess the scalability and reliability at EU level.

Areas of Relevance	Area	Comments	Relevance
	12. Use distributed energy solutions to address network and system constraints	The project evaluates different methods to involve the Distributed Energy Sources in the ancillary service. The project fits the objective quite well by developing different technical solutions, just to utilize distributed renewable energy resources to management and reduce network constraints.	Med
	14. Improve techniques for forecasting renewable energy output	The project conducts research of methods to integrate the forecasting techniques in network operation. Forecasting is an important element to manage the increasing sources of renewable generation and supply effectively.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The project aims to create new services to integrate demand, a new business model for energy market in Europe. Therefore, for any new business model developed out of the project, it is important to take Australian context into consideration before the adoption.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources	Develop Distributed Generation Control Centre to strengthen the network control over Distributed Energy Resources. The technological feasibility of this renewable integration and management approach need to be evaluated with the current state of Australian network infrastructure.	Med
	9. Strengthen the network to manage higher renewable energy penetration	IGREENGrid project focuses on increasing the hosting capacity for Distributed Renewable Energy Sources (DRES) in power distribution grids without compromising the reliability or jeopardizing the quality of supply. The project monitors and controls the MV and LV network to improve its performance on renewable integration. The technological feasibility of this renewable integration and management approach needs to be evaluated with the current state of Australian network infrastructure.	Med

Approaches	Approach	Comments
	Case Study	IGREENGrid Project follows a rational process in which first of all, the problems are identified (barriers for DRES integration) and the assessment methodology is defined(1) (Project team also synchronize IGREENGrid tasks with Demo Project activities). Then, with the data features clarified, the information from the Demo Project outputs is collected and prepared for the analysis (2). At that point, based on selected KPIs a comparative evaluation (3) among Demo Project results is carried out to identify the most promising solutions. Next step is the development of necessary tests (4) in order to consider the potential scalability and replicability of the suggested solution in the previous step. Finally, according to Project results and outputs, a set of recommendation (5) will be produced in order to enable the future massive integration of RES in distribution grids.

Results	Result	Comments
	Other	In order to achieve the project objectives the following topics will be addressed: 1. Establishing a family of relevant solutions focused on the effective integration of variable distributed generation in power distribution grids (DRES), identifying most promising solutions to scale and replicate them at European level. 2. IGREENGrid will establish an economic and technical evaluation framework and assessment methodology for the evaluation of different projects. 3. Evaluating and classifying the developed solutions for the effective integration of DRES in the European distribution networks in accordance with their technical and economic performance and characteristics. 5. Identifying most promising solutions and learnt lessons of DRES that could be replicated at European scale to be tested in different scenarios.

6. A simulation & evaluation framework will be designed and developed: this environment will be developed to simulate most promising solution under different conditions. Scalability and reliability of the solutions will be evaluated in this environment.

7. Sharing the knowledge about the different solutions to let adapt specific and successful technical solutions to other EU regions facing similar problems.

8. Producing guidelines for the future massive integration of DRES in distribution grids.

Impact of Increasing Harmonic Levels on Distribution System Equipment

Project ID	259
Organisation	University of New South Wales
Organisation Type	Research
Partners	ASTP
Story	Renewable energy systems such as wind turbines and photovoltaic systems use power electronic inverters and these will generate harmonics so that there is a potential for increased electrical losses in items such as transformers used with renewable energy systems. The aim of this project was to investigate the impact of harmonics on losses in distribution transformers. The project attempted to determine the impact on electrical losses by performing laboratory tests on transformers with harmonic contaminated voltage and current excitation; and performing open circuit and short circuit tests. It also investigated and developed high frequency current transformers for help in monitoring harmonic losses better. This project determined that harmonics are a significant source of increased losses when power electronic control devices are used without adequate filtering. The results apply to both renewable energy systems and also to existing distribution networks which supply loads that are non-linear (such as power electronic controllers). The monitoring of increased losses due to harmonics is important for determining useful life and effective loading of distribution transformers. This will require installation of improved monitoring means by using higher frequency-response current transformers.
Start Date	2012
End Date	2013
Customer Segment	
Customers Involved	
Cost	AUD 53,000
Funding Source	Regulator-Approved Spend
Network	None
Connection Point	Customer Connections, Distribution Feeders, Zone Substations
Location	Sydney
State	NSW
Country	Australia
Future Plans	The author currently has a research project that is continuing on this work, primarily in the monitoring improvement area.
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Contact Link	
Background	The development of power electronic control systems generates significant levels of harmonics in power systems and these harmonics will increase losses in many electrical components. The aim of this project was to investigate the impact of harmonics on losses in distribution transformers.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	Renewable energy systems such as wind turbines and photovoltaic systems use power electronic inverters and these will generate harmonics so that there is a potential for increased electrical losses in items such as transformers used with renewable energy systems.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Filtering of harmonics can reduce their impact on losses and improve costs for networks.	Low
	8. Establish control over, or otherwise influence, intermittent generation sources	The project aimed to improve the overall generation efficiency of renewable sources by applying appropriate filtering.	Low
	9. Strengthen the network to manage higher renewable energy penetration	The project aimed to investigate means of monitoring harmonics and their cost. It also looked at the cost/benefit of filtering of harmonics. The project also investigated and developed high frequency current transformers for help in monitoring harmonic losses better.	Med

Approaches	Approach	Comments
	Improve transformer design	The project attempted to determine the impact on electrical losses by performing laboratory tests on transformers with harmonic contaminated voltage and current excitation and performing open circuit and short circuit tests. It also investigated and developed high frequency current transformers for help in monitoring harmonic losses better.

Results	Result	Comments
	Harmonics are a significant source of increased losses	The project did determine that harmonics are a significant source of increased losses when power electronic control devices are used without adequate filtering, which is the most common situation. The results apply to both renewable energy systems and also to existing distribution networks which supply loads that are non-linear (such as power electronic

Impacts of PV, AC, and Other Technologies and Tariffs on Consumer Costs

Project ID	113
Organisation	Australian PV Institute (APVI)
Organisation Type	Research
Partners	
Story	The uptake of new technologies such as air conditioners, solar water heater, photovoltaic and energy efficiency measures can both increase or decrease electricity use as well as demand peaks. These counteracting effects may not only change electricity costs for the households that use them, but also the costs of other households. This project aims to help identify and quantify the real impacts of the uptake of these new technologies. The impacts of the various tariffs that may be used to help households reduce their demand peaks and so reduce costs imposed on other customers were also analysed. This project developed a model that can assess the impacts of a range of technologies that can increase or decrease electricity bills for both the customer responsible for installing that technology, and on other customers indirectly affected. Key results from this project are as follows: 1) Under a Time Of Use (TOU) tariff, DNSPs receive 23% less income than they would under a Standard tariff. 2) Under revenue cap regulation, placing a responsible customer that has air conditioning on a demand charge results in the lowest costs for other customers, whereas a Time Of Use (TOU) tariff results in the highest costs. 3) PV reduces the impact of AC on other customers by about 10% if the responsible customer is on a demand charge tariff, under both Weighted Average Price Cap (WAPC) and revenue cap regulation.
Start Date	
End Date	01-11-2013
Customer Segment	Residential
Customers Involved	
Cost	
Funding Source	Discretionary Spend Consumer Advocacy Panel
Network	None
Connection Point	None
Location	
State	
Country	Australia
Future Plans	
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Background	In recent years, residential electricity prices across Australia have increased and electricity usage has decreased. The uptake of new technologies such as air conditioners, solar water heater, photovoltaic and energy efficiency measures can both increase or decrease electricity use as well as demand peaks. These counteracting effects may not only change electricity costs for the households that use them, but also the costs of other households.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	This project aims to help identify and quantify the real impacts of the uptake of technologies such as air conditioners, photovoltaic, solar hot water heaters and energy efficiency.	Med
	2. Support the transition to an alternative electricity pricing approach	The project aims to understand the impacts of the various tariffs that may be used to help households reduce their demand peaks and so reduce costs imposed on other customers. Thus, it provides information that should be useful to consumers, utilities and policy-makers, so that tariffs and regulatory frameworks can be designed to optimise outcomes for consumers, utilities and society generally.	Med
	4. Inform the regulatory environment for renewable energy	The project provides information that should be useful to consumers, utilities and policy-makers, so that tariffs and regulatory frameworks can be designed to optimise outcomes for consumers, utilities and society generally.	Med

Approaches	Approach	Comments
	Market Modelling	A model was developed that can be used to assess the combined impact of two effects: Firstly, if a customer is on a kWh-based tariff and uses less electricity because of the new technology, they will make smaller payments to the electricity networks, and this may increase the bills for other customers; Secondly, if a customer significantly increases their electricity use at a particular time of day, this can increase the demand peak, and so the networks may need to be augmented to meet that demand, and again, this can increase the bills of other customers. These effects were modelled for a range of technologies – both on the customer responsible for installing that technology, and on other customers. This provides a useful way of assessing possible new tariff structures. The impact of customers taking up particular types of tariffs is also assessed, because this can affect the income received by networks and so may affect the bills paid by other customers. In addition to quantifying these impacts for customers, we separately quantify them for transmission network service providers (TNSPs), distribution network service providers (DNSPs) and retailers.

Results	Result	Comments
	Time of Use tariff can be less profitable than standard tariff for DNSPs	Under a Time Of Use (TOU) tariff, DNSPs receive 23% less income than they would under a Standard tariff.
	Demand charges improve customer equity	Under revenue cap regulation, placing a responsible customer that has air conditioning on a demand charge results in the lowest costs for other customers, whereas a Time Of Use (TOU) tariff results in the highest costs.
	PV can reduce the impact of installing air conditioners (AC)	PV reduces the cost burden of AC on other users of the network by about 10% if the responsible customer is on a demand charge tariff, under both Weighted Average Price Cap (WAPC) and revenue cap regulation.

Improving accessibility of the System Advisor Model (SAM) for Australian concentrating solar power users

Project ID	124
Organisation	Australian Solar Thermal Energy Association (AUSTELA)
Organisation Type	Association
Partners	
Story	Predicting the output of a CSP system is a complex process. Thermal systems include multiple subsystems whose behaviour at any point in time depends not only on the instantaneous conditions the whole system experiences, but also the recent history of its operation. There are a range of approaches to modelling CSP systems and it is an on-going area of R&D. One of the most respected is the free to use System Advisor Model (SAM) developed by the National Renewable Energy Laboratory (NREL) in the USA. The SAM model is general purpose in nature and can predict hourly, monthly and annual output of CSP, CPV, flat plate PV and also a range of other renewable energy systems. There has been an extensive body of work around its application to CSP systems in particular. This project aimed to improve the accessibility of the System Advisor Model (SAM) for Australian concentrating solar power users, which will help them predict hourly, monthly and annual output of CSP, CPV, flat plate PV and also a range of other renewable energy systems. This project has produced three resources for public use: 1) The "Australian Companion Guide to SAM for Concentrating Solar Power" Guide. 2) A collection of SAM project files with financial settings for Australian Conditions for modelling of trough, tower, linear Fresnel and dish based CSP systems. 3) A selection of solar data files for input to SAM for selected representative Australian sites and years.
Start Date	01-09-2012
End Date	01-03-2013
Customer Segment	
Customers Involved	
Cost	AUD 73,500
Funding Source	ARENA
Network	
Connection Point	
Location	Canberra and Sydney
State	ACT, NSW
Country	Australia
Future Plans	
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Background	Predicting the output of a CSP system is a complex process. Thermal systems include multiple subsystems whose behaviour at any point in time depends not only on the instantaneous conditions the whole system experiences, but also the recent history of its operation. There is a range of approaches to modelling CSP systems and it is an on-going area of R&D. One of the most respected is the free to use System Advisor Model (SAM) developed by the National Renewable Energy Laboratory (NREL) in the USA. The SAM model is general purpose in nature and can predict hourly, monthly and annual output of CSP, CPV, flat plate PV and also a range of other renewable energy systems. There has been an extensive body of work around its application to CSP systems in particular.

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Areas of Relevance	Area	Comments	Relevance
	14. Improve techniques for forecasting renewable energy output	This project aimed to improve the accessibility of the System Advisor Model (SAM) for Australian concentrating solar power users, which will help them predict hourly, monthly and annual output of CSP, CPV, flat plate PV and also a range of other renewable energy systems.	Med

Approaches	Approach	Comments
	Electrical System Modelling	This project has produced three resources for public use: The "Australian Companion Guide to SAM for Concentrating Solar Power" Guide. A collection of SAM project files with financial settings for Australian Conditions for modelling of trough, tower, linear Fresnel and dish based CSP systems. A selection of solar data files for input to SAM for selected representative Australian sites and years.

Results	Result	Comments
	Produced information resources	This project has produced three resources for public use: 1) The "Australian Companion Guide to SAM for Concentrating Solar Power" Guide. 2) A collection of SAM project files with financial settings for Australian Conditions for modelling of trough, tower, linear Fresnel and dish based CSP systems. 3) A selection of solar data files for input to SAM for selected representative Australian sites and years.

Improving China's Existing Renewable Energy Legal Framework: Lessons from the International and Domestic Experience

Project ID	275
Organisation	Natural Resources Defense Council
Organisation Type	Research
Partners	
Story	Expanding the share of renewable energy in its energy mix is one of the key pillars of China's low-carbon development strategy. China's rapid growth in renewable energy, particularly wind, has been accompanied by some growing pains, and there is room for improving the legal framework to address these challenges. This project identified the need for better network information and stronger planning from regulators and policy makers. This report emphasises the future looking role of regulators to keep up with the changes occurring in the industry. It also provides recommendation of the standards and information to be provided to the network for distributed generation connections. Highlighting the need for available and standardised information to promote a smooth transition to the up-take of distributed generation.
Start Date	2010
End Date	2010
Customer Segment	SME
Customers Involved	
Cost	
Funding Source	Federal Government
Network	
Connection Point	
Location	
State	
Country	China
Future Plans	
Contact Name	Natural Resources Defense Council
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Background	Expanding the share of renewable energy in its energy mix is one of the key pillars of China's low-carbon development strategy. China's rapid growth in renewable energy, particularly wind, has been accompanied by some growing pains, and there is room for improving the legal framework to address these challenges.

Areas of Relevance	Area	Comments	Relevance
	4. Inform the regulatory environment for renewable energy.	The project identifies the need for better network information and stronger planning from regulators and policy makers. This report emphasises the future looking role of regulators to keep up with the changes occurring in the industry.	Low
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The project provides recommendation of the standards and information to be provided to the network for distributed generation connections. Highlighting the need for available and standardised information to promote a smooth transition to the up-take of distributed generation.	Low
Approaches	**Approach**	**Comments**	
	Policy advocacy	This study focused on: - Section I explains the key mechanisms for renewable energy development established under the 2005 Renewable Energy Law, including setting a national renewable energy target, the mandatory connection and purchase policy, the establishment of a national feed-in tariff system, and arrangements for cost-sharing and funding of renewable energy. - Section II details some of the major issues that arose after the Renewable Energy Law went into effect, which continue to pose challenges to expanding renewable energy in China. - Section III details the changes to the legal framework brought about by the December 2009 amendments to China's Renewable Energy Law, including changes to the mandatory connection and purchase policy, streamlining of the renewable energy fund, and increased central government oversight of renewables planning. - Finally, Section IV provides recommendations for effective implementation of the amended Renewable Energy Law, based on Chinese and international experiences, which may be helpful as China develops future implementing regulations.	

Results	Result	Comments
	Policy recommendations	The project provided recommendations on making the renewable power quota system more effective, formulating an effective priority dispatch policy, setting appropriate technical standards for connection of renewable resources with the grid, improving operation of the renewable energy development fund, and promoting provincial and local planning and experimentation for renewable energy.

Improving translation models for predicting the energy yield of photovoltaic power systems

Project ID	261
Organisation	CSIRO
Organisation Type	Research
Partners	US DoE National Renewable Energy laboratory (NREL); CAT Projects; Lend Lease
Story	Predicting the energy output of a PV power plants is critical to forecasting future revenue. To reduce the investment risk for large-scale PV power plants, CSIRO and its partners are investigating the relationship between the manufacturer's power rating for solar panels and the energy the panels generate over time. This involves studying the way solar PV cells respond to typical variations in solar conditions, such as temperature, irradiance and the solar spectrum. A large part of the project is the construction of a major PV research facility at the CSIRO Energy Centre in Newcastle. The project then conducts a series of work packages that seek to address present shortcomings in the collective understanding of certain aspects of PV energy yield modelling. The outcomes of this research will form the basis for more accurate revenue projections to industry and finance institutions, to encourage investment and widespread deployment of large-scale PV power stations. The results of the project will also contribute to the development of Australian and international standards for predicting the performance of solar PV power systems.
Start Date	17-09-2012
End Date	25-02-2015
Customer Segment	
Customers Involved	
Cost	AUD 2.6M
Funding Source	Federal Government
Network	
Connection Point	
Location	
State	
Country	Australia
Future Plans	
Contact Name	Dr Christopher Fell
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Contact Phone	02 4960 6032
Contact Link	
Background	A major obstacle to the implementation of large-scale photovoltaic (PV) power plants is that the cost of these systems is almost entirely up-front, with the financial returns spread over the life of the system, which is around 25 years. The manufacturer's power rating for a solar panel comes from measurements in a laboratory, and says little about the energy the panel will deliver over time in the field. Predicting the energy output of a PV power plant is critical to forecasting future revenue. To reduce the investment risk for large-scale PV power plants, CSIRO and its partners are investigating the relationship between the manufacturer's power rating for solar panels and the energy the panels generate over time. This involves studying the way solar PV cells respond to typical variations in solar conditions, such as temperature, irradiance and the solar spectrum. The outcomes of this research will form the basis for more accurate revenue projections to industry and finance institutions, to encourage investment and widespread deployment of large-scale PV power stations. The results of the project will also contribute to the development of Australian and international standards for predicting the performance of solar PV power systems.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	Understanding PV energy yield and its dependence on climate and solar conditions contributes to an understanding of the overall benefits of PV as an energy source.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	It is anticipated that improved standards and energy prediction models will contribute to de-risking the cost of large-scale PV, hence reducing regulatory hurdles (hence costs) as well as finance costs.	Med
	14. Improve techniques for forecasting renewable energy output	Energy yield models are critical for PV output forecasting.	Med

Approaches	Approach	Comments
	Demonstration Project	A large part of the project is the construction of a major PV research facility at the CSIRO Energy Centre in Newcastle.
	Weather Forecasting	The project then conducts a series of work packages that seek to address present shortcomings in the collective understanding of certain aspects of PV energy yield modelling. A draft list of these work packages includes: (i) characterising the Australian solar climate and its influence on PV energy yield; (ii) understanding the role of the changing solar spectrum on PV output, and finding a cost-effective way to predict this for a given site; (iii) understanding the extent to which this effect flows on into PV system output at large scale, i.e. placing its magnitude into context and perhaps identifying other issues that may be more important, e.g. module degradation, soiling, system-level effects.
	Electrical System Modelling	Comparing the performance of three different models for current-voltage translation, as a pathway toward a future international standard for PV energy yield prediction.

Results	Result	Comments
	No results yet	No results yet, but the project is on track.

Integrated PV in Yungngora

Project ID	335
Organisation	Horizon Power
Organisation Type	Network
Partners	
Story	Details of this project available on request.
Start Date	
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	

Network	Horizon Power
Connection Point	
Location	
State	WA
Country	Australia
Future Plans	
Contact Name	Scott Davis
Contact Email	Scott.Davis@horizonpower.com.au
Contact Phone	0457 784 119
Contact Link	
Background	

Areas of Relevance	Area	Comments	Relevance

Approaches	Approach	Comments

Integrating PV into Asset Management and Capital

Project ID	333
Organisation	Horizon Power
Organisation Type	Network
Partners	
Story	Details of this project available on request.
Start Date	
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	

Network	Horizon Power
Connection Point	
Location	
State	WA
Country	Australia
Future Plans	
Contact Name	Brian Connolly
Contact Email	Brian.Connolly@horizonpower.com.au
Contact Phone	
Contact Link	
Background	

Areas of Relevance	Area	Comments	Relevance

Approaches	Approach	Comments

Integrating Renewable Energy - Wind Integration Studies Report

Project ID	187
Organisation	AEMO
Organisation Type	Network, Other
Partners	None
Story	Integrating 8.88GW of new wind generation will present challenges in operating the power system and the electricity market. These challenges are expected to arise first in South Australia and Tasmania, where forecast levels of wind generation are highest compared to demand. Further challenges are expected to arise from technological innovations, including increased distributed generation such as rooftop PV; and from changing consumer behaviour contributing to a trend of declining electricity consumption from the power system. This project was about assessing NEM transmission level impacts of sufficient wind generation to meet 41TWh LRET target; what operational impacts might occur with around 11.5 GW of wind on the NEM; are AEMO's current operational systems and processes adequate to handle this; what might be the consequences of a BAU approach to integrating this level of wind generation into the NEM. The project Identified areas where AEMO will need to carefully monitor and manage network capability if transmission connected renewables continue to grow. There could be some material curtailment of wind generation required if bulk of new capacity is located in SA, VIC and TAS, due to a range of network limitations in these regions.
Start Date	01-03-2013
End Date	01-09-2013
Customer Segment	Large commercial
Customers Involved	
Cost	N/A
Funding Source	Discretionary Spend
Network	
Connection Point	
Location	NEM
State	NSW, VIC, TAS, QLD, SA
Country	Australia
Future Plans	Looking more closely at some of the issues identified in relation to the South Australian system.
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Contact Phone	03 9609 8781
Contact Link	http://www.aemo.com.au/Electricity/Planning/Integrating-Renewable-Energy
Background	The National Electricity Market (NEM) design incorporates several features which will assist in effectively managing the expected 8.88 GW of new wind generation forecast to connect to the power system by 2020. Nevertheless, integrating this level of new wind generation will present challenges in operating the power system and the electricity market. These challenges are expected to arise first in South Australia and Tasmania, where forecast levels of wind generation are highest compared to demand. Further challenges are expected to arise from technological innovations, including increased distributed generation such as rooftop PV; and from changing consumer behaviour contributing to a trend of declining electricity consumption from the power system.

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Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	Market modelling was used to assess possible impacts on market of high levels of wind generation.	Low
	4. Inform the regulatory environment for renewable energy	The project broadly discusses network and operational issues that might ultimately drive regulatory or market changes. No particular changes or proposals suggested or supported at this time.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Identify to renewable developers possible consequences of concentration of new renewable installation in SA, VIC and TAS.	Low
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	Identify areas where AEMO may need to carefully monitor network and operational capability as renewable generation levels grow.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources	Considers how rising renewables can affect existing central dispatch process.	Low
	9. Strengthen the network to manage higher renewable energy penetration	Assess when network limits could arise with high levels of renewables, and whether network augmentation could address these.	Med
	10. Smooth out intermittent generation output	Assess whether aggregate variability of increased renewables may have implications for AEMO.	Low

Approaches	Approach	Comments
	Market Modelling	Identify possible emerging network and operational impacts for AEMO as renewable generation significantly increases. Use market modelling to try and quantify some of these impacts.
Results	**Result**	**Comments**
	Wind generation had to be curtailed	Identified areas where AEMO will need to carefully monitor and manage network capability if transmission connected renewables continue to grow. Suggests there could be some material curtailment of wind generation required if bulk of new capacity is located in SA, VIC and TAS, due to a range of network limitations in these regions.

Isernia Smart Grid Project

Project ID	167
Organisation	Enel Distribuzione
Organisation Type	Network
Partners	
Story	A high level of wind and PV is causing reverse flow conditions leading to over voltage conditions in the MV feeder. The project includes:- Innovative regulation of MV voltage, modulating reactive and active power injected by each distributed generation unit- New automatic fault selection strategies on MV networks involving users' General Protection device- Monitoring/control of the injections from distributed generators to provide both the TSO with differentiated data about generators and loads and regulation capabilities, and to exchange signals/commands from/to the TSO to improve control transmission network- Advance monitoring providing 8000 customers, who have smart meters, with consumption data on local displays, smart phones and PCs These functions are implemented with new control and protection systems and equipment; a broadband communication network which is always on and allows the primary substation to extend its supervisory and protection system along MV feeders. The project has been successful in achieving its objectives.
Start Date	01-03-2011
End Date	31-12-2014
Customer Segment	Industrial, Large commercial, Residential
Customers Involved	8000
Cost	ADD 8.5 M
Funding Source	Regulator-Approved Spend
Network	Other
Connection Point	
Location	Isernia
State	
Country	Italy
Future Plans	Yes, the infrastructure developed and tested in this project will be extended to other Enel networks according to available funding.
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Contact Link	http://www.autorita.energia.it/it/operatori/smartgrid.htm
Background	The transformer feeding the busbar currently has reverse flow conditions 1.4% of the time, which leads to over voltage conditions in the MV feeder. More PV producers have applied to be connected which will exacerbate the problem. Consequently there is a need to improve control of the network and flexibility.

Areas of Relevance	Area	Comments	Relevance
	4. Inform the regulatory environment for renewable energy	The results of the project will be used by Italian Regulators to introduce innovations into regulation rules to foster smart grid applications. Learnings from these educational changes requires further evaluation from an Australian context.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The main scope of the project is a demonstration in real field of smart grid techniques in order to improve the management of active networks and the hosting capacity of the network with reference to distributed generation.	High
	9. Strengthen the network to manage higher renewable energy penetration	Hosting capacity is increased improving network security (anti-islanding countermeasures, generation shedding, network monitoring, etc.), introducing voltage control and active/reactive power control.	High
	12. Use distributed energy solutions to address network and system constraints	This project aimed to improve the control of the network and flexibility. At every delivery substation and secondary substation remote control and automation has been installed.	High
	14. Improve techniques for forecasting renewable energy output.	A system called "MAGO" has been developed for renewable forecasting to help distribution network operators and to send information to TSO.	High
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	Advance monitoring providing 8000 customers, who have smart meters, with consumption data on local displays, smart phones and PCs. The energy monitoring kit has been distributed to 5000 customers to date, which is a high uptake rate (about 25%). Acceptance (measured by surveys) is very high. There has been an efficiency gain of >4% (after having excluded possible external factors comparing with a control group).	Med
	Other	Measure the impact on energy efficiency of direct feedback. Assess the acceptance of Enel Smart Info and identify the possible enabled services.	

Approaches	Approach	Comments
	Distributed Energy Solutions	At every delivery substation and secondary substation with remote control and automation has been installed:- - One new switch with on load interruption power together with a new generation fault detector system One router with modem for internet protocol connection - One new generation remote terminal unit in a secondary substation. At each distributed generator an Ethernet switch unit is installed with optic fibre termination to implement LAN connection with the delivery substation and:- - A control system for the generator to actuate commands to set active and reactive power to receive production measures, etc. - An IEC 61850 interface for the general protection or replacement of both panels with new protection
	Low Voltage Regulation	Innovative regulation of MV voltage, modulating reactive and active power injected by each distributed generation unit.
	Network Monitoring & Analysis	Monitoring/control of the injections from distributed generators to provide both the TSO with differentiated data about generators and loads and regulation capabilities, and to exchange signals/commands from/to the TSO to improve control transmission network
	Storage, Grid-Connected	A “recharge infrastructure” for electric vehicles will be integrated with a storage system and a PV plant, to optimize energy management and load profiles and provide ancillary services when necessary to the distribution network. The battery storage system connected to the MV network is also used to control MV voltage over the feeder.
	Smart Meters and In-Home Displays	Advance monitoring providing 8000 customers, who have smart meters, with consumption data on local display, smart phones and PCs

Results	Result	Comments
	No results yet	The results of the project can be considered successful but the official report will not be available until the beginning of the next year. Some peripheral devices and central system functions have been developed and successfully tested. A broadband and "always on" communication network has been implemented to support advanced functions and several private power plants have been connected to the distributor control system.
	In-home display devices help consumers understand their energy consumption	Interfaces and protocols respect international standards but they should be standardized to be widely used. The energy monitoring kit has been distributed to 5000 customers to date, which is a high uptake rate (about 25%). Acceptance (measured by surveys) is very high. There has been an efficiency gain of >4% (after having excluded possible external factors comparing with a control group).

Jeju Island Smart Renewable project

Project ID	175
Organisation	KEPKO, HYUNDAI Heavy industries, POSCO
Organisation Type	Government, Network, Proponent, Retailer
Partners	KOSPO, HYOSUNG, LS Industrial System, AXCOM, ISEL Systems Korea, LG CHEM, LTD., WOOJIN Industrial System, DAEKYUNG Engineering and others.
Story	The Jeju Island Smart Grid Test Bed serves as the foundation for the commercialization and industrial export of Korean smart grid technologies. It is expected to greatly contribute to strengthening Korea's position as a leader in the global smart grid industry. The vision and goals of the Jeju Island Smart Grid Test Bed state a commitment to developing a low carbon, green growth strategy. From the Korean national standpoint, this project aims to raise energy efficiency and implement green-energy infrastructure by building eco-friendly infrastructure that reduces CO2 emissions. From the industrial standpoint, this project seeks to secure a new growth engine that will drive Korea in the age of green growth. The Smart Renewable Project in particular, is to improve the power quality of renewable sources, especially wind turbines, when they are connected to power grid. KEPCO wants to test the operating system to stably supply energy considering wind power and grid status, BESS (Battery Energy Storage System) to maximize revenue by energy sales according to power demands and electric rates, and STATCOM to improve voltage stability by supplying reactive energy. The main components to be tested in Jeju Island are EMS (Energy Management System), PCS (Power Conditioning System), BMS (Battery Management System) and batteries. There are two test models for Smart Renewable Project; type-A for big source with tens of MW, whose EMS has up to 20,000 points, and type B for medium source with several MW, whose EMS has up to 5,000 points.
Start Date	2009
End Date	2030
Customer Segment	Residential
Customers Involved	6000
Cost	AUD 43.8 M
Funding Source	Commercial Partner, Local Government, Regulator-Approved Spend
Network	Other
Connection Point	Customer Connections, Zone Substations
Location	Jeju Island
State	
Country	South Korea
Future Plans	
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Contact Link	
Background	In 2009, South Korean Government selected Jeju Island as the site for the construction of a smart grid test-bed. The Jeju Island Smart Grid project is a USD 200 million (AUD 213 million) Korean government initiative to build the world's largest Smart Grid community that allows for the testing of advanced smart grid technologies and R&D results, as well as the development of business models. It is the Korean Government's 20 year vision to see its USD 58.3 billion (AUD 62.1 billion) electricity market connected in a smart grid and to win 30 percent of the global smart grid market (estimated between USD 20 billion to USD 160 billion or AUD 21.3 billion to AUD 170.4 billion) for its home industries. The deployment of smart grid will save the country about USD 10 billion (AUD 10.65 billion) a year in energy import costs and will reduce the country's CO2 level by 30% .The Jeju Smart Renewable project aims to build a smart renewable energy power generation complex across the nation by rolling out microgrids. This will ultimately lead to the emergence of houses, buildings, and villages which can achieve energy self-sufficiency through the deployment of small-scale renewable energy generation units in every end-user premise.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	The Smart Renewable project allows the testing of advanced renewable and smart grid technologies and R&D results, which may become a commercial service for Jeju Island in the future. One of Jeju Island's goals is to become world's largest test-bed for renewable and smart grid technologies. The plan itself creates a new business model of commercializing technology testing services for smart grid deployment around the world.	Low
	8. Establish control over, or otherwise influence, intermittent generation sources.	Prepare optimal design, analysis, operation and standardization of devices. This initiative aims to address many renewable integration related issues to develop a viable commercial offer in the future. Its level of relevance to Australian context need to be further evaluated.	Med
	10. Smooth out intermittent generation output	Prepare detailed design and build system for stabilizing of renewable resource output .This initiative aims to address many renewable integration related issues to develop a viable commercial offer in the future. Its level of relevance to Australian context need to be further evaluated.	Med
	12. Use distributed energy solutions to address network and system constraints	Constructed network of test site, basic design for all devices (energy storage, reactive power compensation device, PCS, EMS and so on).This initiative aims to address many renewable integration related issues to develop a viable commercial offer in the future. Its level of relevance to Australian context need to be further evaluated.	Med

Approaches	Approach	Comments
	Power stabilisation	Implement power stabilisation to increase the quality of renewable resources.
	Storage, Grid-Connected	Develop the energy storage devices, power conversion unit, reactive power compensation system, battery management system.
	Demonstration Project	Build energy management system for Smart City and build the micro-grid operation platform.

Kalasatama Smart Grid Project

Project ID	223
Organisation	Helsingin Energia
Organisation Type	Network
Partners	ABB, Nokia Solution Networks (NSN)
Story	Kalasatama is a district in the heart of Helsinki that is currently under an extensive redevelopment plan. The development which was originally a harbor and industrial area, is to be converted into a residential and commercial hub covering 175 hectares with a total of 1.3 million square meters of homes, offices and service areas and housing a population of 18,000. The City of Helsinki has envisioned the Kalasatama development as a flagship for synergy and technological innovation in energy, information and telecommunications. The concept has included the ambition of Kalasatama to be a "Smart City". In 2010, Helsingin Energia (Helsinki public utility) announced its involvement in developing the smart city concept in Kalasatama. Helsingin Energia's plans for the smart city include - Demand Response Management Integration of renewable energy - Integration of electric vehicles Energy storage - House and building automation. The goal is to develop a model neighbourhood with a smart grid of global significance, employing the latest technological advances in energy, information and automation to create a sustainable energy system with services suitable for further application in other places. - The consortium partners planned a smart grid based on industry-wide standards supporting a stable, secure, efficient and environmentally sustainable power system. It will also accommodate customer demand response management systems that allow local producers and consumers to interact with the network operator and the energy market, to reduce peak loads and increase efficiency.
Start Date	2013
End Date	2030
Customer Segment	Large commercial, Residential, SME
Customers Involved	18,000 residents
Cost	
Funding Source	Commercial Partner, Local Government
Network Connection Point	
Location	Helsinki
State	
Country	Finland
Future Plans	The project is on-going
Contact Name	Clinton Davis
Contact Email	
Contact Phone	
Contact Link	
Background	Helsinki public utility Helsingin Energia together with Nokia Solution Networks (NSN) and ABB are working on the joint development of a large scale smart grid in the new Kalasatama district of Helsinki. The R&D project will test the concept of a flexible, low emission power network in the district as part of a larger initiative to lift Helsinki's environmental profile with a focus on the sustainable and efficient distribution of power. Kalasatama, located in central Helsinki, will have an innovation centre to showcase the latest technologies being tested and deployed

Areas of Relevance	Area	Comments	Relevance
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	Kalasatama project focuses on developing district-wide demand response management system for all the residential and commercial customers in the area. This system will address the integration of electric vehicles and renewable energy, and help shape energy consumers' behaviour and understanding of distributed energy resources.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Kalasatama project tackles the cost-efficiency aspect of renewable integration with automation and information technologies. Its technological feasibility and relevance to Australian context need to be further evaluated.	Low
	12. Use distributed energy solutions to address network and system constraints	Kalasatama project uses distributed energy sources, such as distributed Solar PV, Wind, Energy Storage and EV to help manage network constraints.	Med
	13. Store and organise information on customer renewable energy deployments	Information on the consumer end is an important component of the project, especially with the adoption of advanced ICT technology from NSN.	Med

Approaches	Approach	Comments
	Demonstration Project	The project consortium will develop a variety of solutions based on modern communication, information and energy technologies. These include solutions to ensure that excess power generated from renewable energy sources in the district, for instance from solar panels and wind turbines, can be fed into the power grid; to enable electric vehicles to draw electricity from the grid or feed it back; to store energy; to create easy-to-use services and to provide more flexibility and transparency in the distribution grid, helping to lower consumption and emissions.

Results	Result	Comments
	No results yet	The project is on-going

Karnataka Project

Project ID	224
Organisation	Karnataka Power Transmission Corporation Limited (KPTCL)
Organisation Type	Network
Partners	ABB
Story	Karnataka Power Transmission Corporation Limited (KPTCL) is Karnataka's leading power transmission utility that serves nearly 18 million customers across the state in India. The need of KPTCL is to implement a common integrated solution to cater to the network covering the entire state of Karnataka – more than 1300 Stations of both transmission and distribution companies. Karnataka Project deployed a network management system that integrates supervisory control and data acquisition (SCADA) technology with energy management (EMS) and distribution management systems (DMS) monitor and control 867 main transmission and distribution substations spread across the state of Karnataka, including the city of Bangalore. Subsequently, 450 substations were integrated by ABB making a total of 1317 to date. The benefits of the project are:- Real time data of renewable generation at the injection points in substations- Network visibility of power generation by Independent Power Producers (IPPs) and Open Access.
Start Date	2009
End Date	
Customer Segment	Large commercial, Residential, SME
Customers Involved	18 million customers
Cost	
Funding Source	Commercial Partner
Network Connection Point	Customer Connections, Distribution Feeders, Subtransmission Feeders, Zone
Location	
State	Karnataka
Country	India
Future Plans	
Contact Name	Clinton Davis
Contact Email	
Contact Phone	
Contact Link	
Background	Karnataka is among the fastest growing Indian states and its capital, Bangalore, is an international hub for the global IT and biotechnology industries. In 2009, ABB delivered a network management solution that integrates the state's power transmission and distribution systems, energy audit and customer billing systems into a single state-of-the-art platform. The solution monitors the power network of the entire state, provides accurate and real-time information on power supply and revenues, and enables operators to identify and correct faults quickly.

Areas of Relevance	Area	Comments	Relevance
	14. Improve techniques for forecasting renewable energy output.	Karnataka Project focused more on building an integrated network management system. Regarding the aspect of renewable integration, the deployed technology allows KPTCL to monitor real time data of renewable generation in their network. This can be an important technological capability to help the integration and management of renewables in Australian context.	Med
Approaches	**Approach**	**Comments**	
	Communications Network	Highlights of Karnataka Project's approach: The first Smart Grid project in India covering entire state electricity network of generation, transmission & distribution- The first SCADA project implementation in India with MFTDMA VSAT Communication, connected to 867 locations across Karnataka through INSAT 3A with communication bandwidth of 11.5 MHz. Another 450 locations added subsequently as a result, the new system is able to provide real time data of renewable generation at the injection points in substations. In addition, the system provides network visibility of power generation by Independent Power Producers (IPPs) and Open Access	
Results	**Result**	**Comments**	
	Confidential information	The project results are confidential and cannot be disclosed.	

Keihanna Eco City Project

Project ID	326
Organisation	Keihanna City
Organisation Type	Government
Partners	Multiple organisations
Story	The Keihanna Eco City Project is a five-year program being undertaken with a consortium technology companies. Under this project, various initiatives such as large-scale implementation of demand response programme, critical peak pricing, demonstration of EV for demand management, community energy management systems, etc., have been implemented. The project (funded by METI) is being implemented in 3 areas namely Kyotanabe City, Kizugawa City and Seika Town in Kyoto. The main feature of the Keihanna pilot is to optimize the use of energy throughout the entire area and reduce CO2 emissions. The main features of the Keihanna experimental project are to optimize the use of energy throughout the entire area and reduce CO 2 emissions. This includes the following: - Large scale installation of smart meters among domestic and commercial consumers- Installation of HEMS for general households, BEMS, and CEMS for energy management
Start Date	2010
End Date	2014
Customer Segment	Residential, SME
Customers Involved	700
Cost	
Funding Source	Commercial Partner, Regulator-Approved Spend
Network Connection Point	Kansai Electric Power Network
Location	Keihanna
State	
Country	Japan
Future Plans	
Contact Name	Confidential
Contact Email	
Contact Phone	
Contact Link	
Background	Keihanna city is located in a hilly region of three prefectures of Kyoto, Osaka and Nara and is also known as Kansai science city. The city includes to other seven cities and one town namely Kyotanabe, Seika, Kizugawa, Hirakata, Shijonawate, Katano, Nara and Ikoma in these three prefectures. It was developed recently - Demonstration of Vehicle to building technology for transportation under a national project to serve as a centre of culture, learning, and research, a new cultural capital intended to open paths into the future. The area consists of various research institutes, universities, companies and other institutions. Thus, it has been identified as one of the cities for testing and verifying the outcomes of research on advanced technologies and new social systems. Kansai Electric Power Company is responsible for electricity distribution in this city.

Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach.	The project uses a critical peak pricing programme. The approach of this project fits the objective quite well, however its applicability in Australia need to be further evaluated, specifically the right pricing design is required since the current project is to e Japan's domestic energy market.	Low
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	The extension of the new technological systems and business models emerging from the operational experiments to the world. The approach of this project fits the objective quite well, however, its business model remain unclear, and need to be followed up as the project progresses.	Low
	8. Establish control over, or otherwise influence, intermittent generation sources.	Installation of HEMS for general households, BEMS, and CEMS for energy management. The overall technical structure is well thought and designed. However, it is important to evaluate the technical feasibility in Australian context.	Low

Approaches	Approach	Comments
	Distributed Energy Solutions	The Keihanna Eco City experimental project involves the installation of energy-saving equipment, which will be operated at optimal rates to try to reduce CO2 emissions. To achieve this, HEMS, BEMS and other equipment will be installed to encourage general consumers to change their customary behaviour by making energy use visible and with different price rates during simulated timeframes. The project will also start work on electricity recharging management linked to V2X and CEMS in anticipation of a time when electric vehicles (EV) are in widespread use.

Results	Result	Comments
	No results yet	Project is currently ongoing.

King Island Renewable Energy Integration Project

Project ID	196
Organisation	Hydro Tasmania
Organisation Type	Proponent
Partners	
Story	The main aim of the King Island Renewable Energy Integration Project (KIREIP) is to increase renewable energy generation and reduce dependence on fossil fuels. To do this, KIREIP built on 15 years of operational experience of the King Island power system, with a history of progressively introducing renewable technology to displace increasing amounts of diesel fuel. This knowledge and experience were used to design a project and set of objectives that would allow 100% renewable energy penetration, trial energy storage and demand side management in order to save costly diesel fuel. The King Island grid had previously utilised significant amounts of wind energy, with an annualised average renewable energy use of around 33% and instantaneous penetration of up to 80%. KIREIP has used the existing renewable energy sources to increase average renewable energy penetration in the system to up to 65%. The designs developed and proven by KIREIP are readily applicable to similar sized remote power grids that rely on diesel fuel and have a reasonable source of renewable energy. The KIREIP team is aware of thousands of power systems that might benefit from the implementation of similar technology. This project is believed to be the world's first island grid of this size and has been successful in achieving sustained operation of the King Island power grid on 100% renewable energy, without support from conventional fossil fuelled generators.
Start Date	20-02-2010
End Date	29-05-2014
Customer Segment	Large commercial, Residential, SME
Customers Involved	93
Cost	AUD 18.25M
Funding Source	Discretionary Spend, Federal Government, State Government
Network	
Connection Point	Customer Connections, Distribution Feeders, Zone Substations
Location	Currie, King Island
State	TAS
Country	Australia
Future Plans	The team were also aware of the huge number of off-grid power systems around Australia and the Asia Pacific region and so approached KIREIP with a view to developing technology that could be applied in other locations. The team has actively engaged with three external Clients interested in using similar technology in their power systems. The team is also formulating a project to implement a similar project in the Flinders Island power system which is owned and by Hydro Tasmania.
Contact Name	Simon Gamble
Contact Phone	03 6230 5340
Contact Link	http://www.kingislandrenewableenergy.com.au
Contact Email	simon.gamble@hydro.com.au
Background	KIREIP implemented a range of renewable energy enabling technologies that managed the variability of renewable energy sources thus displacing the use of diesel fuel. The project has been successful in achieving sustained operation of the King Island power grid on 100% renewable energy, without support from conventional fossil fuelled generators. This is believed to be a world first for a grid of this size. The King Island grid had previously utilised significant amounts of wind energy, with an annualised average renewable energy use of around 33% and instantaneous penetration of up to 80%. KIREIP has used the existing renewable energy sources to increase average renewable energy penetration in the system to up to 65%.

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Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The project has disproved the popular notion that renewables cannot be used as base load for electricity supply. The project has also demonstrated that it is possible to displace diesel fuel and replace it with renewable energy in an economic way while achieving up to 100% renewable energy penetration.	High
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The technology mix proved by KIREIP has potential for use on the fringes of large scale grids where high levels of distributed renewable energy sources has the potential to cause instability. Although not an objective of KIREIP, analysis of system performance and the understanding of the technology developed through KIREIP has made the team aware of how the KIREIP technology mix can be applied to fringe of grid applications.	High
	4. Inform the regulatory environment for renewable energy	KIREIP has shown that running certain types of B100 biodiesel through conventional generators is technically viable, however the current excise regime makes the use of blends above 20% biodiesel (B20) completely uneconomic.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	KIREIP has demonstrated cost effective concepts of how to integrate very high levels of renewable energy into small isolated grids. The concepts are scalable and so have potential for use on the fringes of large scale grids to avoid or defer expenditure on distribution networks.	High
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	Although not a primary objective of KIREIP, the enabling technology implemented enables the King Island power system to accept far higher levels of distributed renewable energy than would otherwise be the case.	High
	8. Establish control over, or otherwise influence, intermittent generation sources	KIREIP has implemented a mix of enabling technologies that manage the variability of renewable energy sources in a way that enables them to be used as base load generation. The King Island power system has been operated continuously on 100% renewable energy for periods of up to 8 hours, with a total of in excess of 150 hours of Zero Diesel Operation (ZDO) achieved to date.	High
	9. Strengthen the network to manage higher renewable energy penetration	One of the benefits of the KIREIP technology has been to enhance grid stability and reliability. The flywheels connected to synchronous condensers keep frequency within a very tight band and the ability of the machines to generate large amounts of fault current leads to much improved fault differentiation and clearance. There have not been any examples of under-frequency load shedding on customer distribution feeders while the KIREIP enabling technology has been in operation. Faults that previously would have blacked out the entire system are now limited to individual customer feeders.	High

10. Smooth out intermittent generation output	The main purpose of the KIREIP enabling technology is to manage variability of renewable energy sources. The technology successfully manages the highly variable wind resource in a way that automatically shuts conventional generators down when there is sufficient wind and re-starts them when wind energy levels drop. Standby technology incorporated into the system safeguards against sudden loss of wind generation, giving the confidence to automatically shut down all conventional diesel generators when wind conditions permit.
11. Alter local load profile to match a desired level	KIREIP incorporates a Demand Side Management system (Smart Grid) which monitors selected non-critical customer load and trips them when the margin between available renewable energy and customer load drops to a level that would otherwise cause a diesel generator to start. The Smart Grid technology saves diesel by preventing unnecessary diesel starts and also provides customers and system operators with useful web based information on energy consumption.
Other	Trial the technical and economic viability of using biodiesel in conventional diesel generators. KIREIP showed that use of a wide range of 20% biodiesel (B20) and 100% tallow based biodiesel (B100) was technically viable. Current fuel excise regimes make use of blends above B20 commercially non-viable compared to mineral diesel.

Approaches	Approach	Comments
	Electrical System Modelling	An experienced team was assembled in order to carry out system modelling, concept and detailed designs for the enabling technologies. Some enabling technology, particularly the dynamic resistor had been installed for several years and so we well understood.
	Other	An experienced implementation and commissioning team carefully assessed the risks to the power system in carrying out tests of new and untried equipment and devised a staged test plan that progressively demonstrated the capabilities of the new mix of technologies in a way that did not put customer supply or equipment at risk. The staged test schedule took some time to implement, however the requirement to identify and manage risks was of paramount importance.

Results	Result	Comments
	Reduced reliance on diesel fuels	KIREIP has successfully achieved its objectives. The enabling technologies have been implemented, tested and optimised so that achievement of 100% renewable energy penetration when conditions allow is routine and automated. Significant volumes of diesel fuel are being saved as a result of KIREIP, which was the primary commercial objective.
	Applicable to remote power grids	The designs developed and proven by KIREIP are readily applicable to similar sized remote power grids that rely on diesel fuel and have a reasonable source of renewable energy. The KIREIP team is aware of thousands of power systems that might benefit from the implementation of similar technology.
	Wind generation had to be curtailed	The King Island grid had previously utilised significant amounts of wind energy, with an annualised average renewable energy use of around 33% and instantaneous penetration of up to 80%. KIREIP has used the existing renewable energy sources to increase average renewable energy penetration in the system to up to 65%.

Kitakyushu Smart Community Project

Project ID	323
Organisation	Kitakyushu City
Organisation Type	Government
Partners	
Story	The Kitakyushu Smart Community project is a five-year (ending in 2014) programme being undertaken with a consortium of technology companies. Under this project, various initiatives such as demonstration of Vehicle to Building, use of hydrogen generated from steel plants for meeting the local energy needs, demonstration of energy management systems, solar PV, etc., have been
Start Date	2010
End Date	2014
Customer Segment	Residential, SME
Customers Involved	225 households 50 workplaces
Cost	
Funding Source	Commercial Partner, Regulator-Approved Spend
Network	Kyushu Electric Power Network
Connection Point	
Location	Kitakyushu
State	
Country	Japan
Future Plans	
Contact Name	Confidential
Contact Email	
Contact Phone	
Contact Link	
Background	Kitakyushu is a city located in Fukuoka Prefecture of Japan with a total population of one million. The local government has implemented various projects related to controlling environment pollution, enhancing energy efficiency, and waste recycling in the city. The Kyushu Electric Power Company is responsible for electricity distribution in the city and the Sumitomo Metal Corporation (formerly Nippon Steel Corporation) is responsible for electricity distribution in the Higashida district of Kitakyushu, which is its designated supply area. The Kitakyushu Smart Community project (funded by METI) is being implemented in this specified supply area where a natural gas cogeneration system of 3,3MW capacity is used for electricity and heat supply. In addition, the 6.6 kV distribution systems are connected to Kyushu Electric Power's power grid. The Sumitomo Metal Corporation operates the Yahata Higashida natural gas based 33-MW cogeneration power plant which is used to provide heat and electricity in the pilot area.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	The extension of the new technological systems and business models emerging from the operational experiments to Asia via an Asia Low-carbon Centre, and then to the world. The feasibility of the specific business model developed in the project need to be further evaluated to see if it is transferrable to Australia.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Development of HEMS and BEMS, which can be coordinated with community energy management, increasing the efficiency of energy saving in normal homes and various types of buildings. The approach is mainly designed to meet Japanese energy industry's needs and its long term development plan.	Low
	8. Establish control over, or otherwise influence, intermittent generation sources.	Establishment of a Community Setsuden-sho, which provides advanced energy control and optimizes total energy distribution, encompassing electric vehicles (EV), storage batteries, etc. The project focuses well on the objective. The experience gained may be a reference to Australia, if community-based energy manage system is an area of interest.	Med
	9. Strengthen the network to manage higher renewable energy penetration	Increase the rate of introduction of new energy sources, including photovoltaic generation, fuel cells, and small-scale wind power generation, to 10% or more. The project informs a number of important aspects regarding different renewable energy sources and how they can be utilized in an appropriate way (including Solar PV, fuel cell and small scale wind generation).	High

Approaches	Approach	Comments
	Other	The Kitakyushu Smart Community project is being implemented in the Higashida area of Kitakyushu city. The Higashida district emits 30% less CO 2 than other areas in the city due to establishment of various environment friendly technologies and new energy sources implemented by the local government. The broad objective of the Smart Community project is to achieve a further 20% reduction, reducing CO_2 emissions to more than 50% less than other areas in the city.
	Distributed Energy Solutions	Transform consumers who use energy, such as residents and businesses, into "prosumers" by installing photovoltaic arrays and other systems. The project implemented demand-side self-management, where individuals and corporates work with energy providers in managing electricity demand.
	Demand Side Incentives	The project introduced dynamic pricing and incentives programmes.

Results	Result	Comments
	No results yet	The project is close to completion.

Large Embedded Generation Project

Project ID	301
Organisation	Ausgrid
Organisation Type	Government
Partners	n/a
Story	Embedded generators are seen as a significant potential demand management option. However, there are concerns that parallel connected embedded generators installed for non-network purposes may not exhibit the level of reliability required for them to operate as effective network support options. This project used an existing large embedded generator with a good operating history, and completed a series of reliability improvement actions in conjunction with the operators. These included a review of protection systems and settings, modifications to permit better fault ride-through capacity and a network support contract with financial incentives for reliable performance. While modifications and incentives were seen to improve generator reliability during the peak winter season, it has not been possible to conclusively show that these modifications have improved the ability of the generator to 'ride through' network faults or disturbances. However, the analysis and alteration to relay protection settings that led to a generator outage linked to a network fault indicates that there is the potential for improvements to generator performance during network faults.
Start Date	01-07-2010
End Date	30-06-2012
Customer Segment	
Customers Involved	n/a
Cost	AUD 1M
Funding Source	Regulator-Approved Spend
Network	Ausgrid
Connection Point	Subtransmission Feeders, Zone Substations
Location	Sydney
State	NSW
Country	Australia
Future Plans	Yes, on other sites with other customers.
Contact Name	Paul Myors
Contact Email	pmyors@ausgrid.com.au
Contact Phone	61292697316
Contact Link	
Background	Embedded generators are seen as a significant potential demand management option. However, there are concerns that parallel connected embedded generators installed for non-network purposes may not exhibit the level of reliability required for them to operate as effective network support options. In particular, the protection and anti-islanding systems commonly used on embedded generators may result in generators being tripped due to disturbances in the network. As such disturbances are commonly the result of exactly the situation that network 'n-1' redundancy is intended to solve, it may be the case that an otherwise highly reliable generator might trip at the most critical time when network support is required.

Areas of Relevance	Area	Comments	Relevance
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	By improving reliability and fault-ride through capability of embedded generators during critical times of network congestion or peaking. To some extent.	Low
	12. Use distributed energy solutions to address network and system constraints	Embedded generators can address network constraints if reliability/fault-ride through capability of generation can be improved e.g.; if protection/paralleling systems are properly set and if the project owners/operators are provided financial incentives to implement these technical improvements	Med

Approaches	Approach	Comments
	Commercial Venture	Project also included a network support contract with financial incentives for reliable performance.
	Changing System / Protection Settings	This project used an existing large embedded generator with a good operating history, and completed a series of reliability improvement actions in conjunction with the operators. A review of protection systems and settings and modifications to permit better fault ride-through capacity.

Results	Result	Comments
	Distributed energy resources were not able to ride through network faults	While modifications and incentives were seen to improve generator reliability during the peak winter season, it has not been possible to conclusively show that these modifications have improved the ability of the generator to 'ride through' network faults or disturbances. However, the analysis and alteration to relay protection settings that led to a generator outage linked to a network fault indicates that there is the potential for improvements to generator performance during network faults.

Large LV Statcom

Project ID	312
Organisation	Ergon Energy
Organisation Type	Network
Partners	
Story	Ergon Energy has extensive networks of long rural and remote feeders which are being stressed by the increasing demands placed on them by modern customer electricity needs and by the increasing prevalence of distributed generation particularly residential PV. These networks are also aging and their augmentation and replacement by traditional (poles and wires) technologies is not economically feasible. Ergon Energy Asset Management has placed a high priority on finding alternative solutions to reinforce these feeders and improve customer supply. The project will trial three phase 400kVAr LV statcom unit which have the ability to inject both capacitive and inductive reactive power into the electricity network.
Start Date	01-02-2012
End Date	01-10-2014
Customer Segment	
Customers Involved	
Cost	AUD 348,000
Funding Source	Discretionary Spend
Network	Ergon Energy
Connection Point	Distribution Feeders
Location	Fraser Coast
State	QLD
Country	Australia
Future Plans	
Contact Name	Michelle Taylor
Contact Email	michelle.taylor@ergon.com.au
Contact Phone	
Contact Link	
Background	Ergon Energy has extensive networks of long rural and remote feeders which are being stressed by the increasing demands placed on them by modern customer electricity needs and by the increasing prevalence of distributed generation particularly residential PV. These networks are also aging and their augmentation and replacement by traditional (poles and wires) technologies is not economically feasible. Ergon Energy Asset Management has placed a high priority on finding alternative solutions to reinforce these feeders and improve customer supply. Distributed LV STATCOMS are low voltage power electronic products which have the ability to inject both capacitive and inductive reactive power into the electricity network. This gives them the capability to influence network voltage.

Areas of Relevance	Area	Comments	Relevance
	12. Use distributed energy solutions to address network and system constraints	The Large Statcom offers the potential to improve voltage management on MV feeders where the levels of distributed generation (PV penetration) are high, and the voltage swing between high load and low load/high generation is high. Large Statcom can also help in rural locations with townships at the end of long feeders and where voltage management is an issue.	Med

Approaches	Approach	Comments
	Low Voltage Regulation	The Large LV STATCOM project will trial a three phase 400kVAr unit on the Ergon Energy network. The main application is to support the voltage on a long medium voltage rural feeder with and voltage regulation issues, partially due to a high penetration of PV, and avoid the conventional network upgrade which may otherwise be required.

Results	Result	Comments
	No results yet	Project not yet completed no interim results available.

Large Scale (e.g. Pumped Hydro) Energy Storage

Project ID	213
Organisation	University of Melbourne Energy Institute
Organisation Type	Research
Partners	ARUP
Story	Large scale energy storage is key to future greater penetration of large scale renewables. Pumped hydro is widely used technology but the profile in Australia is very low. The project reviewed the state of pumped hydro economics and technology globally and looked at new Australian applications. Through this project, the profile of large scale energy storage (e.g. pumped hydro) has been raised in Australia and the pros, cons, enablers and potential sites for pumped hydro energy storage were identified.
Start Date	01-01-2013
End Date	12-06-2014
Customer Segment	Industrial, Large commercial, Residential, SME
Customers Involved	
Cost	AUD 50,000
Funding Source	Commercial Partner
Network Connection Point Location	
State	SA, VIC
Country	Australia
Future Plans	We have many funding leads that we will be pursuing (including with ARENA). But if no funding is found, research cannot continue.
Contact Name	Tim Forcey
Contact Email	timothy.forcey@unimelb.edu.au
Contact Phone	0419019864
Contact Link	http://www.energy.unimelb.edu.au/opportunities-pumped-hydro-energy-storage-australia
Background	Large scale energy storage is key to future greater penetration of large scale renewables. Pumped hydro is widely used technology but the profile in Australia is very low. We reviewed the state of pumped hydro economics and technology globally and looked at new Australian applications.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	We examined and documented how large scale energy storage can complement renewable energy, increase its value to the market, and enable its further penetration.	Med
	4. Inform the regulatory environment for renewable energy.	Our work aimed to put "large scale energy storage" on the radar for key Australian stakeholders. This includes regulators. More work needs to be done (akin to what has been done overseas) looking at regulatory barriers and enablers for large scale energy storage in Australia to make the process of integrating renewable energy more cost-efficient.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	This was a major focus of our study because this is a key driver for large-scale energy storage. We examined, modelled, and documented how wind and pumped hydro could work together in Victoria and South Australia.	Med
	9. Strengthen the network to manage higher renewable energy penetration	Large scale energy storage strengthens the network and allows greater penetration of renewables.	Low
	10. Smooth out intermittent generation output	Large scale energy storage smooths out intermittent generation output. We presented / documented modelling output as to how this could work in eastern Australia.	Med
Approaches	**Approach**	**Comments**	
	Economic Modelling	The researchers reviewed what is going on with large scale energy storage globally and identified opportunities for large scale energy storage in Australia, as well as barriers. We modelled costs and economics.	

Results	Result	Comments
	Raise the profile of large scale energy storage in Australia	Project was very successful. Profile of large scale energy storage (e.g. pumped hydro) has been raised in Australia. We have a number of funding leads that we are pursuing to keep the ball rolling. Pros, cons, enablers and potential sites for pumped hydro energy storage were identified. Economics examined.

Least-cost carbon abatement modelling

Project ID	129
Organisation	The University of Melbourne
Organisation Type	Research
Partners	University of New South Wales, Australian Energy Market Operator, Bureau of Meteorology, GE, Market Reform
Story	Avoiding dangerous climate change will require at least an 80% reduction in CO2 emissions in the electricity sector. This can be achieved through reducing demand and replacing fossil fuel generation with wind, solar PV, concentrating solar, wave, biomass and hydro power, or capturing CO2 from fossil fuel power stations. The new system will require a mix of many technologies (there is no one silver bullet) and each comes with its own benefits and disadvantages. Deciding how much of each technology should be deployed to achieve the least cost carbon abatement is difficult. The decision requires consideration of the cost of capital and operations, reliability, dispatch ability, and cost of transmission. It requires that the covariance of the different technologies and demand are understood over timescales of seconds to decades. This model will link together the weather variability, renewable and fossil technologies, transmission and economics market models within an optimization scheme to facilitate the search for the least cost solution. This project is developing a software tool that links together weather variability, renewable and fossil technologies, transmission and economic market models, in many hundreds of thousands of combinations. The model will use a high powered search algorithm to find the least cost combination of supply-side and demand-side options over a transition period from the present with the current generation mix out to 2050 and beyond.
Start Date	1-07-2012
End Date	
Customer Segment	
Customers Involved	
Cost	AUD 1.2M
Funding Source	Federal Government ARENA
Network	
Connection Point	
Location	
State	
Country	Australia
Future Plans	The model may be extended at a future stage to include: uncertain weather inputs; coverage of NT and WA; and weather adjustments based on expected climate change by 2050
Contact Name	Dr Roger Dargaville
Contact Email	rogerd@unimelb.edu.au
Contact Phone	+61 3 8344 3514
Contact Link	http://www.energy.unimelb.edu.au/optimising-emission-abatement-electricity-
Background	. Avoiding dangerous climate change will require at least an 80% reduction in CO2 emissions in the electricity sector. This can be achieved through reducing demand and replacing fossil fuel generation with wind, solar PV, concentrating solar, wave, biomass and hydro power, or capturing CO2 from fossil fuel power stations. The new system will require a mix of many technologies (there is no one silver bullet) and each comes with its own benefits and disadvantages. Deciding how much of each technology should be deployed to achieve the least cost carbon abatement is difficult. The decision requires consideration of the cost of capital and operations, reliability, dispatch ability, and cost of transmission. It requires that the covariance of the different technologies and demand are understood over timescales of seconds to decades. This model will link together the weather variability, renewable and fossil technologies, transmission and economics market models within an optimization scheme to facilitate the search for the least cost solution.

Areas of Relevance	Area	Comments	Relevance
	10. Smooth out intermittent generation output	Shows how the geographic spread of renewable energy resources can de-correlate their output.	Med
	1. Measure or quantify the benefits and costs of renewable energy	Models the total cost, over a long period of time, of every potential renewable generation scenario	High
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Models the total cost, over a long period of time, of every potential renewable generation scenario. Recommends the lowest-cost option.	High

Approaches	Approach	Comments
	Market Modelling	This project is developing a software tool that links together weather variability, renewable and fossil technologies, transmission and economic market models, in many hundreds of thousands of combinations. The model will use a high powered search algorithm to find the least cost combination of supply-side and demand-side options over a transition period from the present with the current generation mix out to 2050 and beyond.

Results	Result	Comments
	No results yet	The modelling project is ongoing

Leonards Hill Wind Farm

Project ID	280
Organisation	Hepburn Community Owned
Organisation Type	Other
Partners	Hepburn Shire, Powercor
Story	A project recently completed by Powercor is the work to integrate a community owned wind farm into the local HV distribution network. This was a complex project whereby a smallish wind farm (2-4MW) had to be connected into the local rural 22kV supply, while ensuring the voltage quality along the skinny feeder was controlled in a sophisticated manner to not affect nearby customers. The wind farm send s its generated energy into the local electricity distribution network (Powercor), where electricity retailers purchase energy in the wholesale market and sell it to households and businesses. One key finding this project found is that wind farms aren't suitable for connection to weak distribution feeder networks. There can be a large amount of augmentation required to have the network operate within the distribution code and this can make the project economically unviable.
Start Date	2010
End Date	2012
Customer Segment	Residential
Customers Involved	2000
Cost	AUD 13M
Funding Source	Commercial Partner
Network	Powercor
Connection Point	Distribution Feeders
Location	Leonards Hill, Heburn
State	VIC
Country	Australia
Future Plans	We continually monitor the performance of the wind farm via the SCADA system.
Contact Name	John Garvey
Contact Email	jgarvey@powercor.com.au
Contact Phone	0352407565
Contact Link	http://hepburnwind.com.au/the-project/
Background	The project was to establish a community owned wind farm of 2 X 2 MW. The wind farm was community owned with shares issued via a public offering. A consultant did the technical negotiations for the shareholder group. The wind farm was established to sell electricity to a retailer.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The Leonards Hill Wind Farm is the first community owned wind farm in Powercor's network.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources	Being the first community owned wind farm in the Powercor's network, the community was educated on the benefits of renewable energy.	Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The Leonards Hill Wind Farm is the first large scale wind farm connected to a 22kV distribution feeder. For the wind farm to be economically viable, a 22kV feeder in a rural area with 4 MW could be the limit. This solution can be applied to other locations across Australia.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources	The project established a special voltage control scheme which kept the voltage variations within the distribution code.	Low
	9. Strengthen the network to manage higher renewable energy penetration	Further changes to voltage regulation and automatic circuit recloser devices were required.	Med
	11. Alter local load profile to match a desired level	The wind farm did offer some base load support when operating.	Low
	14. Improve techniques for forecasting renewable energy output	A remote monitoring and control system was installed to monitor the wind farm output and its effects on the network.	Low
	1. Measure or quantify the benefits and costs of renewable energy	There can be a large amount of augmentation required to have the network operate within the distribution code. This can make the project economically unviable. For the wind farm to be economically viable, a 22kV feeder in a rural area with 4 MW could be the limit. This solution can be applied to other locations across Australia.	Med

Approaches	Approach	Comments
	Network Monitoring & Analysis	Project scope of network augmentation devised after system studies. Offer to connect were made and accepted by the proponent. Wind farm was connected and monitored to distribution code requirements.
Results	**Result**	**Comments**
	Voltage control scheme kept voltage variations within distribution code	The innovative voltage control scheme worked as designed. This kept the voltage variations within the distribution code.
	Wind farms are not suitable for connection to weak distribution feeder networks	Wind farms aren't suitable for connection to weak distribution feeder networks. There can be a large amount of augmentation required to have the network operate within the distribution code. This can make the project economically unviable.

Low cost building-integrated photovoltaics (BIPV) for Australian residential and commercial/industrial rooftop power generation

Project ID	243
Organisation	BlueScope Steel Limited
Organisation Type	Other
Partners	
Story	Despite the potential for roof-top solar to significantly contribute to national energy requirements (estimate capacity for 16GW on residential homes alone), widespread uptake by Australian consumers has not yet eventuated. BlueScope market research indicates that demand for PV systems is driven primarily by financial considerations, with secondary drivers being aesthetics, reliability (including brand reputation) and grid load management. By optimising existing technologies to develop an affordable building integrated PV (BIPV) system, BlueScope believes that a sustainable market for roof-top PV can be created, significantly contributing to national energy generation and reduced LCOE. Please contact the project lead for further information on results achieved by this project.
Start Date	27-06-2012
End Date	31-10-2014
Customer Segment	Large commercial, Residential, SME
Customers Involved	2
Cost	AUD 5,050,540
Funding Source	Discretionary Spend, Federal Government
Network	
Connection Point	Customer Connections
Location	Shellharbour and Glebe
State	NSW
Country	Australia
Future Plans	Please contact the project lead for more information
Contact Name	Dr Robert Scott
Contact Email	Robert.Scott@bluescopesteel.com
Contact Phone	02 4275 6108 or 0411 065 953
Contact Link	
Background	Despite the potential for roof-top solar to significantly contribute to national energy requirements (estimate capacity for 16GW on residential homes alone), widespread uptake by Australian consumers has not yet eventuated. BlueScope market research indicates that demand for PV systems is driven primarily by financial considerations, with secondary drivers being aesthetics, reliability (including brand reputation) and grid load management. By optimising existing technologies to develop an affordable building integrated PV (BIPV) system, BlueScope believes that a sustainable market for roof-top PV can be created, significantly contributing to national energy generation and reduced LCOE.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The Commercialisation Leader employed through this project has specifically focused on the development of the business model to enable BIPV to happen. This is no small challenge, given the nature of the building market supply chain.	High
	1. Measure or quantify the benefits and costs of renewable energy	The costs of delivering the BIPV and BIPV-T systems have been determined through the full supply chain, using the two commercial trials as bases for actual costs of manufacture and installation of these systems. The two trials currently provide data on the qualitative and quantitative benefits that are derived in terms of electrical output of the solar modules and thermal benefit (reduced air conditioning requirement) derived from the passive heating and cooling associated with the BIPV-T system.	High
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The development is aimed at providing a more cost effective solution for residential and commercial customers (without the need for government incentive programs), leading a greater level of uptake of renewable BIPV and BIPV-T systems.	Low
	9. Strengthen the network to manage higher renewable energy penetration	Please contact the project contact for more information on how this project addressed this objective.	High
	11. Alter local load profile to match a desired level	The thermal profile is designed to both create thermal energy that can be used for direct space heating, and to reduce thermal demand by providing a fly roof system to reduce heat gain into a building	High

Approaches	Approach	Comments
	Distributed Energy Solutions	Driving the market for BIPV and BIPV-T is enabled through cost reductions. The project focused on achieving this by: 1. PV module and inverter efficiency improvements 2. Optimised PV form factor for optimised roofing profile 3. An automated in-factory integration process 4. Reduced packaging and transport 5. Synergistic whole-of-system optimisation (not simply component optimisation) 6. Ease-of-installation so that the BIPV system installation replicates as much as possible current BlueScope roofing installation requirements and capabilities 7. Reducing building operational energy requirements and lowering installation costs through bundling with PV – thermal 8. Support the grid, resulting in reduced infrastructure and servicing costs (by reducing peak demand through active power compensation and energy storage capabilities with inverters).
Results	**Result**	**Comments**
	Confidential information	Please contact the project contact for more information.

Low Voltage Network Management: LV Monitoring and the Trial of LV Statcoms

Project ID	314
Organisation	Energex
Organisation Type	Government, Network
Partners	
Story	This project came about because of a lack of available engineering data for the LV network combined with increasing rooftop solar installations and the potential for EV/batteries. This project focussed on understanding the operation of the LV network to enable improved and more cost effective management through the use of emerging technologies. The project rolled out remote-read interval meters at various customer premises in the trial area and installed LV Statcoms with batteries on one distribution transformer LV network. Data was then collected and analysed. Through this project, Energex has gathered useful information to help characterise the operation of the network at the low voltage level and is in the process of exploring the use/cost efficiency of LV Statcoms and/or batteries installed on the LV network to help manage distributed energy resources. The project is in the process of exploring the use/cost efficiency of LV Statcoms and/or batteries installed on the LV network to help manage distributed energy resources.
Start Date	30-06-2011
End Date	30-06-2015
Customer Segment	
Customers Involved	
Cost	
Funding Source	Regulator-Approved Spend
Network	Energex
Connection Point	Customer Connections, Distribution Feeders
Location	Brisbane
State	QLD
Country	Australia
Future Plans	The project has been rescoped to align with changes in business priorities. The trial will focus on manual control of STATCOMs and batteries and will not include the in-house development of an active control application. Testing will continue toward the end of 2015 to assess the benefits of developing standard network building blocks to complement existing network augmentation solutions.
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Background	Lack of engineering data for the LV network combined with increasing rooftop solar installations and the potential for EV/batteries led to this project which is focussed on understanding the operation of the LV network to enable improved and more cost effective management through the use of emerging technologies.

Areas of Relevance	Area	Comments	Relevance
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The project has gathered useful information to help characterise the operation of the network at the low voltage level and is in the process of exploring the use/cost efficiency of LV Statcoms and/or batteries installed on the LV network to help manage distributed energy resources.	Med
	9. Strengthen the network to manage higher renewable energy penetration	The project is in the process of exploring the use/cost efficiency of LV Statcoms and/or batteries installed on the LV network to help manage distributed energy resources.	Med
	11. Alter local load profile to match a desired level	The project is in the process of exploring the use/cost efficiency of LV Statcoms and/or batteries installed on the LV network to help manage distributed energy resources.	Med
Approaches	**Approach**	**Comments**	
	Smart Meters and In-Home Displays	The project rolled out remote-read interval meters at various customer premises in the trial area.	
	Storage, Grid-Connected	The project installed LV Statcoms with batteries on one distribution transformer LV network. The project collected and analysed data from various tests.	
Results	**Result**	**Comments**	
	Other	Following the rectification of database limitations, testing will continue in late 2015.	

Low-Voltage Regulator Trial

Project ID	294
Organisation	United Energy
Organisation Type	Network
Partners	
Story	Renewable energy generators within the United Energy network (such as solar PV panels) are intermittent in their power output. This brings with it a need to investigate localised impacts on network flicker and steady state voltage profiles. The impacts can be cumulative if embedded within the distribution network in geographic clusters. The application of an LV regulator can potentially tighten up the voltage regulation window and provide faster response to sudden changes in voltage. They will facilitate the connection of intermittent renewable generation by smoothing out flicker impacts and when available with remote control functionality can be used as a demand reduction or energy conservation measure by reducing the voltage towards the bottom of the regulatory voltage band. The initial results for this project have confirmed the effectiveness of LV regulators at mitigating steady state voltage issues and regulating the delivered voltage to the customers. However, the final performance assessment will be carried out upon completion of the project.
Start Date	01-07-2013
End Date	30-06-2015
Customer Segment	Residential
Customers Involved	157
Cost	
Funding Source	Regulator-Approved Spend
Network	United Energy
Connection Point	Customer Connections
Location	Vermont/Forest Hill
State	Vic
Country	Australia
Future Plans	On completion of the trial, it is expected the LV regulators will be added to the standard materials list for use by UE in solving voltage issues where it is identified that customers are exposed to both steady-state over-voltage and steady-state under-voltages at certain times during the year. The device will be utilised when its solution is the least lifecycle cost technically appropriate, when compared to other options.
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Contact Link	
Background	Renewable energy generators within the UE network (such as solar PV panels) are intermittent in their power output. This brings with it a need to investigate localised impacts on network flicker and steady state voltage profiles. The impacts can be cumulative if embedded within the distribution network in geographic clusters.

Areas of Relevance	Area	Comments	Relevance
	9. Strengthen the network to manage higher renewable energy penetration	By installing the LV regulators at the middle of the circuits supplied by distribution transformers and tapping down the transformers, the downstream voltages will be regulated by the LV regulators and remained within the Victorian Electricity Distribution Code limits and the upstream voltages will be low enough not to be influenced by the over-voltages due to the installed solar PV panels.	Med

Approaches	Approach	Comments
	Low Voltage Regulation	Application of an LV regulator can potentially tighten up the voltage regulation window and provide faster response to sudden changes in voltage. They will facilitate the connection of intermittent renewable generation by smoothing out flicker impacts and when available with remote control functionality can be used as a demand reduction / energy conservation measure by reducing the voltage towards the bottom of the regulatory voltage band.

Results	Result	Comments
	No results yet	The initial results for this project have confirmed the effectiveness of LV regulators at mitigating steady state voltage issues and regulating the delivered voltage to the customers. However, the final performance assessment will be carried out upon completion of the project.

LV Network Modelling

Project ID	236
Organisation	SP AusNet
Organisation Type	Network
Partners	The University of Melbourne
Story	As disruptive technologies such as PVs and EVs emerge in greater numbers on LV distribution networks, the need to understand the potential impact this has on distribution assets has become essential for smart grid development. This project aims to demonstrate that it is possible to model existing LV networks on a per-phase basis in near real time with a high degree of accuracy, given household smart meter demand data combined with zone substation SCADA voltage data. The project focussed on achieving the objectives by constructing the LV model on 4 wire 3 phase 415v capable modelling software and conducting a validation exercise to ensure model matches actual LV network. Additionally, the project ran various case scenarios to establish impact on network from renewables and EVs. The results from the LV model simulation show that even low (i.e. 30%) EV or PV uptake scenarios can cause LV distribution assets to operate beyond their limits. The model also shows how the impact to the network is exacerbated when EVs and PVs are distributed unevenly across the 3 phases. The project investigated whether LV network support batteries can be used to mitigate some of the impact caused from EVs and PVs; and found that LV network support batteries were effective in reducing impact to the network. Further work is required to develop better battery management strategies to mitigate all impacts observed from disruptive technologies.
Start Date	01-03-2012
End Date	01-06-2014
Customer Segment	Residential
Customers Involved	
Cost	AUD 35,000
Funding Source	Discretionary Spend
Network	SP Ausnet
Connection Point	Customer Connections, Distribution Feeders, Zone Substations
Location	Epping
State	VIC
Country	Australia
Future Plans	Yes in order to establish the tool for business as usual purposes.
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Contact Phone	03 9695 6248
Contact Link	
Background	As disruptive technologies such as PVs and EVs emerge in greater numbers on LV distribution networks, the need to understand the potential impact this has on distribution assets has become essential for smart grid development. This project demonstrates that, given household smart meter demand data combined with zone substation SCADA voltage data; it is possible to model existing LV networks on a per-phase basis in near real time with a high degree of accuracy. Then using the LV network as a baseline, various uptake scenarios of EVs and PVs can be added to the model to estimate the impact disruptive technologies may have on SP AusNet's distribution assets. The results from the LV model simulation show that even low (i.e. 30%) EV or PV uptake scenarios can cause LV distribution assets to operate beyond their limits. The model also shows how the impact to the network is exacerbated when EVs and PVs are distributed unevenly across the three phases. To investigate future battery storage options, the study investigates whether LV network support batteries can be used to mitigate some of the impact caused from Evs and PVs. It was found that LV network support batteries were effective in reducing impact to the network. Further work is required to develop better battery management strategies to mitigate all impacts observed from disruptive technologies.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The project aimed to understand the maximum LV network utilisation capability.	Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The project aimed to inform maximum renewable capacity threshold.	Med
	9. Strengthen the network to manage higher renewable energy penetration	The project aimed to understand the maximum renewable capacity threshold.	Med
	12. Use distributed energy solutions to address network and system constraints	The project examined the effects of residential storage to manage peak demand.	Med

Approaches	Approach	Comments
	Electrical System Modelling	The project focussed on achieving the objectives by constructing the LV model on 4 wire 3 phase 415v capable modelling software and conducting a validation exercise to ensure model matches actual LV network.
	Electrical System Modelling	The project focussed on achieving the objectives by running various case scenarios to establish impact on network from renewables and EVs.

Results	Result	Comments
	PV, if uncontrolled, can create voltage problems for the network	Impact on one LV network was predicted over a day in winter and can be observed to exceed the LV network limitations under all PV uptake scenarios. The impact is expected to be worse if the study were to be repeated over a day in summer. In order to understand the overall impact, more LV networks need to be modelled and analysed. The results from the LV model simulation show that even low (i.e. 30%) EV or PV uptake scenarios can cause LV distribution assets to operate beyond their limits.
	Low Voltage network support batteries effective in reducing impact	To investigate future battery storage options, the study investigates whether LV network support batteries can be used to mitigate some of the impact caused from EVs and PVs. It was found that LV network support batteries were effective in reducing impact to the network. Further work is required to develop better battery management strategies to mitigate all impacts observed from disruptive technologies.

Machine learning based forecasting of distributed solar energy production

Project ID	263
Organisation	The Australian National University and NICTA
Organisation Type	Research
Partners	NICTA, University California San Diego, University Central Florida, Armada Solar, Laros Technologies, ActewAGL
Story	The current and future contributions of distributed solar energy systems to the grid are currently unknown. This project monitors a selection of several hundred PV systems and forecasts their current and future outputs via machine learning and computer vision techniques (jointly with up to 12 sky imagers). The primary focus of this project is to make the process of integrating renewables into the grid more cost-efficient. If the energy contributed by distributed micro-generators can be quantified and accurately forecast into the future, the problems arising from over or under production of these systems can be corrected via additional dispatches of energy and/or placement of storage systems. The project is still underway, but has already been able to exceed all baseline forecast measures from similar methods, has recorded data from 200+ PV systems in Canberra, developed and deployed new low-cost sky imagers and is now developing new machine-learning and computer vision methods specific to solar energy forecasting.
Start Date	01-01-2013
End Date	Early 2015
Customer Segment	Residential
Customers Involved	Up to 200
Cost	AUD 850,000
Funding Source	
Network	ActewAGL
Connection Point	Customer Connections
Location	
State	
Country	Australia
Future Plans	This project will run into early 2015 when ARENA funding expires. Continued funding for the project will allow it to both expand in scope and further develop the technology for Australian use, with the potential to sell the technology to other countries.
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Background	The current and future contributions of distributed solar energy systems to the electrical grid are unknown. This project monitors a selection of several hundred PV systems and forecasts their current and future outputs via machine learning and computer vision techniques (jointly with up to 12 sky imagers).

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	At the current production of PV systems is unknown on a day-to-day basis, this project will help to quantify the value of PV energy by recording interval data.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	Distributed solar forecasting will be essential for consumer side energy storage technologies.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	This is a primary focus of the project. If the energy contributed by distributed micro-generators can be quantified and accurately forecast into the future, the problems arising from over or under production of these systems can be corrected via additional dispatches of energy and/or placement of storage systems.	High
	8. Establish control over, or otherwise influence, intermittent generation sources.	Small-scale energy storage MUST have accurate solar forecasts to operate effectively.	Low
	9. Strengthen the network to manage higher renewable energy penetration	This project will provide key information on distributed PV production to distributors, energy providers and AEMO	Low
	12. Use distributed energy solutions to address network and system constraints	Distributed micro-generators can destabilise the grid – knowing when and by how much this will happen could enable distributors to correct such problems.	Med
	14. Improve techniques for forecasting renewable energy output.	There is no forecasting system for distributed PV micro-generators in Australia. This project has already been able to exceed all baseline forecast measures from similar methods, has recorded data from 200+ PV systems in Canberra, developed and deployed new low-cost sky imagers.	High

Approaches	Approach	Comments
	Renewable Energy Resource Mapping	This project will record of home solar energy system power output via 3G enable data loggers (100s of systems) and develop and deploy low cost cloud-imaging devices (10s of locations). With the collected data, it will apply Machine Learning and Computer Vision based forecast algorithms to estimate the current and future contributions of distributed PV micro-generators.

Results	Result	Comments
	Machine learning and computer vision techniques improve forecasting	This project has already been able to exceed all baseline forecast measures from similar methods, has recorded data from 200+ PV systems in Canberra, developed and deployed new low-cost sky imagers and is now developing new machine-learning and computer vision methods specific to solar energy forecasting.

Mackay Sugar Cogeneration Plant

Project ID	353
Organisation	Mackay Sugar Ltd
Organisation Type	Other
Partners	
Story	Mackay Sugar reuse and recycle their by-products (bagasse and molasses) to create renewable energy/green products and introduce additional revenue streams for the business. Bagasse, a biomass energy source, is a fibre derived through the milling of harvested sugar cane and which, when placed in an industrial boiler, fuels combustion to heat water and produce steam. This steam drives the turbine that generates high voltage electricity (renewable energy) and this energy is then used in Mackay Sugar's plant operations and distributed to households across the Mackay electricity grid. Other sugar mills can take learnings from this process and replicate it across their units. The cogeneration plant provides an additional income stream for Mackay Sugar, where they reuse and recycle the by-products produced from their sugar mill to generate renewable energy. The 38 MW plant exports around 27MW into the grid to power approximately 30 per cent of Mackay.
Start Date	2010
End Date	2013
Customer Segment	
Customers Involved	
Cost	AUD 120 M
Funding Source	Commercial Partner, State Government
Network	Ergon Energy
Connection Point	Customer Connections, Distribution Feeders
Location	Mackay
State	QLD
Country	Australia
Future Plans	Mackay Sugar is continuing to invest in energy efficiency projects at other sugar factories to maximise the amount of surplus bagasse for the cogeneration plant. We are also investigating a second cogeneration plant at another factory, subject to continuation of the RET.
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Background	Mackay Sugar reuse and recycle their by-products (bagasse and molasses) to create renewable energy/green products and introduce additional revenue streams for the business. Mackay Sugar's 38 megawatt Racecourse Cogeneration Plant produces enough renewable energy to power approximately 30 per cent of Mackay .The construction phase of this project saw the installation of a new high pressure boiler (to optimise bagasse steam generation) and steam turbine generator. The Racecourse Mill's own bagasse serves as fuel for the high efficiency plant during crushing season, whilst Mackay's other sugar mills provide bagasse during the off season.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The cogeneration plant provides an additional income stream for Mackay Sugar, where they reuse and recycle the by-products produced from their sugar mill to generate renewable energy. The 38 MW plant exports around 27MW into the grid.	High
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Mackay Sugar creates high voltage renewable energy produced by the steam generators using fibre left over from crushing the sugarcane to extract sugar. Other sugar mills can take learnings from this process and replicate it across their units. There are some unique features of this project that could be transferred to other potential sugar mill projects, such as the transfer and storage of bagasse from other mills, the year-round operation of the plant to provide consistent base-load type electricity, and the colocation of an energy consuming manufacturer (like a refinery). All current and potential sugar mill cogeneration projects are dependent on the 20% RET scheme for viability.	High

Approaches	Approach	Comments
	Energy Efficiency Measures	Bagasse, a biomass energy source, is a fibre derived through the milling of harvested sugar cane and which, when placed in an industrial boiler, fuels combustion to heat water and produce steam. This steam drives the turbine that generates high voltage electricity (renewable energy) and this energy is then used in Mackay Sugar's plant operations and distributed to households across the Mackay electricity grid.

Results	Result	Comments
	Distributed energy solutions reduce energy consumed from the network	The 38 megawatt plant produces enough renewable energy to power about 30% of Mackay. The plant currently exports about 24 megawatts into the grid and the facility can work around 50 weeks a year. As the factory crushing rate increases, the export levels will increase to the design level of 27 megawatts.
	Other	Given the large-scale nature of this project, a 5.5 kilometre 66 kilovolt transmission line was constructed by Ergon Energy, from the sugar mill to a substation at Glenella, North Mackay.

Magnetic Island and Townsville Solar City: A Case Study of Increasing PV Penetration in Electricity Networks

Project ID	9
Organisation	Australian PV Institute (APVI)
Organisation Type	Research
Partners	Centre for Energy and Environmental Markets (CEEM) and Ergon Energy
Story	This research project presents the results of a case study undertaken into technical issues posed by growing photovoltaic (PV) penetrations in the distribution networks of Magnetic Island and Townsville in North Queensland, Australia, and their management by the local Distribution Network Service Provider (DNSP), Ergon Energy. Like many other DNSPs, Ergon Energy also experiences voltage control issues due to existing PV penetration on their network. The main aim of this research project is to broaden the knowledge of the technical, economic and regulatory requirements needed to achieve high levels of PV penetration in electricity grids in Australia. The results from relevant projects and trials of new technology implemented by Ergon Energy on Magnetic Island and Townsville was discussed. It was found that Ergon Energy mainly experiences voltage issues due to high PV penetration. None of the other potential power quality issues such as reverse power flow, power factor distortion or harmonics are currently of significant concern on the Ergon Energy network. There are network stability concerns in relation to islanding, however there is no evidence of this having occurred on the network to date.
Start Date	
End Date	2013-09-01
Customer Segment	None
Customers Involved	
Cost	
Funding Source	Federal Government
Network	Ergon Energy
Connection Point	None
Location	Magnetic Island and Townsville
State	QLD
Country	Australia
Future Plans	
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Background	This research project presents the results of a case study undertaken into technical issues posed by growing photovoltaic (PV) penetrations in the distribution networks of Magnetic Island and Townsville in North Queensland, Australia, and their management by the local Distribution Network Service Provider (DNSP), Ergon Energy. Like many other DNSPs, Ergon Energy experiences voltage control issues due to existing PV penetration on their network.

Areas of Relevance	Area	Comments	Relevance
	4. Inform the regulatory environment for renewable energy.	The main aim of this research project is to broaden the knowledge of the technical, economic and regulatory requirements needed to achieve high levels of PV penetration in electricity grids in Australia.	Low
	9. Strengthen the network to manage higher renewable energy penetration	This case study reports that Ergon Energy has developed tests to detect voltage issues before or directly after PV system installation, and is engaging with installers to ensure correct inverter settings and use of these tests.	Med

Approaches	Approach	Comments
	Storage, Grid-Connected	Ergon undertook a RedFlow (zinc bromide) battery trial and data monitoring project to assess the impact of distributed storage on the network. The project has provided clarity for the work required to connect battery systems to the grid and other valuable lessons on integrating storage into the network.
	Transformer Upgrade	Distribution Transformer TVS55 was rated at 200 kVA with 25 PV systems connected, amounting to 62 kW of generation. This was, at the time, the highest amount of installed PV on any DTx. After Ergon performed load flow modelling on the subdivision it was decided to upgrade TVS55 and also to move it closer to the subdivision in order to reduce the voltage drop between the DTx and the customers. Although this was not a voltage issue related to PV, upgrade of small transformers and relocation has been demonstrated as an option for voltage management.
	Volt / VAR Control	Ergon Energy conducted reactive power injection trials utilising the 100 kW Solar Skate Park (SSP) PV system. The trials demonstrated the effectiveness of reactive power injection for managing voltage levels. Ergon has also conducted trials at the SSP to determine the effectiveness of automated control for self regulation of voltage levels.
	Volt / VAR Control	The Smart Lifestyle Centre (SLC) was experiencing high voltage levels during the middle of the day when the 17 kW PV system installed at the Smart Lifestyle Centre was exporting and demand was low. To resolve this problem a Low Voltage Regulator (LVR) was installed on all three phases at the SLC. The LVRs performed as expected with voltage levels at the SLC being maintained at 230V throughout the day.
	Interviews and Surveys	Interviews were conducted with Ergon Energy staff to discuss technical issues associated with integrating a high penetration of PV systems in Magnetic Island. Engineering staff were engaged to provide their opinion on the technical issues the network is experiencing and solutions to manage these issues. Local network personnel were also engaged to reveal the issues experienced on the network first hand. Strategies for further PV system integration were also discussed.

Results	Result	Comments
	PV, if uncontrolled, can create voltage problems for the network	The main issue experienced by Ergon Energy due to high penetration PV has been voltage related. None of the other potential power quality issues: reverse power flow, power factor distortion or harmonics, are currently of significant concern.
	PV voltage problems can be resolved	Voltage issues to date have been successfully resolved through network balancing, adjustment and minor augmentation. Ergon Energy has developed tests to detect voltage issues before or directly after PV system installation, and is engaging with installers to ensure correct inverter settings and use of these tests.
	PV islanding not currently an issue	Some concerns about the potential for PV system islanding, no other significant impacts are currently being experienced. Minor reverse power flow has not caused any network operation problems, while inverters have not produced significant harmonics or caused power factor issues. There are different views within Ergon Energy on the potential risks of islanding but, again, no recorded instances have yet occurred.

Mapping Potential Network Opportunities for Renewable Energy and Demand Management

Project ID	362
Organisation	Institute for Sustainable Futures
Organisation Type	Research
Partners	Ergon Energy, NSW government Department of Industry, Electranet, Transgrid
Story	This project will develop freely available, annually updated, online maps of network constraints, planned investment and the potential value of decentralised energy resources in networks across the Australian National Electricity Market (NEM). It fills a fundamental information gap by providing clear, consistent and timely information on network opportunities and constraints to renewable energy and demand management (DM) project proponents. These "Network Opportunity Maps" will allow network service providers (NSPs), their customers, and proponents of non-network alternatives to develop a common understanding of the costs associated with additional loads and constraints in different parts of the network. The project will develop nationally consistent, annually updated and publicly accessible, online maps of network constraints and potentially avoidable electricity network investment potentially achievable through investment in renewable energy and demand management. The maps provide indicative value calculations to initiate conversations regarding network support payments for renewable energy and demand management proponents. A core objective of the maps, through the provision of standardised, transparent information, is to build the market for renewable energy and demand management as providers of network support services. This will aid aggregator-style and other new business models, that will to assist in the shift to high penetration renewables. The maps are designed to assist in lowering electricity costs, raising energy productivity, lifting network capital efficiency and developing markets for decentralised energy. As an indirect benefit, the maps hope to streamline and standardise the approach of network service providers to RE and DM providers.
Start Date	9-6-14
End Date	30-9-17
Customer Segment	Industrial, Large commercial, Residential, SME
Customers Involved	
Cost	$1,020,003
Funding Source	Commercial Partner, State Government
Network	Australian National Electricity Market (NEM)
Connection Point	Subtransmission Feeders, Zone Substations
Location	Australian National Electricity Market (NEM)
State	NSW, VIC, ACT, QLD, SA, TAS
Country	Australia
Future Plans	The project goals include having an annually updated online map tool. Finding suitable map, data and model hosts into the future will be Therefore ISF will continue to monitor the annual updates.
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Background	This project will develop freely available, annually updated, online maps of network constraints, planned investment and the potential value of decentralised energy resources in networks across the Australian National Electricity Market (NEM). It fills a fundamental information gap by providing clear, consistent and timely information on network opportunities and constraints to renewable energy and demand management (DM) project proponents. These "Network Opportunity Maps" will allow network service providers (NSPs), their customers, and proponents of non-network alternatives to develop a common understanding of the costs associated with additional loads and constraints in different parts of the network.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The project will develop nationally consistent, annually updated and publicly accessible, online maps of network constraints and potentially avoidable electricity network investment potentially achievable through investment in renewable energy and demand management.	Med
	2. Support the transition to an alternative electricity pricing approach	The maps provide indicative value calculations to initiate conversations regarding network support payments for renewable energy and demand management proponents.	Low
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	A core objective of the maps, through the provision of standardised, transparent information, is to build the market for renewable energy and demand management as providers of network support services. This will aid aggregator-style and other new business models, that will to assist in the shift to high penetration renewables.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The maps are designed to assist in lowering electricity costs, raising energy productivity, lifting network capital efficiency and developing markets for decentralised energy.	Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	As an indirect benefit, the maps hope to streamline and standardise the approach of network service providers to RE and DM providers.	Low
	12. Use distributed energy solutions to address network and system constraints	The maps aim to show the network cost deferral benefits of distributed energy in different areas of the network.	Med

Approaches	Approach	Comments
	Capacity Mapping	The project will use the Dynamic Avoidable Network Cost Evaluation (DANCE) model developed by ISF. ISF has previously undertaken DANCE mapping for Sydney, metropolitan Victoria and for rural areas of the NEM suitable for concentrating solar power (www.breakingthesolargridlock.net). These previous DANCE versions involved highly time intensive manual processes, and the information became out of date very quickly. Producing updates in the same manner would be inefficient and expensive. This project streamlines the network opportunity mapping process. ISF will work with NSPs across the NEM to develop a clear, standardised data protocol to populate an annually updated, publicly available mapping resource. The three-year project will allow time to engage with NSPs and regulators and work through methodological considerations. The proposed program involves six key tasks: 1. Consultation with all NSPs to refine the methodology, inputs and outputs 2. Development of a robust data protocol 3. Model and platform development 4. Mapping iterations 5. Broader stakeholder engagement, including policy makers, regulators, decentralised energy proponents 6. Identifying a host organisation for annual updates

Results	Result	Comments
	No results yet	The project is still in progress.

Maximum Photovoltaic Penetration Levels on Typical Distribution Feeders

Project ID	232
Organisation	National Renewable Energy Laboratory
Organisation Type	Government
Partners	
Story	The study presents simulation results for a taxonomy of typical distribution feeders with various levels of photovoltaic (PV) penetration. A commonly used rule of thumb in the U.S. allows distributed PV systems with peak powers up to 15% of the peak load on a feeder (or section thereof) to be permitted without a detailed impact study. This necessarily conservative rule has been a useful way to allow many distributed PV systems to be installed without costly and time-consuming distribution system impact studies. But with much more PV being installed this simplistic approach could be wasteful. To model the effects of various PV penetrations across the wide spectrum of U.S. distribution feeder architectures, this study employs a publicly available taxonomy of 24 radial distribution feeder models, which statistically represent typical radial distribution feeders from five U.S. climate regions.
Start Date	2012
End Date	
Customer Segment	Large commercial, Residential
Customers Involved	
Cost	
Funding Source	Federal Government
Network	
Connection Point	Distribution Feeders
Location	
State	
Country	United States
Future Plans	
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Background	The study presents simulation results for a taxonomy of typical distribution feeders with various levels of photovoltaic (PV) penetration. For each of the 16 feeders simulated, the maximum PV penetration that did not result in steady-state voltage or current violation is presented for several PV location scenarios: clustered near the feeder source, clustered near the midpoint of the feeder, clustered near the end of the feeder, randomly located, and evenly distributed. In addition, the maximum level of PV is presented for single, large PV systems at each location.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The project aims to assess by simulation the maximum PV penetration that does not result in a voltage or current violation.	Med

Approaches	Approach	Comments
	Network Monitoring & Analysis	To model the effects of various PV penetrations across the wide spectrum of U.S. distribution feeder architectures, this study employs a publicly available taxonomy of 24 radial distribution feeder models developed at Pacific Northwest National Laboratory. The 24 models represent detailed utility feeder models, which statistically represent typical radial distribution feeders from five U.S. climate regions.

Results	Result	Comments
	Moderate to high PV penetration observed on most feeders	Several trends were noted when considering maximum PV penetration relative to steady-state voltage and overcurrent. For distributed PV systems, maximum PV penetration was nearly always above 50% unless the feeder already exhibited maximum load voltages on the very high end of ANSI range A without PV. Maximum PV penetration generally decreases as the distance from the feeder source to the PV system increases, but most feeders still tolerate moderate to high PV penetrations even for PV systems near the end of the feeder.

MeRegio (Minimum Emission Region)

Project ID	165
Organisation	ENBW
Organisation Type	Proponent
Partners	ABB, IBM, SAP, Systemplan, Karlsruhe Institute of Technology
Story	The primary goal of the project is to create an E-Energy model regions that demonstrate how the potential for optimization presented by information and communication technologies can best be utilized to achieve greater efficiency, supply security, and environmental compatibility in power supply in an area with significant wind and PV. A powerful information and communication infrastructure is provided that links the physical infrastructure to the marketplace, and allows operation of the infrastructure according to market conditions. The aim is to integrate multiple distributed resource types (conventional power plants, distributed combined heat and power plants, distributed energy storage systems, PV) with customers derived from the incorporation of dynamic rates based on wholesale conditions. The project studied the behaviour of 950 residential customers, who were given two-way interacting smart meters, and 300 of them also had direct control of appliances; 15 minute consumption data was backhauled daily from the meters. They were also given a small wireless display device which everyday between 17.00-18.00hrs displayed tomorrow's hourly prices based on the European Energy Exchange; the prices were also sent to customers' computers. Furthermore they were given a wall socket that detects when electricity is cheap and switches the dishwasher on.
Start Date	01-10-2008
End Date	01-09-2012
Customer Segment	Residential, SME
Customers Involved	965
Cost	AUD 32 M
Funding Source	Commercial Partner, Federal Government
Network Connection Point	
Location	Göppingen (Goppingham) and Freiamt
State	
Country	Germany
Future Plans	We are currently thinking about business models based on the results of the project which we could offer when the regulatory framework will be adjusted.
Contact Name	Helmuth Frey
Contact Email	hfrey@enbw.com
Contact Phone	00 49 721 6317 887
Contact Link	http://www.meregio.de/en/
Background	Project MeRegio was one of six sponsored by the German Ministry of Economics under its E-Energy competition. The primary goal is to create E-Energy model regions that demonstrate how the potential for optimization presented by information and communication technologies can best be utilized to achieve greater efficiency, supply security, and environmental compatibility in power supply. The main emphasis of the study was on how customers can be engaged in the new energy world, in particular in responding to dynamic price signals to offset intermittency from wind and PV. The focus of the study was on low voltages, although the importance of integrating with the high voltage transmission system was not forgotten.

Areas of Relevance	Area	Comments	Relevance
	11. Alter local load profile to match a desired level	Price signals have been used to adjust energy generation and consumption.	Med
	12. Use distributed energy solutions to address network and system constraints	The project developed a mechanism to predict and avoid network congestion. This has been tested in a demonstrator.	Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	A lot of new practices and processes have been developed and successfully tested regarding their functionality.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Dynamic price systems might be able to improve the use of renewable energy.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	A field test showed how the participants were able to deal with a dynamic tariff. The regulatory framework conditions are not sufficient for the creation of new business models yet.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	The project studied the behaviour of 950 residential customers, who were given two-way interacting smart meters, and 300 of them also had direct control of appliances; 15 minute consumption data was backhauled daily from the meters. The residential customers responded positively to the price signals and the transparency of the smart meters, reducing energy demand by 5-10% and shifting load by about 10%.	High

Approaches	Approach	Comments
	Transformer Upgrade	The project is served by a single 20kV line; includes 9MW of wind, several PV plants, and several biomass plants; was (just) a net exporter of electricity. To offset the network problems ENBW installed adjustable transformers in several substations to regulate the voltage.
	Distributed Energy Solutions	The project studied the behaviour of 950 residential customers, who were given two-way interacting smart meters, and 300 of them also had direct control of appliances; 15 minute consumption data was backhauled daily from the meters. They were also given a small wireless display device which everyday between 17.00-18.00hrs displayed tomorrow's hourly prices based on the European Energy Exchange; the prices were also sent to customers' computers. Furthermore they were given a wall socket that detects when electricity is cheap and switches the dishwasher on

Results	Result	Comments
	Information alone can have a behaviour changing effect	The residential customers responded positively to the price signals and the transparency of the smart meters, reducing energy demand by 5-10% and shifting load (i.e. dish and clothes washing machines and tumble dryers) by about 10%. Contrary to expectations, there was only one company that took an interest in responding to price signals, food storage/freezer business for whom electricity was a significant cost factor and which had flexibility in its consumption pattern.

Midwest Distributed Generation Project

Project ID	334
Organisation	Horizon Power
Organisation Type	Network
Partners	
Story	Details of this project available on request.
Start Date	
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	
Network	Horizon Power
Connection Point	
Location	
State	WA
Country	Australia
Future Plans	
Contact Name	Kelli Friar
Contact Email	kelli.friar@horizonpower.com.au
Contact Phone	0429 889 506
Contact Link	
Background	

Areas of Relevance	Area	Comments	Relevance

Approaches	Approach	Comments

Results	Result	Comments

Modelling the impact of distributed energy resources on the LV network

Project ID	304
Organisation	SA Power Networks
Organisation Type	Network
Partners	
Story	The scope of this project was to develop a power systems model to predict the impact of distributed energy resources on the quality of supply for typical LV and SWER network areas. The four DER categories considered in this analysis were: 1. Photovoltaic (PV) solar. 2. Plug-in electric vehicles. 3. Controllable Load (considered to be hot water systems); and 4. Battery Storage This investigation was carried out by creating models of fifteen representative feeders, spanning several categories of supply area, including underground, overhead and SWER networks. Simulations were run on these models to assess the quality of supply parameters under varying DER penetration levels.
Start Date	01-01-2014
End Date	01-05-2014
Customer Segment	
Customers Involved	
Cost	
Funding Source	Discretionary Spend
Network	SA Power Networks
Connection Point	Distribution Feeders
Location	
State	SA
Country	Australia
Future Plans	A number of the mitigation measures investigated will be utilised in areas where issues are currently being experienced from increased DER levels. Some of the more innovative solutions explored, for example, dynamic control of hot water, are also proposed to be trialled. It is also proposed to install monitoring equipment on LV and SWER feeders that have a higher risk of QOS compliance issues.
Contact Name	Mark Vincent
Contact Email	mark.vincent@sapowernetworks.com.au
Contact Phone	0427 580 119
Contact Link	
Background	With recent and forecast increases in penetration of distributed energy resources (DER) in the low voltage (LV) and SWER systems, SA Power Networks initiated a project to assess the impact of DER penetration on quality of supply. The scope of this project was to develop a power systems model to predict the impact of distributed energy resources on the quality of supply for typical LV and SWER network areas. The four DER categories considered in this analysis were: 1. Photovoltaic (PV) solar; 2. Plug-in electric vehicles; 3. Controllable Load (considered to be hot water systems); and 4. Battery Storage Quality of supply parameters which were examined included steady state voltage regulation, voltage fluctuations and voltage unbalance.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The project assessed the impact of DER on SA Power Networks' LV and SWER networks and looked at a number of mitigation measures to investigate their effectiveness in overcoming issues associated with increased DER penetration at minimum cost.	Low
	9. Strengthen the network to manage higher renewable energy penetration	The purpose of this project was to model the impact of DER and to assess a number of mitigation measures which can be used to manage increased DER penetration on the network. The final report presents a number of suggested solutions which could be used to manage increased DER levels.	Med
	11. Alter local load profile to match a desired level	A number of the solutions to manage increased DER penetration relied upon altering the local load profile.	Med

Approaches	Approach	Comments
	Electrical System Modelling	This investigation was carried out by creating models of fifteen representative feeders, spanning several categories of supply area, including underground, overhead and SWER networks. Simulations were run on these models to assess the quality of supply parameters under varying DER penetration levels.

Results	Result	Comments
	PV, if uncontrolled, can create voltage problems for the network	On a high proportion of older LV feeders in both overhead and underground networks, voltage regulation requirements limit acceptable photovoltaic solar (PV) penetration to around 25% of customers.
	PV voltage problems are contingent on the level of demand on the network	For SWER feeders, voltage regulation limits are stressed under peak demand even prior to the introduction of DER. Addition of photovoltaic penetration to 100% of customers introduces no new voltage regulation violations under minimum demand.
	PV voltage problems can be resolved	Voltage fluctuations are, with one exception, within the acceptable range suggested by AS/NZS 61000-3-7 across the scenarios studied.

Modelling the impact of various tariff structures on distributed energy resource take-up and electricity pricing

Project ID	305
Organisation	SA Power Networks
Organisation Type	Network
Partners	
Story	The purpose of the project was to assess the potential impact of four different network tariff scenarios on consumer energy consumption, investment in solar and other distributed energy resources, network costs and customer bills. The project modelled the impact of different network tariffs on consumer investment in distributed energy resources (DER) over a 20 year forecast period and showed that tariffs levied primarily on consumed energy such as an Inclining Block Tariff (IBT) or Time of Use (ToU) over-signal the value of embedded generation. The project found that cost-reflective network tariffs based on maximum demand lead to reduced cross-subsidy, more efficient investment choices and reduced
Start Date	01-07-2013
End Date	15-07-2014
Customer Segment	
Customers Involved	
Cost	
Funding Source	Discretionary Spend
Network	SA Power Networks
Connection Point	
Location	Statewide
State	SA
Country	Australia
Future Plans	Project outcomes have informed long-term tariff strategy.
Contact Name	Mark Vincent
Contact Email	mark.vincent@sapowernetworks.com.au
Contact Phone	0427 580 119
Contact Link	
Background	The purpose of the project was to assess the potential impact of four different network tariff scenarios on consumer energy consumption, investment in solar and other distributed energy resources, network costs and customer bills

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The project modelled the impact of different network tariffs on consumer investment in distributed energy resources (DER) over a 20 year forecast period and showed that tariffs levied primarily on consumed energy such as an Inclining Block Tariff (IBT) or Time of Use (ToU) over-signal the value of embedded generation	High
	2. Support the transition to an alternative electricity pricing approach	The project illustrated that, compared to IBT or ToU tariffs, network tariffs based on maximum demand (MD) give rise to less cross-subsidy from customers without DER to those with DER, giving more equitable recovery of network revenue and reducing growth in network prices over time	High
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The project modelled future consumer uptake of solar PV (already at a high level in SA), battery storage and Combined Heat and Power (CHP) under different network tariff scenarios. IBT and ToU tariffs were associated with the 'death spiral' of increasing cross-subsidy driving increasing network prices driving increasing investment in DER. Cost-reflective network tariffs based on maximum demand moderated this effect and yielded more sustainable network price paths.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources	The project examined the impact of different network tariffs on the total cost to the community over time, taking into account both the cost of grid-supplied energy and the cost of community investment in DER.	Low
	13. Store and organise information on customer renewable energy deployments	The project built an economic model to forecast long-term renewable energy uptake under different network tariff scenarios.	

Approaches	Approach	Comments
	Economic Modelling	The project built an economic model that took into account various feedback loops to forecast DER uptake in residential, commercial and industrial sectors over 20 years, and the associated impact on network price, under different network tariff scenarios
Results	**Result**	**Comments**
	Demand charges improve customer equity	The project found that cost-reflective network tariffs based on maximum demand lead to reduced cross-subsidy, more efficient investment choices and reduced network price growth over time compared to other tariff types.

NETFLEX – Network-enhanced flexibility

Project ID	162
Organisation	Elia System Operator S.A.
Organisation Type	Proponent
Partners	RTE, Coreso, ULg, ULB, KUL, Alstom Grid, Siemens
Story	Connecting and integrating more wind power to accommodate increasingly massive and volatile flows requires tremendous system flexibility, and upgrading, uprating and installing new overhead lines and underground cables, which takes time. The aim of the project was to increase the capacity and control of transmission lines with dynamic line rating and power flow controlling devices, and a Smart Controller that assesses flows at a distance to ensure that there were no adverse consequences. An improved approach to forecasting transmission capacity on a dynamic basis was developed. • The Dynamic Line Rating forecaster allowed an average 10-15% higher transmission capacities thanks to an accurate monitoring of overhead line sag and local wind forecasting • The Smart Controller allowed coordination of multiple phase-shifting transformers and HVDC links to impact on the flows on some critical branches and to route electricity when it is needed and where there is capacity is left.
Start Date	1-04-2010
End Date	30-09-2013
Customer Segment	
Customers Involved	
Cost	AUD 7 M
Funding Source	Commercial Partner, Discretionary Spend, European Commission, Regulator-
Network	Other
Connection Point	
Location	Brussels
State	
Country	Belgium
Future Plans	We have decided to equip more overhead line with Ampacimon and we are investigating the reinforcement of the border with France using Ampacimon and the DLR forecaster. Regarding Smart Controlling, other ongoing implementations in Central Western Europe make it very difficult to reach an agreement in the short run.
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Contact Phone	+322479977448
Contact Link	http://www.twenties-
Background	Connecting and integrating more wind power to accommodate increasingly massive and volatile flows it requires tremendous system flexibility, and upgrading, uprating and installing new overhead lines and underground cables, which takes time.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The aim was to increase the capacity and control of transmission lines with dynamic line rating and power flow controlling devices. The technologies used to implement Dynamic Ratings on distribution feeders are different to those used to implement Dynamic Ratings on transmission lines.	Low
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The aim was to increase the capacity and control of transmission lines with dynamic line rating and power flow controlling devices. The technologies used to implement Dynamic Ratings on distribution feeders are different to those used to implement Dynamic Ratings on transmission lines.	Low
	9. Strengthen the network to manage higher renewable energy penetration	Dynamic line rating allowed an increase in transmission capacity, and a Smart Controller that assesses flows at a distance to ensure that there are no adverse consequences. The technologies used to implement Dynamic Ratings on distribution feeders are different to those used to implement Dynamic Ratings on transmission lines.	Low
	14. Improve techniques for forecasting renewable energy output	An improved approach to forecasting transmission capacity on a dynamic basis was developed. The technologies used to implement Dynamic Ratings on distribution feeders are different to those used to implement Dynamic Ratings on transmission lines.	Low

Approaches	Approach	Comments
	Dynamic Equipment Rating	The transmission capacity, or ampacity, of an overhead line is closely related to local weather conditions, especially low wind speeds of 0 to 5 m/s. However, predictions of ampacity based purely on weather forecasts are not accurate enough. Combining field measurements into the forecasting algorithm improves accuracy. The methodology predicted 2-day-ahead ampacity to 98% confidence (meaning that capacity was overestimated in just 2% of cases). Some dynamic line rating devices, like Ampacimons, are quick and easy to install and can precisely monitor a network's transmission capacity in real time. They open up the possibility of exploiting additional capacity without jeopardising safety margins.
	Power stabilisation	Power-flow-controlling devices like phase-shifting transformers (PSTs) and high-voltage direct-current links (HVDCs) can be used to control power flows, alleviate congestion and free up available capacity.
	Changing System / Protection Settings	An algorithm was developed capable of controlling the tap positions of existing PSTs in the Central West European region to resolve congestion problems and possibly maximise N-1 margins on specified lines if required.

Results	Result	Comments
	Greater renewable penetration enabled by smart technologies	The Smart Controller allowed coordination of multiple phase-shifting transformers and HVDC links to impact on the flows on some critical branches and to route electricity when it is needed and where there is capacity is left.
		The Dynamic Line Rating forecaster can use higher capacities while achieving the same level of reliability because the Smart Controller compensates for over-estimation.
		The Smart Controller allows a greater wind penetration thanks to more coordinated actions by multiple PFCs.
	Dynamic Line Rating allows high transmission capacities	The Dynamic Line Rating forecaster allowed an average 10-15% higher transmission capacities thanks to an accurate monitoring of overhead line sag and local wind forecasting.
	Other	Damping can be reliably forecast based on flows and injections.

Network Capacity Value Functions for Integrated Planning of Distributed Demand Side Resources

Project ID	195
Organisation	Monash University: Ross Gawler, adjunct Senior Research Fellow is pursuing this
Organisation Type	Government
Partners	Nil
Story	The project has identified a conceptual framework for assessing marginal and incremental network value for changes in peak demand using the concept of a Network Value Function (NVF). The project proposed that these NVFs should be published as a part of planning statements to reveal the economic opportunity for future demand side response so that supply/demand planning can be integrated across multiple stakeholders. The researcher is preparing a technical report showing how NVF methods can be developed from simple and more complex and detailed network analysis. Ultimately, the project would seek to inform regulatory network activities that influence network planning reports and information made available publicly. Some simple methods have been developed using DC load flow for subtransmission loops. Simple spreadsheet analysis for radial subtransmission/zone substations has been developed to show marginal values and incremental values. Current work is focused on representation of uncertainty of demand growth in the method development.
Start Date	01-06-2009
End Date	01-06-2020
Customer Segment	
Customers Involved	
Cost	AUD 200,000
Funding Source	Discretionary Spend
Network	None
Connection Point	Distribution Feeders, Subtransmission Feeders, Zone Substations
Location	Melbourne
State	VIC
Country	Australia
Future Plans	Ross Gawler, adjunct Senior Research Fellow is pursuing this project on his own initiative and his own expense. Monash University is providing research facilities and will monitor progress.
Contact Name	Ross Gawler
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Contact Phone	03 9504 8373 / 0419 890 723
Contact Link	
Background	The project arose out of a realisation that the methods for assessing the marginal and incremental value of electricity networks in respect of demand side response that increases or reduces peak demand had not been previously formulated in a standard method for detailed locational analysis. The project has identified a conceptual framework for assessing marginal and incremental network value for changes in peak demand using the concept of a Network Value Function (NVF). The Network Value Function describes how the present value of network costs changes as a function of peak demand at defined network nodes. It is proposed that these NVFs should be published as a part of planning statements to reveal the economic opportunity for future demand side response so that supply/demand planning can be integrated across multiple stakeholders. It is assumed that the prevailing structure of network charges does not provide price signals suitable for integrated planning of demand side resources.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The project informs how integration of renewable energy loads or unloads electricity networks and how that affects future network costs. NVFs provide a basis for assessing these changes in network cost and consequently provide a basis for efficient feed-in tariffs, and the basis for planning of future distributed resources.	Med
	2. Support the transition to an alternative electricity pricing approach	NVF reveal how network costs will change with development of distributed resources over a period of time. This would inform network pricing that would be expected to support efficient investment in distributed demand side resources.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The publication of NVFs would enable third party energy service providers to more accurately assess the value for customers of embedded resources as they are likely to affect network service charges and the scope for network support revenue where network prices are unsuitable for the purpose of driving embedded resource development.	Med
	4. Inform the regulatory environment for renewable energy	By revealing the variability of marginal network impact costs by location, these methods will reveal where flat feed-in tariffs are inefficient.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources	Publishing of network value functions would better enable customers and energy service providers to anticipate how network prices will change in response to demand side response. They can be used to assess where distributed resources can induce escalating network service charges where network charges are based upon delivered energy and delivered energy is decreasing.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Network value functions would dissuade inefficient pricing methods and inefficient investments and would inform more efficient network service including network support services from embedded resources where they are more efficient than network upgrades.	Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The development of NVF by network planners would reveal to them the broader consequences of integration of demand side resources and enable them to better manage network investment risks. By revealing the potential value of distributed resources, a more competitive demand side response industry may yet develop to capitalise on the opportunities that are more transparent in technical and economic value.	High
	8. Establish control over, or otherwise influence, intermittent generation sources	Publishing NVFs would highlight where network support would be efficient and where embedded resources have little value in reducing future network costs. Ideally, this information would influence planning for embedded resources.	Low

	12. Use distributed energy solutions to address network and system constraints	The publication of NVFs would show where distributed resources have the greatest economic value in reducing future network costs.	High
	Other	The combination of using NVF to describe future network costs as affected by demand side resources and more sophisticated methods to define the coincidence of network peak loading and intermittent generations resources would enable more accurate assessment of network supply reliability in the presence of intermittent generation and demand side resources.	
Approaches	**Approach**	**Comments**	
	Electrical System Modelling	Ross Gawler is preparing a technical report showing how NVF methods can be developed from simple and more complex and detailed network analysis. This will be developed into a series of technical papers to be published as progress is made. The research work is expected to support student projects and other research activities in the Department of Electrical and Computer Systems Engineering.	
	Policy advocacy	Ultimately, the project would seek to inform regulatory network activities that influence network planning reports and information made available publicly.	

Results	Result	Comments
	Other	Research is in progress. The concept of the Network Value Function has been defined and applied in some case study examples. It is to be applied in a student project in late 2014. Some simple methods have been developed using DC load flow for subtransmission loops. Simple spreadsheet analysis for radial subtransmission/zone substations has been developed to show marginal values and incremental values. Current work is focused on representation of uncertainty of demand growth in the method development.

Network solar policy

Project ID	281
Organisation	Citipower and Powercor
Organisation Type	Network
Partners	
Story	There is a large volume of solar connections beings observed on the Citipower and Powercor networks. To match this demand, the expensive option of network augmentation would be required. The network company realised the value of introducing a solar connection preapproval process and solar policy to ensure there were no quality of supply issues. Customers were educated through the company website and technical bulletins on the preapproval process. The project was successful in educating the customers on the solar preapproval process before connection. Customers were also advised of how much solar generation that could be connected before augmentation was required.
Start Date	2013
End Date	On going
Customer Segment	Residential
Customers Involved	All Citipower & Powercor customers are covered by the policy
Cost	AUD 50,000
Funding Source	Discretionary Spend
Network	Powercor
Connection Point	Customer Connections
Location	Melbourne CBD and inner urban suburbs plus western half of Victoria
State	VIC
Country	Australia
Future Plans	The Network solar policy is reviewed on an annual basis. The latest update takes consideration of the features of smart Inverter technologies.
Contact Name	John Garvey
Contact Email	jgarvey@powercor.com.au
Contact Phone	0352407565
Contact Link	
Background	There is a large volume of solar connections being observed on the Citipower and Powercor networks. A preapproval process and policy was required to be introduced to ensure there weren't quality of supply issues.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	Sizes of acceptable Grid Connected Inverters were determined which could be connected without network augmentation.	Low
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	The policy presents uniform process and assessment of connection requirements introduced.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	Customers were educated through the company website and technical bulletins. The project was successful in educating the customers on the solar preapproval process before connection.	High
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The policy helped better manage timeframes for connection assessments.	Low
	8. Establish control over, or otherwise influence, intermittent generation sources.	The policy aimed to help control the level of penetration of solar so network issues were contained.	Med
	9. Strengthen the network to manage higher renewable energy penetration	The policy aimed to help provide an assessment of costs to customers to strengthen the network for more generation to be able to be connected.	Low
	12. Use distributed energy solutions to address network and system constraints	The Grid Interactive Inverter assessment process confirmed and communicated.	Low

Approaches	Approach	Comments
	Improve connection process	The network solar policy outlined the process for handling solar connections. It set solar penetration levels on distribution substations before further technical assessment was required.

Results	Result	Comments
	Produced information resources	The project was successful in educating the customers on the solar preapproval process before connection. Customers were able to be advised of how much solar generation that could be connected before augmentation was required. Quality of supply issues were managed to the distribution code.

Network Transformation Roadmap

Project ID	364
Organisation	Energy Networks Association
Organisation Type	Association
Partners	CSIRO
Story	There has also been a major shift in the way Australians interact with electricity services and providers. This evolution of the way customers use, produce and value electricity and energy services will continue well into the future. While these changes challenge traditional business models for the Grid and the established electricity system, they also create opportunities for alternative services which can unlock additional value for customers and businesses alike. In this context, Australia's national science agency CSIRO and the peak national body representing gas distribution and electricity transmission and distribution businesses in Australia, the Energy Networks Association (ENA) have partnered to develop an Electricity Network Transformation Roadmap (the Roadmap).In this time of unprecedented change for global energy services, the Roadmap is designed to identify the preferred transition which the electricity network industry must make in the next decade, to be ready to support better customer outcomes under a diverse range of long-term energy scenarios. By setting out a pathway for the transition of electricity networks by 2025, the Roadmap seeks to position network businesses and the whole energy supply chain for the future, to support the evolving needs of customer, innovate and develop new services that customers value and foster the long-term resilience and efficiency of Australia's energy system. Focused on the 2015-25 decade, the Roadmap development process will involve collaboration with consumer representatives, service and technology providers, policy makers, regulators, and academia.
Start Date	
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	
Network	
Connection Point	
Location	
State	
Country	Australia
Future Plans	
Contact Name	Stuart Johnston
Contact Phone	62721513
Contact Email	sjohnston@ena.asn.au
Contact Link	
Background	

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.		Med
	2. Support the transition to an alternative electricity pricing approach.		High
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.		High
	4. Inform the regulatory environment for renewable energy.		High
	5. Engage customers to build their and the industry's understanding of distributed energy resources.		High
	6. Make the process of integrating renewable energy into the grid more cost-efficient		Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network		High
	8. Establish control over, or otherwise influence, intermittent generation sources.		Med
	9. Strengthen the network to manage higher renewable energy penetration		Med

Approaches	Approach	Comments

Results	Result	Comments

Nyngan Solar Plant

Project ID	239
Organisation	AGL Energy
Organisation Type	Proponent
Partners	First Solar (Australia) Pty Ltd
Story	The Nyngan Solar Plant site is located on an agricultural property approximately 10 kilometres west of the Nyngan township. The solar plant will be connected to a new substation which will be constructed at the site. A 33/132kV transformer will convert the output from the plant to grid voltage. A short section (approximately three kilometres long) of new 132kV transmission line will be built to connect the substation to the existing Nyngan – Cobar transmission line, located south of the project site. This project will help the large-scale solar industry develop in Australia, encourage economic and industry development
Start Date	01-07-2012
End Date	31-12-2015
Customer Segment	
Customers Involved	1
Cost	AUD 290M
Funding Source	Discretionary Spend, Federal Government, State Government
Network	Essential Energy
Connection Point	Subtransmission Feeders
Location	Nyngan
State	NSW
Country	Australia
Future Plans	On completion of construction, First Solar will be the Operations and Maintenance subcontractor for the first 5 years of operation.
Contact Name	Nicole Ghiotto
Contact Email	nicole.ghiotto@firstsolar.com
Contact Phone	
Contact Link	http://www.agl.com.au/about-agl/how-we-source-energy/renewable-energy/nyngan-solar-plant
Background	The Australian government released its Solar Flagships program in 2009 as a way to kick-start the utility scale solar market in Australia. The major barrier to utility scale project was the absence of experience and projects in the Australian context, and implementing the first projects would reduce barriers for subsequent projects.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Building utility scale plants develops localised capacity and expertise to build further plants in future - subsequent plants can be sold at lower cost thanks to in-country supply chain and suppliers.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources	Utility scale PV plants are designed to meet a different set of generation or network standards than small scale PV. Utility scale PV plant outputs are controllable and can be set-up to react more pro-actively to grid disturbances that are more in line with conventional generation than small-scale PV anti-islanding measures can.	Low

Approaches	Approach	Comments
	Large Scale Renewable Plant	Being the first utility scale project on the NEM is important to prove that utility scale PV projects can be developed and implemented at this scale, which will develop investor and financier understanding of this market, and reduce their perceived risk of this scale of project. Various stakeholders in the development process (including local and state government planning agencies and the network operator AEMO) also gained familiarity with this type of project through implementation of the first project.

Results	Result	Comments
	No results yet	The project has successfully completed its development phase and has commenced construction.

Off-river pumped hydro Electricity storage

Project ID	268
Organisation	Australian National University
Organisation Type	Research
Partners	Tara Green, Electranet
Story	Incorporation of variable renewable energy sources into the electricity grid is rapidly increasing. Energy storage assists very high penetration of renewable energy. In many countries, short-term off-river pumped hydro energy storage (PHES) can provide unlimited storage at far lower cost than alternatives. PHES is by far the most widely used from of energy storage. An off-river PHES system comprising twin 10 hectare reservoirs, each 30 metres deep, with a 750 metre head, can operate at 1000 MW for 5 hours. Such systems can substantially stabilise a 100% renewable electricity grid at far lower cost than batteries, demand management, gas power stations or conventional hydroelectric storage. Australia has hundreds of suitable sites to introduce this form of technology. This project is currently in its early stages, and results will be published on completion of the project.
Start Date	1-09-2014
End Date	1-09-2016
Customer Segment	Industrial, Large commercial, SME
Customers Involved	
Cost	AUD 1.4M
Funding Source	Commercial Partner, Federal Government
Network	Canberra
Connection Point	
Location	Canberra
State	ACT
Country	Australia
Future Plans	
Contact Name	Professor Andrew Blakers
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Contact Phone	02 612 55905
Contact Link	https://theconversation.com/how-pushing-water-uphill-can-solve-our-renewable-energy-issues-28196
Background	More and more renewable energy sources are being plugged into Australia's electricity grids. South Australia, for example, will get 40% of its electricity from wind and solar once the Snowtown wind farm is completed later this year. But if renewable energy is ultimately to dominate the market, we will need ways to store the energy so we can use it round the clock.

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Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	This project aims to provide comprehensive data on the sitting and cost of off-river pumped hydro energy storage.	Low
	10. Smooth out intermittent generation output	This project examines the output provided by hydro energy generation and its relevance in smoothing out intermittent generation from other forms of renewable energy.	Med
	12. Use distributed energy solutions to address network and system constraints	The project proposes the use of large-scale off-river hydro energy generation to address future energy demands.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The project will investigate how low cost mass storage will facilitate high penetration of renewables.	Med

Approaches	Approach	Comments
	Demonstration Project	This project looks at the effectiveness of off-river pumped hydro energy storage (PHES). There is little further opportunity in Australia for on-river hydroelectric development due to environmental and other constraints. However, there are vast opportunities for short term off-river energy storage ("STORES"). This study explains how PHES can be used and what is required to implement this source of energy and energy storage.

Results	Result	Comments
	No results yet	In progress

Opower's Data Presentment Project

Project ID	324
Organisation	Opower
Organisation Type	Proponent
Partners	A regulated utility located on the West Coast of the United States
Story	The objectives of this project were to increase customer satisfaction for solar customers and reduce the cost to service solar customers through call reduction related to bill confusion. This was to be achieved by providing unique visualizations to help address different points of confusion in the solar customer's experience including: a view that distinguishes between energy charges and banked costs; an annual view of charges and costs; incorporation of messaging that speaks directly to solar customers to help answer their questions; unique experience for helping solar customers validate their investment; and unique experience for helping customers understand how their energy costs are changing over time.
Start Date	2014
End Date	Ongoing
Customer Segment	Residential
Customers Involved	Available to all of the partner utility's customers with net metering/solar
Cost	
Funding Source	Regulator-Approved Spend
Network	California ISO
Connection Point	Customer Connections
Location	
State	California
Country	United States
Future Plans	
Contact Name	Shawn Thompson
Contact Email	shawn.thompson@opower.com
Contact Phone	
Contact Link	
Background	Opower's utility client wanted to provide an online experience for their customers with rooftop solar to help them understand their solar charges and to evaluate these charges against an easy to understand benchmark.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	Opower's solution approach provides a unique experience for helping customers validate their investment and understand how their energy costs are changing over time. Opower's approach is very consumer oriented and critical to measuring the benefit for both renewable energy self-generators and consumers.	Med
	2. Support the transition to an alternative electricity pricing approach.	Opower's solution provides a unique visualization to help solar customers understand their solar charges and to evaluate these charges against an easy to understand benchmark. Opower takes a different approach compared to other technological focused project. Its main focus summer feedback and engagement.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	Once customers have enrolled in a solar program, Opower's program can help them understand how their net energy use will affect their bill. By presenting this information right next to their other utility data and integrating with the utility website, we can present this data where they're most likely to look for other information.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	One success metric is to reduce the cost to service for solar customers through call reduction related to bill confusion. With the help of software to reduce massive hardware investment for network companies, the approach can be transferrable in Australia.	Med

Approaches	Approach	Comments
	Distributed Energy Solutions	Opower's solution provides a unique visualization to help solar customers understand their solar charges and to evaluate these charges against an easy to understand benchmark. The solution approach is to provide unique visualizations to help address different points of confusion in the solar customer's experience.

Results	Result	Comments

Optimal deployment of renewable resources in a distribution network

Project ID	252
Organisation	Monash University
Organisation Type	Research
Partners	University of Queensland, University of Cambridge
Story	When investing in renewables in a distribution network there are a large number of locations where they can be deployed: the number of possible deployment configurations in even a small network (say 10 buses) number in the millions. This project provides a prototype set of tools and methodologies that will enable a global analysis of the best deployment configuration for the various types of renewable technologies. This means the best value for money options can be identified which take into account globally optimal trade-offs between location, size of investment, and the network augmentation required to support it. The project has now successfully completed its demonstration phase where we have shown that it is possible to analyse a large number (100,000) deployment configurations in a 30-Bus subtransmission network. We found that as expected the best solutions, or investment configurations, are very much location dependent and technology dependent. We also found that solar and wind are good complements to each other in many situations.
Start Date	01-06-2010
End Date	01-08-2014
Customer Segment	
Customers Involved	
Cost	AUD 150,000
Funding Source	Discretionary Spend, Federal Government
Network	
Connection Point	Subtransmission Feeders, Zone Substations
Location	
State	
Country	Australia
Future Plans	We are developing this project in two different directions. It will be applied to both distribution level integration of renewables and to large scale Transmission and Generation Expansion Planning (TGEP). The distribution level project now requires distribution utility participation to be applied to existing planning issues.
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Contact Link	
Background	The project developed around the fact that when investing in renewables in a distribution network there are a large number of locations where they can be deployed. Along with sensitivity of the system the type and size of resource the possible number of deployment configurations is very large. In fact, the number of possible deployment configurations in even a small network (say 10 buses) number in the millions. The engineering and economic software tools such as PSS/E and Plesxos used to analyse the impacts and benefits of a particular investment were designed before distributed renewable technologies were economically viable. However now a new generation of tools and methodologies is now needed. The transformation of the system with new smart grid technologies and renewable distributed generation connected at lower voltages means that there are many more scenarios that need to be analysed. This requires a new approach as there are many more possible connection points and configurations.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	This project's main purpose is to support the integration of renewables into a distribution system by providing planners and investors with the tools to comprehensively analyse the benefits of deploying renewables. It does so by identifying the best size and mix of technologies for a given network configuration.	Med
	4. Inform the regulatory environment for renewable energy	By comprehensively mapping out the best locations for investing a particular type of technology in arbitrary network configurations, the tools and methodologies developed can be used by regulators to model the impacts of different incentive schemes.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	This project provides a prototype set of tools and methodologies that will enable a global analysis of the best deployment configuration for the various types of renewable technologies. This means the best value for money options can be identified which take into account globally optimal trade-offs between location, size of investment, and the network augmentation required to support it.	High
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	These tools could be deployed to support decision making by distribution business and adapted to work with any other engineering tools they may use to assess the impacts of distributed renewables on their networks. This can provide significant additional comfort to the engineers that all possible contingencies have been accounted for.	Med
	9. Strengthen the network to manage higher renewable energy penetration	The tools and methodologies can be used to identify the optimal network reinforcement configuration required to support a given level of renewable penetration.	Med
	12. Use distributed energy solutions to address network and system constraints	As these methods and tools are designed to provide a holistic /global modelling and analysis framework for renewable integration, this means it is design to address constraints, optimal location, and reinforcement of the system simultaneously.	Med

Approaches	Approach	Comments
	Electrical System Modelling	This project involved the development of a methodology and toolset for evaluating a very large numbers of deployment configuration and the appropriate objectives to be met, such as reliability and capital costs. A set of software tools was then developed that can manage a large scale multi objective optimisation to determine the impact of deployment of various distributed generation configurations where the actual computation of the objectives is done using commercial tools such as Plexos and PSS/E. The software has the ability to execute hundreds of instances of these tools on commercially available cloud infrastructure.

Results	Result	Comments
	Dispersion of distributed energy can reduce localised voltage and stability issues	The project has now successfully completed its demonstration phase where we have shown that it is possible to analyse a large number (100,000) deployment configurations in a 30-Bus subtransmission network where there are 24 possible locations where renewable energy sources can be deployed. We modelled the choice of three technologies and an arbitrary level of investment in each technology at each of the 24 locations. This means there are 72 decision variables. The objectives to be met simultaneously were the NEM reliability standard, investment cost, the wholesale market operating costs, CO2 emissions. We found that as expected the best solutions, or investment configurations, are very much location dependent and technology dependent. We also found that solar and wind are good complements to each other in many situations.

Orkney Island Smart Grid

Project ID	169
Organisation	Scottish & Southern Energy Power Distribution (SSEPD)
Organisation Type	Network
Partners	Strathclyde University, Smarter Grid Solutions
Story	The electricity network on the Orkney Islands is served by two 33 kV circuits of 20MW import/export each connected to the Scottish mainland. The existing generation at the outset of the project included 21 MW of capacity that could be automatically 'intertripped' in the event of an outage on one of the circuits to the mainland regardless of the demand on the Islands. According to conventional planning standards the Orkney network was 'full'. SSEPD sought a quicker and more cost effective way to provide further wind generation than the traditional approach of costly and time-consuming upgrades to the network including an additional subsea cable, which would cost about Au$500m. It also wanted to:- • Facilitate bankable connections for new generators • Minimise dependency on operator and manual actions An active network management system was developed which curtails the real-time output of participating generators, demand or storage devices, to manage capacity constraints when they arise. It includes dynamic line ratings assessment. Generators are instructed directly under automated controls to limit their power output to match the available export capacity to the mainland grid. Crucial to the scheme was agreement on defining the grid access arrangements including the real-time curtailment of wind generation output when necessary. This approach was modelled and the curtailment forecasts were found to be acceptable to the banks who finance the schemes. There are now 20 generators with a capacity of 24MW, and in 2013 Orkney became a net exporter of renewable energy with 100% of local demand met by wind.
Start Date	2003
End Date	2009
Customer Segment	
Customers Involved	
Cost	AUD 865,000
Funding Source	Regulator-Approved Spend
Network	
Connection Point	Distribution Feeders, Subtransmission Feeders, Zone Substations
Location	Orkney Islands
State	
Country	United Kingdom
Future Plans	
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Contact Phone	
Contact Link	http://www.ssepd.co.uk/uploadedFiles/SSEPD_Microsites/Orkney_smart_grid/Cont

Background	The electricity network on the Orkney Islands is served by two 33 kV circuits of 20MW import/export each connected to the Scottish mainland. The maximum demand on the Islands is 31MW and the minimum is 6MW, and thus considering an N-1 criterion for the circuits to the mainland, the firm generation would be limited to a maximum of 26MW. (There are also constraints in parts of the network within Orkney that may limit wind). The existing generation at the outset of the project included 21 MW of capacity that could be automatically 'intertripped' in the event of an outage on one of the circuits to the mainland regardless of the demand on the Islands. According to conventional planning standards the Orkney network was 'full' and unable to accommodate any additional generator capacity from further wind farms and other renewable generator projects. SSEPD sought a quicker and more cost effective way to provide further wind generation than the traditional approach of costly and time-consuming upgrades to the network including an additional subsea cable, which would cost about AU$50m. It also needed to ensure that security and quality of supply were not compromised. It also wanted to:- - Facilitate bankable connections for new generators - Minimise dependency on operator and manual actions

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Part of the study involved analysing the network standards, and part was modifying grid access for wind subject to “bankability”.	High
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The aim was to increase the ability of the island network to accommodate more wind without reinforcement of the network or another subsea cable.	High
	8. Establish control over, or otherwise influence, intermittent generation sources	A crucial part of the project was the design and implementation of an active network management system which involved extensive monitoring of power flows and of wind	Med
	10. Smooth out intermittent generation output	The access arrangement permitted real time curtailment of wind output when necessary to avoid congestion. The flexible access arrangement smoothed out generation to manage constraints.	Med
	12. Use distributed energy solutions to address network and system constraints	This is the role of the active network management system which was successful.	Low
	Other	Increase wind capacity without building another subsea cable by improving control of generation output and power flows on the island	
	1. Measure or quantify the benefits and costs of renewable energy	The total cost of developing and delivering this innovative technical solution was less than Au$850K. To connect similar levels of renewable generation by reinforcing the network in the conventional way, it would have cost around Au$50 million, and taken considerably longer.	High

Approaches	Approach	Comments
	Demonstration Project	With Strathclyde University and Smarter Grid Solutions it investigated the scope for active network management (ANM) technology to monitor and regulate the network in real time, and maximises the real-time output of new renewable generators within the prevailing constraints of the network.
	Electrical System Modelling	Crucial to the scheme was agreement on defining the grid access arrangements including the real-time curtailment of wind generation output when necessary. This approach was modelled and the curtailment forecasts were found to be acceptable to the banks who finance the schemes.

Results	Result	Comments
	Technology cost effective to resolve grid congestion	Smarter Grid Solutions' technology has the potential to significantly improve the efficiency of the electricity distribution network in the UK. The Orkney network is a blueprint for how power companies can use smart grids to connect high levels of renewable generation cost effectively to resolve grid congestion. The total cost of developing and delivering this innovative technical solution was less than Au$850K. To connect similar levels of renewable generation by reinforcing the network in the conventional way, it would have cost around Au$50 million, and taken considerably longer.

Pacific Northwest Smart Grid Demonstration Project

Project ID	350
Organisation	Battelle
Organisation Type	Research
Partners	11 utilities in the five-state region, the Bonneville Power Administration, and multiple technology participants
Story	The PNW-SGDP project, the largest of the 16 smart grid demonstration projects funded by the U.S. Department of Energy under the American Recovery & Reinvestment Act (ARRA), is a unique demonstration of unprecedented geographic breadth across five Pacific Northwest states. The project is moving the region and nation of USA closer to establishing a more efficient and effective electricity infrastructure that is expected to help contain costs, reduce emissions, incorporate more various types of renewable energy, increase power grid reliability, and provide greater flexibility for consumers.
Start Date	2010
End Date	2015
Customer Segment	Residential, SME
Customers Involved	60,000
Cost	AUD 191.12 M (USD 178 M)
Funding Source	Commercial Partner, Federal Government, Local Government
Network	Idaho, Montana, Oregon, Washington, and Wyoming's networks belonging to the
Connection Point	Customer Connections
Location	Seattle, WA; Gig Harbor, WA; Ellensburg, WA; Pullman, WA; Kennewick, WA;
State	Five Pacific Northwest states-Idaho, Montana, Oregon, Washington, and Wyoming
Country	United States
Future Plans	Battelle (Pacific Northwest National Laboratory) will continue its research and development on transactive systems.
Contact Name	Don Hammerstrom or Ron Melton
Contact Email	donald.hammerstrom@battelle.org or ron.melton@pnnl.gov
Contact Phone	
Contact Link	
Background	Over the past decade, the Pacific Northwest region has been a pioneer in the nation's emerging smart grid agenda, contributing technology, utility applications, customer engagement strategies, and policy. The Pacific Northwest Smart Grid Demonstration Project (PNW-SGDP) is taking the region's involvement in smart grid to a new and exciting level.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The project aims to quantify smart grid costs and benefits. The PNW-SGDP project takes cost / benefits assessment as one of the top priorities. The takeaway from this project is its approach to quantify the benefit (cost) of smart grid and renewable integration at a large scale.	Med
	2. Support the transition to an alternative electricity pricing approach	The project generates a transactive incentive signal representing a forward forecast of the cost of power delivered to a given point in the system. This can provide the basis for a real-time price (five minute intervals). The project aims to support the introduction of real-time pricing. The relevance of this real-time pricing scheme to Australia's current or future contexts should be evaluated.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Validate new smart grid technologies and business models and the technology is a distributed approach that supports the integration of distributed energy resources. The project addresses this objective quite well. However, the transferability of these business cases and models requires further study.	
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	Advance standards for interoperability (the smooth, seamless integration of all elements of the electric system) and cyber security approaches. The project aims to advance the standards for interoperability of the electric system and ICT system components, which is quite critical to the future scale-up of smart grid and renewable integration.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources	Provide two-way communication between distributed generation, storage, and demand assets and the existing grid infrastructure. The concept of PNW-SGDP is quite similar to some of the other international projects, in terms of establishing better control over the renewable generation. The technologies deployed may require further investigation.	Med
	14. Improve techniques for forecasting renewable energy output	The project aims to forecast wind energy resource. The project informs this objective on a large scale across five US states.	Low

Approaches	Approach	Comments
	Demonstration Project	Battelle Memorial Institute is collaborating with utilities, universities, and technology partners in this Smart Grid demonstration project across five states and three climatic regions, spanning the electrical system from generation to end-use, and containing all key functionalities of the future Smart Grid. This demonstration will validate new technologies; provide two-way communication between distributed generation, storage and demand assets, and the existing grid infrastructure; quantify Smart Grid costs and benefits; advance interoperability standards and cyber security approaches; and validate new business models. More than 20 types of responsive Smart Grid assets will be tested across six regional and utility operational objectives at 15 unique distribution sites operated by 11 utilities. A base of Smart Grid technology serving more than 60,000 customers will be installed, validated, and operated. All use classes are represented in the demonstration including residential, commercial, industrial, and irrigation customers. The demonstration will develop a single integrated Smart Grid incentive-signalling approach and will test and validate its ability to continuously coordinate the responses of Smart Grid assets to meet a wide range of operational objectives. It will also be among the first to engage distributed control so that wind integration problems are mitigated. Micro-grid islanding will also be evaluated for its potential to enhance reliability for customers and relieve energy demand. Team members are committed to commercializing proven technologies. A unique distributed communication, control and incentive system will be implemented, designed to bring the electric transmission system into the information age. A new combination of devices, software, and advanced analytical tools will give homeowners more information about their energy use and cost. Data will be collected to provide insights into energy consumers' behaviour while testing new technologies. The project expands upon the region's experience in the 2006 DOE-funded Pacific Northwest GridWise™ Demonstration Project on the Olympic Peninsula, which successfully tested demand-response concepts and technologies.

Results	Result	Comments
	No results yet	The project is on-going.

Perth Solar City

Project ID	143
Organisation	Western Power
Organisation Type	Network
Partners	The Botanic Gardens and Parks Authority, the Eastern Metropolitan Regional Council, Mojarra, Prospero Productions, Solahart, SunPower and Synergy
Story	The Perth Solar City Program aimed to identify and understand barriers to the uptake of energy efficiency and renewable energy in the residential sector of Perth's Eastern Region. The project tested new energy efficiency technologies by undertaking the Smart Grid Trial, Time of Use Trial, In home display trial, air conditioning trial, solar photovoltaic saturation trial, plus installation of residential solar photovoltaic and solar hot water systems, to gauge behaviour change. Key results from the project can be summarised below: 1) An average 1.5% reduction in total electricity consumption and 5% reduction during Super-Peak (2pm – 8pm weekdays) was observed. 2) The ability to view electricity costs in real-time via an in home display, as enabled by a smart meter, provided participants with the capability to better manage their electricity use and reduce their consumption. 3) Findings from the solar photovoltaic saturation trial shows that approximately 30% saturation of solar PV systems (by transformer size) can result in voltage rise outside of compliance limits at the customer level, but within appliance tolerance limits. 4) Households who replaced an electric storage or electric instantaneous hot water system with an electric-boosted solar hot water system achieved an average 18% reduction in average daily electricity use
Start Date	01-11-2009
End Date	30-09-2012
Customer Segment	Residential
Customers Involved	33,365
Cost	AUD 44.1 M
Funding Source	Commercial Partner, Discretionary Spend, Federal Government
Network	Western Power
Connection Point	Customer Connections
Location	Perth
State	WA
Country	Australia
Future Plans	
Contact Name	Western Power
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Background	As the business and administrative centre of a resource-rich state, Perth has grown consistently faster than the national average. It experiences hot, dry summers and relatively cool and wet winters with long periods of sunshine. Perth's economic growth has contributed to major growth in peak energy demand. Up to $60 million is spent annually on parts of Western Australia's energy infrastructure that service less than 60 hours of peak demand.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Identify and understand barriers to the uptake of energy efficiency and renewable energy in the residential sector of Perth's Eastern Region.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources	The project tested new energy efficiency technologies by undertaking the Smart Grid Trial, Time of Use Trial, In home display trial, air conditioning trial, solar photovoltaic saturation trial, plus installation of residential solar photovoltaic and solar hot water systems, to gauge behaviour change.	High
	2. Support the transition to an alternative electricity pricing approach	The Perth Solar City developed a Time of Use Tariff trial called PowerShift, which is a voluntary three-part time-of-use tariff. It is the first tariff in Western Australia that seeks to more closely align electricity consumption blocks with time based costs of generation.	Med

Approaches	Approach	Comments
	Distributed Energy Solutions	Test new energy efficiency technologies by undertaking trials such as the Smart Grid Trial, Time of Use Trial, In home display trial, air conditioning trial, solar photovoltaic saturation trial, residential solar photovoltaic and solar hot water systems and behaviour change to analyse electricity consumption data and conduct customer surveys.

Results	Result	Comments
	In-home display devices help consumers understand their energy consumption	The analysis post deployment indicates an average 1.5% reduction in total electricity consumption and 5% reduction during Super-Peak (2pm – 8pm weekdays). A qualitative survey showed that 82% of participants who paired their in home displays felt the device was useful in reducing their electricity use, and would recommend it to others.
	Information alone can have a behaviour changing effect	The ability to view electricity costs in real-time via an in home display, as enabled by a smart meter, provided participants with the capability to better manage their electricity use. Analysis shows an average 9% reduction in participant electricity consumption during Super-Peak (2pm - 8pm weekdays). When combined with an in home display, participants achieved an average 13% reduction in electricity consumption during Super-Peak.
	PV, if uncontrolled, can create voltage problems for the network	Findings from the solar photovoltaic saturation trial shows that approximately 30% saturation of solar PV systems (by transformer size) can result in voltage rise outside of compliance limits at the customer level, but within appliance tolerance limits.
	Distributed energy solutions reduce energy consumed from the network	With the installation of 673 residential solar PV systems at an average size of 2.30kW, analysis shows that the average household used 41% less electricity from the network, or 8.15kWh per day.
	Distributed energy solutions reduce energy consumed from the network	Households who replaced an electric storage or electric instantaneous hot water system with an electric-boosted solar hot water system achieved an average 18% reduction in average daily electricity use.

Photovoltaic Systems Interconnected onto Secondary Network Distribution Systems – Success Stories

Project ID	231
Organisation	National Renewable Energy Laboratory
Organisation Type	Government
Partners	Sentech Inc., Consolidated Edison of New York Inc., Pacific Gas & Electric Company, Xcel Energy
Story	The aim of the project was to look at six case studies of successful large rooftop PV installations on:- A large multi-functional building in San Francisco The headquarters of the US Department of Energy in Washington DC -A redevelopment project in Brooklyn -An office building in Brooklyn -An industrial building in New York City -A convention centre in Denver Networks incorporate "network protector" (NP) devices, which are installed on the low-voltage side of each network transformer to identify reverse flow and open the NP devices. Also PV systems utilize electronic inverters, which convert DC power to AC power. They are designed to commutate on AC voltage, ceasing power production in the event of an outage. The various schemes had appropriate devices designed in, and had functioned with no problems.
Start Date	2008
End Date	
Customer Segment	Industrial, Large commercial
Customers Involved	37
Cost	
Funding Source	
Network	Xcel Energy, Pacific Gas and Electric, Potomac Electric Power Company,
Connection Point	Distribution Feeders
Location	Denver, San Francisco, Washington DC, New York City
State	
Country	United States
Future Plans	
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Background	The aim of the project was to present case studies of successful PV installations. The Moscone Centre in San Francisco is a large multi-functional facility that is primarily used as a convention centre with more than 2 million square feet in size. The PV system (which is on the roof of the centre) has a capacity of 676kW and generates about 3% of the energy used in the centre in a year. The James Forrestal Building in Washington, D.C. is the headquarters of the U.S. Department of Energy. The building has more than 1.6 million square feet of combined office and parking space. The PV system has a capacity of 205kW and generates about 8% of the building's annual usage. The Big Sue PV system in Brooklyn NY has been installed on a 130-year-old building that is part of a redevelopment project. There are 25 commercial units in the building that are served by the same Con Edison electrical meter, as well as the PV system. The owners of Big Sue have also refurbished a building adjacent to the site, which has six residential apartments. The roof of the apartment building has a 7kW PV system. The Black Bear building houses a limousine service dispatch centre along with a specialized oil company. The PV facility has a capacity of 17kW. The Greenpoint Manufacturing and Design Centre (GMDC) is a non-profit industrial developer in New York City, which has five rehabilitated manufacturing buildings. There are more than 100 businesses in one of the buildings which has a 55kW (DC) PV system. The Colorado Convention Centre in Denver has almost 600,000 square feet of meeting space. Namasté Solar, of Boulder, Colorado, installed a PV system. Three inverters were custom-designed for the centre and have a dynamic control on each. The overall PV system design uses three different methods to ensure no back feed occurs onto the network. The PV facility has a capacity of 300kW and generates 480kWh p.a.

Areas of Relevance	Area	Comments	Relevance
	9. Strengthen the network to manage higher renewable energy penetration	These studies tested the interconnection of PV systems onto Secondary Network Distribution Systems without impairing the reliability of the networks in which they are interconnected. These projects aims to address the interconnection issue of solar PV onto the secondary distribution network system, especially to tackle the integration issues between "network protector" (NP) and distributed renewables, in this case solar PV.	Med

Approaches	Approach	Comments
	Transformer Upgrade	Networks incorporate "network protector" (NP) devices, which are installed on the low-voltage side of each network transformer. The normal direction of the current flow on network feeders is unidirectional from the utility toward customer loads. However, during a short circuit condition (a fault) on the high-voltage side of one of the network transformers, the direction of the current flow will reverse. NP relays are designed to detect this reversal and initiate the opening of the NP to eliminate the fault current contributions from the "healthy" feeders to the faulted feeder. This prevents undesired current flow in the event of a faulted or de-energized circuit, and allows the network to maintain uninterrupted service to customers. When designing PV systems on spot networks, it is important to ensure that the PV system does not cause the network protectors to open. PV systems utilize electronic inverters, which convert DC power to AC power. They are designed to commutate on AC voltage, ceasing power production in the event of an outage. Inverters also produce low-levels of potentially harmful fault current in the event of a fault on the utility system.

Results	Result	Comments
	PV installation did not cause significant effects on the network	The Moscone Centre system has operated as expected. It has not caused any problems for the staff of the Moscone Centre; there have been no known equipment failures or system outages, but there have been reports of protector operations for unknown reasons. There have, however, been an increase in the number of relay operations since the system has come online. For the James Forrestal Building, because the minimum daytime load of the entire building is significantly greater than the PV system peak output, there is no forecasted chance of exporting power to the Potomac Electric and Power Company grid. To reduce network protector operations, the PV system was connected at the switchgear panel that had the highest daytime load in the building. According to the system operators, there have been no problems associated with these PV systems or any equipment within the building. The main PV system has not experienced any failures since it was installed in 2008. In addition to the 205 kW system, there are four "Technology Showcase" systems producing 1 kW each. The Big Sue PV system has not caused any known problems to Con Edison's area network system - the PV system generates a small enough amount of energy that only rarely is it not entirely consumed in the building. However, it is possible that the PV system may export power to the network on weekends during the hours of 10 AM - 2 PM in the unusual instance when the building load is low and the PV system output is high. Other area loads would likely absorb this excess PV system power without adversely impacting the area network. The PV system at the Kinnloch Black Bear building houses has not experienced any operational problems since its installation, nor caused any problems to Con Edison's network system. Usually all generated energy is consumed within the building, but it is possible for the system to export surplus energy to the network on weekends during the hours of 10 AM - 2 PM. The Greenpoint Manufacturing and Design Centre PV system is a medium-sized PV system generating approximately 68 MWh of energy per year. The minimum load demand for the building, during daytime hours, is significantly higher than the AC power output of the PV system. The PV system has not caused any known problems to Con Edison's secondary network because it generates a small enough amount of energy that it is likely all consumed within the building. This is an excellent example of a medium-size commercial PV system that is tied to a network and requires no reverse power protection. The system at the Colorado Convention Centre has had no operational problems since installation in the second-half of 2008. The system was designed with dynamic-controlled inverters, which govern the energy produced by the PV system and will reduce output if the power coming through the meter drops below 50 kW. Xcel Energy required multiple and independent methods to assure themselves that the PV system would not export power into the spot network or jeopardize the reliability of the power delivered to this high profile load. The specific requirements were worked out between Xcel Energy, the customer, and the system integrator to ensure the operational, safety, and reliability needs of all parties were met. The system has been operating within design parameters and has caused no known adverse situation for the customer and Xcel Energy. All energy produced by the PV system is consumed on site.

PV voltage problems can be resolved	Utilities that allow interconnection of PV systems on their secondary networks usually ensure that the energy produced is not fed back toward their system by requiring a minimum threshold power flow toward the customer. In the six cases studied in this report, four methods are employed as means to minimize, reduce, or eliminate the possibility of back feed from the PV system through to the network protectors. These methods are as follows:- - Keep the PV system sized lower than the minimum daytime load at the customer meter - Install a minimum import relay or a reverse power relay - Install a dynamically controlled inverter - Allow smaller PV systems to connect to a network

Planning Future Energy Grids: Renewables

Project ID	265
Organisation	Queensland University of Technology
Organisation Type	Government, Research
Partners	Ergon Energy, Central Queensland University, TU Dortmund University (Germany), University of Duisburg-Essen (Germany), RWTH Aachen University (Germany)
Story	This project aims to address the very unique and complex challenges of the Queensland electricity network as it faces the unprecedented growth in peak load and increase in injection of new, intermittent and distributed energy generation in a carbon constrained future.To do this, the project provides comprehensive, world-first planning and modelling tools and techniques, which enable more flexible network planning and regulation, to accommodate the increasing penetration of fluctuating and distributed generation. Consequently, it facilitates an improved network planning to enable embedded renewable generation to play a role in meeting the peak demand. The proposed planning tool proved to be viable, and demonstrated significant network savings potential in several case studies on urban networks (Townsville) and rural SWER systems within the Ergon Energy.
Start Date	24-11-2010
End Date	24-07-2014
Customer Segment	
Customers Involved	
Cost	AUD 6.7 M
Funding Source	Commercial Partner, State Government
Network	Ergon Energy
Connection Point	Customer Connections, Distribution Feeders, Zone Substations
Location	Townsville
State	QLD
Country	Australia
Future Plans	QUT is looking at continuing this project with Ergon Energy, by incorporating social and technical factors involved in customer response into network planning and operational strategies titled 'Customer Responsive Risk-Managed Planning', currently assessed under Linkage Grant scheme.
Contact Name	Prof Gerard Ledwich
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Contact Phone	+(61 7) 3138 2864
Contact Link	https://www.qut.edu.au/research/research-projects/renewables-on-the-
Background	This project aims to address the very unique and complex challenges of the Queensland electricity network as it faces the unprecedented growth in peak load and increase in injection of new, intermittent and distributed energy generation in a carbon constrained future. A parallel project on Demand Management provided tools for quantification of the effect of demand strategies.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	Our network optimisation programs design cost-efficient network upgrade plans in specific areas of Townsville for the next 10-20 years, based on projected penetration levels of PV, batteries and Electric Vehicles.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	Case studies were done with our agent-based models to explore the network impact of controlled and uncontrolled charging scenarios of Electric Vehicles, and residential battery-pricing scenarios that might allow significant percentages of customers to go off-grid	Med
	4. Inform the regulatory environment for renewable energy.	This project provides the tools and knowledge to fundamentally alter not just the electricity network in Queensland, enabling appropriate investment and operational decisions by network operators and generators, but will also enable the Queensland government to take the leadership role in setting the regulatory framework. This will facilitate a reduction in greenhouse gas emissions, supporting climate change mitigation and increasing the penetration of renewable energy into the electricity network in a cost effective manner.	High
	8. Establish control over, or otherwise influence, intermittent generation sources.	We investigated several alternative battery control algorithms for residential and grid-operated batteries, and alternative charging policies for Electric Vehicles.	Med
	9. Strengthen the network to manage higher renewable energy penetration	Our network optimisation programs can choose the optimal mix of transformer and line upgrades, battery, PV and capacitor installation, to minimise network cost and support a given level of renewables.	Med
	11. Alter local load profile to match a desired level	Our agent-based simulations of residential batteries include load-following control algorithms (driven either by local load, or network load if communications are available) that can reduce the network peak demand.	High
	12. Use distributed energy solutions to address network and system constraints	Our network optimisation programs can choose the optimal size and placement of batteries to support network peak demand, and avoid network upgrades where feasible.	High
	14. Improve techniques for forecasting renewable energy output.	Our agent-based simulations estimate the probabilistic expected level of total PV output for a given premise, or aggregated output at a distribution substation, feeder, or zone substation level, given the expected weather and cloud conditions.	High

Approaches	Approach	Comments
	Market Modelling	The agent-based models simulate the 1/2 hourly demand profiles of the 72,000 residential premises and 7,000 commercial and industrial premises in the Townsville region. However, there was no direct interaction with these customers.
	Literature Review	The project helps to address these objectives by providing a comprehensive, world-first planning and modelling tools and techniques, which enable more flexible network planning and regulation, to accommodate the increasing penetration of fluctuating and distributed generation. Consequently, it facilitates an improved network planning to enable embedded renewable generation to play a role in meeting the peak demand.
Results	**Result**	**Comments**
	Planning tool achieved network savings	The proposed planning tool proved to be viable, and demonstrated significant network savings potential in several case studies on urban networks (Townsville) and rural SWER systems within the Ergon Energy. When fully implemented, this project will assist in meeting Queensland's renewable energy target by enabling reductions in cost associated with network infrastructure.
	Planning tool used for regulatory planning	The tool is currently being incorporated into Ergon Energy's network planning frameworks. This tools will be of enormous value to Ergon Energy, and hence Queensland, underpinning both their technical and business strategies in a changing environment, and also provide an invaluable tool for regulatory planning.

Plug and Play Solar: Simplifying the Integration of Solar Energy in Hybrid Applications

Project ID	127
Organisation	CSIRO
Organisation Type	Government, Research
Partners	ABB Australia, US National Renewable Energy Laboratory (NREL)
Story	Hybrid renewable energy systems combine renewable generators such as solar photovoltaics and wind together with more conventional, non-renewable sources such as diesel or gas generation. These integrated systems will play an important role in the journey toward a lower carbon electricity system. Unfortunately these integrated systems currently have two key barriers: cost and technical complexity. This project seeks to simplify the integration, accelerate the deployment and lower the cost of solar energy in hybrid distributed generation applications by creating 'plug and play' solar technology. By simplifying the process of implementing, expanding and operating solar hybrid systems, the Plug and Play technology will assist system developers, owners and operators and help maximise the contribution of solar energy in these systems. This project is ongoing, however the plug and play technology has been designed, prototyped and tested at CSIRO's Renewable Energy Integration Facility (REIF) in Newcastle, Australia. Further testing and demonstration phases are planned.
Start Date	07-01-2013
End Date	08-01-2016
Customer Segment	Large commercial
Customers Involved	
Cost	
Funding Source	Commercial Partner, Federal Government
Network Connection Point	None
Location	TBC
State	
Country	Australia
Future Plans	
Contact Name	Daniel Rowe
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Contact Phone	0249606000
Contact Link	http://www.csiro.au/Organisation-Structure/Flagships/Energy-Flagship/Plug-and-
Background	Hybrid renewable energy systems combine renewable generators such as solar photovoltaics and wind together with more conventional, non-renewable sources such as diesel or gas generation. These integrated systems will play an important role in the journey toward a lower carbon electricity system but unfortunately they currently have two key barriers: cost and technical complexity. This project seeks to simplify the integration, accelerate the deployment and lower the cost of solar energy in hybrid distributed generation applications by creating 'plug and play' solar technology. In this context, plug and play (PnP) means that upon connection, a system component such as a solar generator, fossil fuel generator, grid stabiliser, energy storage system or load is automatically discovered and configured by the control system without the need for user intervention.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	This project includes a demonstration phase which aims to quantify how plug and play technology can be used to simplify the integration of solar energy in hybrid applications.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	By simplifying the process of implementing, expanding and operating solar hybrid systems, this technology will assist system developers, owners and operators and help maximise the contribution of solar energy in these systems.	High
	8. Establish control over, or otherwise influence, intermittent generation sources	The project aims to address cost and technical complexity barriers to solar hybrid power system growth by developing 'Plug and Play' technology where newly-connected solar generation will automatically be 'discovered' and configured by the main generation control system.	Med
	10. Smooth out intermittent generation output	The project aims to address cost and technical complexity barriers to solar hybrid power system growth by developing 'Plug and Play' technology where newly-connected solar generation will automatically be 'discovered' and configured by the main generation control system.	Med
	11. Alter local load profile to match a desired level	This technology aims to employ load, generation and storage control to optimise off-grid minigrid operation.	Low
	12. Use distributed energy solutions to address network and system constraints	This technology aims to employ load, generation and storage control to optimise off-grid minigrid operation.	Low

Approaches	Approach	Comments
	Direct load control	This project aims to develop 'plug and play' solar technology. This technology will employ integrated planning and operation functionality to optimise network operation and augmentation by controlling load, generation and storage network elements and informing network planning.
Results	**Result**	**Comments**
	No results yet	This project is ongoing, however the plug and play technology has been designed, prototyped and tested at CSIRO's Renewable Energy Integration Facility (REIF) in Newcastle, Australia. Further testing and demonstration phases are planned.

PNM Prosperity

Project ID	216
Organisation	PNM New Mexico
Organisation Type	Network
Partners	Ecoult, Sandia Laboratories, University of New Mexico, EPRI, DOE
Story	Increasing levels of renewable energy penetration poses integration challenges for grids. The project combined a 500kW Solar PV field with 500KW of energy-smoothing capability (utilizing UltraBattery) and 250kW/1MWh of energy-shifting capability. Ecoult worked closely with PNM, Sandia National Laboratories, the University of New Mexico and a number of other contractors to demonstrate: o Peak shaving, targeting elimination of 15% of the feeder peak - benefit defined by avoided industry standard costs of substation and feeder expansion o Smoothing of PV ramp rates and minimizing of voltage fluctuations - benefit defined by avoided cost of system upgrades that would be installed with high-penetration PV The project was joined by EPRI (The Electricity Power Research Institute) and the Department of Energy both of whom work closely with FERC the primary regulator of the USA power industry.
Start Date	01-7-2010
End Date	01-07-2016
Customer Segment	Industrial, Residential
Customers Involved	
Cost	AUD 5.34 M (Approximately USD 5 M)
Funding Source	Commercial Partner
Network Connection Point	Distribution Feeders
Location	Albuquerque
State	New Mexico
Country	United States
Future Plans	
Contact Name	John Wood
Contact Email	info@ecoult.com
Contact Phone	+61 2 9241 3001
Contact Link	http://www.ecoult.com/case-studies/pnm-nm-usa-solar-power-smoothing-and-energy-shifting/
Background	Increasing levels of renewable energy penetration poses integration challenges for grids. In the case of New Mexico, there were two particular objectives: o To better manage the misalignment between PV output and utility distribution grid and system peaks o To better manage intermittency and the volatile ramp rates of renewable energy sources that cause voltage fluctuations.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The project demonstrated the ability of the combination of Solar PV and energy storage to produce firm energy dispatch to support peak load needs on the PNM network and to improve the quality of power to commercial customers on the feeder the project was located on.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The project smooths energy output from the Solar PV field making the process of integrating the output much more effective for the PNM network control centre operators	Med
	8. Establish control over, or otherwise influence, intermittent generation sources	The project smooths, shifts, and makes firm for committed dispatch the electricity generated by the Solar PV field	Med
	10. Smooth out intermittent generation output	This was a direct objective of the project. The project is successfully smoothing and shifting PV output and demonstrating the ability to combine PV with a storage system, providing multiple benefits to making renewable resources reliable and dispatchable.	Med

Approaches	Approach	Comments
	Storage, Grid-Connected	The project combined a 500kW Solar PV field with 500KW of energy-smoothing capability (utilizing UltraBattery) and 250kW/1MWh of energy-shifting capability. Ecoult provided a complete energy storage solution to PNM who then worked with Sandia Laboratories and University of New Mexico to develop algorithms that ran on the Ecoult platform to deliver the Utilities objectives.

Results	Result	Comments
	Storage can help control the ramp rate in a system with high renewable penetration	The project is successfully smoothing and shifting PV output and demonstrating the ability to combine PV with a storage system, providing multiple benefits to making renewable resources reliable and dispatchable.
	Storage can provide frequency regulation to support high penetrations of distributed energy resources	The targeted objectives have been met and exceeded and project objectives were recently extended to the delivery of simultaneous ancillary services even while smoothing and shifting the PV output.
	Other	The Project was a finalist in the US Power communities Platt awards in 2013 (These are the most prestigious awards in the USA power industry) and Ecoult was selected as one of the Global Cleantech 100.

PowerShade

Project ID	310
Organisation	Ergon Energy
Organisation Type	Network
Partners	Griffith University, SkyShades
Story	The project aimed to demonstrate the technical integrity, including electrical output and durability, of photovoltaic panels integrated into tension membrane shade structures, integrated with battery storage. It also looked to demonstrate the effectiveness of Tropic Roofing to reduce the air-conditioning loading of a building. To do this, the project set up a modular tension membrane, and a Tropic Roof sail with 5.2kW of integrated semi-flexible photovoltaic solar panels. Additionally, the project installed a 5kW/10kWh, zinc-bromine, flow battery incorporating a grid integrated charger / inverter system. It was found that the tropic roof sail over the existing building roof made it is possible to reduce the ceiling temperature, which in turn will reduce the air conditioning load on the building.
Start Date	01-02-2011
End Date	01-02-2013
Customer Segment	Large commercial
Customers Involved	
Cost	
Funding Source	Discretionary Spend
Network	Ergon Energy
Connection Point	Distribution Feeders
Location	Brisbane
State	QLD
Country	Australia
Future Plans	
Contact Name	Michelle Taylor
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Contact Phone	
Contact Link	
Background	The project aimed to: Demonstrate the technical integrity, including electrical output and durability, of photovoltaic panels integrated into tension membrane shade structures, integrated with battery storage; and,- Demonstrate the effectiveness of Tropic Roofing to reduce the air-conditioning loading of a building.

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Areas of Relevance	Area	Comments	Relevance
	12. Use distributed energy solutions to address network and system constraints	The project used distributed energy resources to reduce customer load. By placing the tropic roof over the existing building roof it is possible to reduce the ceiling temperature, which in turn will reduce the air conditioning load on the building.	Med

Approaches	Approach	Comments
	Distributed Energy Solutions	The trial setup included a modular, tension membrane, Tropic Roof shade structure (Tropic Roof sail) with 5.2kW of integrated semi-flexible photovoltaic solar panels supplied by SkyShades Pty Ltd.
	Network Monitoring & Analysis	The system included remote monitoring and remote control of the systems' charge and discharge.
	Storage, Grid-Connected	A 5kW/10kWh, zinc-bromine, flow battery incorporating a grid integrated charger / inverter system supplied by RedFlow Ltd was connected.

Results	Result	Comments
	Reduced customer load	By placing the tropic roof over the existing building roof made it is possible to reduce the ceiling temperature, which in turn will reduce the air conditioning load on the building.
	Storage can combine with PV to reduce peak demand	The R510 (with the Zinc-bromine battery) is able to operate in a mode that enables shifting of the solar output to peak times for peak shaving applications based on a consistent peak time programmed via a time clock.
	Other	The PV array fixed to the shade sail is operable however has not been proven to be durable. Redesign must be considered.

PRIME PLC Evaluation

Project ID	316
Organisation	Energex
Organisation Type	Government, Network
Partners	Current, Landis & Gyr
Story	The 2008 Energex Telecommunications Strategy defined a future telecommunications network comprised of three distinct sections, the Core, Intermediate and Edge networks. The Edge network is commonly referred to as the 'Last Mile' network and is the link into customer premises. One of the principal candidates for the Edge network is the power line carrier. Some of the benefits of power line carrier systems are that they use power lines as their communication medium and therefore have naturally connected to each customer. As part of its Smart Grid Pilots & Trials, Energex ran a trial of adopting the PRIME PLC technology. The project was aimed at understanding the performance of PRIME PLC on typical Energex LV networks. The tests were designed to assess performance with regard to handling "typical" expected data traffic. Two types of expected data traffic were established and tested continuously including large volume data (e.g. energy/engineering profile data) and low volume/near real-time data (e.g. for control/pricing signals). The initial results found that PRIME PLC performed sufficiently on Energex LV networks to merit further testing. Further testing would include optimisation techniques, more robust diagnostic/assessment tool development and testing on at additional sites.
Start Date	01-07-2011
End Date	30-06-2014
Customer Segment	Residential
Customers Involved	110
Cost	
Funding Source	Regulator-Approved Spend
Network	Energex
Connection Point	Customer Connections
Location	Various sites in Brisbane
State	QLD
Country	Australia
Future Plans	Any future continuation of this project will depend heavily on the outcomes of the "Power of Choice" review.
Contact Name	Aidan Roberts
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Contact Phone	07 3664 5792
Contact Link	http://www.prime-alliance.org/
Background	The 2008 Energex Telecommunications Strategy defined a future telecommunications network comprised of three distinct sections, the Core, Intermediate and Edge networks. The Edge network is commonly referred to as the 'Last Mile' network and is the link into customer premises. One of the principal candidates for the Edge network is power line carrier. Some of the benefits of power line carrier systems are that they use power lines as their communication medium and therefore have naturally connected to each customer. Furthermore, by using existing utility owned assets, the network can be owned and operated by the utility and may therefore avoid higher ongoing costs typically associated with adopting third party solutions. Another benefit of using a wired solution is that it avoids many of the issues associated with wireless solutions such as spectrum availability and more recently, public health concerns. As part of its Smart Grid Pilots & Trials, Energex ran a trial of PRIME PLC. The major objective of this trial is to evaluate PRIME as a potential 'edge' network solution. To date PRIME has been deployed as a metering solution, however, Energex is aiming to assess how well PRIME would allow additional functionalities above and beyond meter data collection.

Areas of Relevance	Area	Comments	Relevance
	8. Establish control over, or otherwise influence, intermittent generation sources	The project increased monitoring leading to greater understanding of modern requirements of LV networks to identify desired control. Two way communications enabling more sophisticated/dynamic DER control algorithms.	High
	10. Smooth out intermittent generation output	Increased monitoring leading to greater understanding of modern requirements of DER and LV networks to identify desired control. Two way communications enabling more sophisticated/dynamic DER control algorithms.	Med
	11. Alter local load profile to match a desired level	Increased monitoring leading to greater understanding of modern requirements of LV networks to identify desired load level. Two way communications enabling signals to alter local load profile.	High
	13. Store and organise information on customer renewable energy deployments	Increased monitoring leading to greater understanding of DER on LV networks. Two types of expected data traffic were established and tested continuously including large volume data (e.g. energy/engineering profile data) and low volume/near real-time data (e.g. for control/pricing signals).	Low
	14. Improve techniques for forecasting renewable energy output	Increased monitoring leading to greater understanding of DER on LV networks for input to renewable energy forecasting.	Med
	2. Support the transition to an alternative electricity pricing approach	The project increased monitoring and understanding of LV networks leading to more appropriate bottom-up cost-reflective pricing. Investigating performance of a promising lower cost telecommunications solutions which could enable more dynamic/sophisticated pricing mechanisms.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Increased monitoring leading to greater understanding of modern requirements of LV network for input to appropriate new business models. Two way communications enabling more sophisticated/dynamic DER control algorithms.	High
	4. Inform the regulatory environment for renewable energy	Through increased monitoring leading to greater understanding of modern requirements of LV network, the project provided input to AER.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources	Increased monitoring leading to greater understanding of modern requirements of LV network in order to understand optimum behaviour in the presence of DER.	High
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Increased monitoring leading to greater understanding of modern requirements of LV networks to identify true costs and benefits, and target efficiency opportunities. Telecommunications used to facilitate control algorithms necessary to reduce adverse impacts and optimise benefits.	High

Approaches	Approach	Comments
	Communications Network	The project was aimed at understanding the performance of PRIME PLC on typical Energex LV networks. The tests were designed to assess performance with regard to handling "typical" expected data traffic. Two types of expected data traffic were established and tested continuously including large volume data (e.g. energy/engineering profile data) and low volume/near real-time data (e.g. for control/pricing signals).

Results	Result	Comments
	Communications networks are needed to support distributed generation	The initial results found that PRIME PLC performed sufficiently on Energex's LV networks to merit further testing. Further testing would include optimisation techniques, more robust diagnostic/assessment tool development and testing on at additional sites.
	No results yet	No further updates

Qingdao OES Independent Power System Demonstration Project

Project ID	351
Organisation	CNOOC Group
Organisation Type	Government
Partners	
Story	The Qingdao OES Independent Power System Demonstration Project is carried out in northern China's largest ocean energy comprehensive demonstration base. The project is funded by the state oceanic administration of Marine renewable energy special fund, and led by China National Offshore Oil Corporation. The test site is located in Qingdao, Jiao Nan Lang Ya Town, Zhai Tang Island. The Main functions include intelligent independent energy system demonstration, experiment and testing of various new types of ocean energy utilization devices. The project integrated 300kW Ocean Energy System, 150kW Wind Energy and 50kW Solar PV into an independent micro grid, aiming to test the solutions to the issues related to the intermittent renewable energy generation and micro grid integration.
Start Date	November 2012
End Date	September 2013
Customer Segment	Residential, SME
Customers Involved	300 households
Cost	AUD 10.42 M
Funding Source	Commercial Partner, Regulator-Approved Spend
Network	Network in Qingdao, Shandong
Connection Point	Zone Substations
Location	Qingdao
State	Shandong Province
Country	China
Future Plans	This is a lighthouse project to guide the development of ocean energy generation and integration for the 6000 islands in China.
Contact Name	Confidential
Contact Email	
Contact Phone	
Contact Link	
Background	The 500 kW OES independent power system demonstration project and Qingdao Ocean Energy Comprehensive Test Base in Qingdao were officially started in November 2012. The total investment is about 60 million yuan (AUD 10.42 million). The project is completed in September 2013, and can provide 500kW of electricity.

Areas of Relevance	Area	Comments	Relevance
	10. Smooth out intermittent generation output	Qingdao coastal current speed is low. The project and the pilot base in Qingdao focus on the efficient use of the ocean energy, which sets a very promising example for other demonstration projects in China. The project has a total installed capacity of 500 kW renewable generation capacity, including tidal, wind and solar energy systems. The unique aspect of this project is the integration of ocean energy, and wind and solar generation into the micro grid. However, its applicability in Australia worth further investigation.	Med
Approaches	**Approach**	**Comments**	
	Demonstration Project	Qingdao OES Independent Power System Demonstration Project includes 3 sets of 300 kW tidal current energy systems, and 150 kW wind power system and 50 kW solar PV installation, focusing on problems such as the OES (Ocean Energy System) equipment's reliability and generation output bottleneck (instability of renewable generation). The project aims to achieve breakthrough on the key technology of ocean energy system, renewable integration in micro grid and intelligent power supply.	
Results	**Result**	**Comments**	
	No results yet	The project result is under internal evaluation.	

Recovery of Resources from Biomass and Residual Waste

Project ID	250
Organisation	ACT Government, Environment and Sustainable Development Directorate
Organisation Type	Government
Partners	Four companies were shortlisted via an EOI process
Story	Each year Canberra's households and businesses send more than 100,000 tonnes of organic waste to landfill. A regional materials recovery and bioenergy facility could increase resource recovery rates while converting residual ACT and regional organic waste into renewable electricity. This would reduce greenhouse gas emissions from ACT landfills by over 70,000 tonnes per annum. The ACT is looking to procure an Integrated Material Recovery Facility and an Energy from Waste facility - with the support of a contract for difference, bioenergy feed in tariff. This project is currently at the EOI stage.
Start Date	30-01-2013
End Date	30-10-2013
Customer Segment	Industrial, Large commercial, Residential
Customers Involved	None
Cost	
Funding Source	State Government
Network	ActewAGL
Connection Point	
Location	Canberra
State	ACT
Country	Australia
Future Plans	
Contact Name	Bruce Edgerton
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Contact Phone	0402794905
Contact Link	
Background	Each year Canberra's households and businesses send more than 100,000 tonnes of organic waste to landfill. A regional materials recovery and bioenergy facility could increase resource recovery rates while converting residual ACT and regional organic waste into renewable electricity. This would reduce greenhouse gas emissions from ACT landfills by over 70,000 tonnes per annum. The ACT Government is exploring options to deliver an integrated materials recovery and bioenergy facility. Advanced thermal processing technologies such as gasification, pyrolysis and plasma gasification are now sufficiently mature to be effectively deployed in the ACT. Advance thermal processing technologies can not only generate renewable energy more cleanly and efficiently than conventional combustion, but they can also produce value-added products such as bio char for agriculture and sustainable transport fuels. This approach could achieve more than 90% total resource recovery for the ACT, displace fossil fuel power generation and produce valuable products for agriculture and industry.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	Received commercial information around cost of providing Material Recovery Facilities and Energy from Waste facilities in the ACT	Low
	4. Inform the regulatory environment for renewable energy.	Provided information on the degree of pre-processing and exhaust gas clean up required for an EfW facility in the ACT	Low
Approaches	**Approach**	**Comments**	
	Demonstration Project	The ACT is looking to procure an Integrated Material Recovery Facility and an Energy from Waste facility - with the support of a contract for difference, bioenergy feed in tariff.	
Results	**Result**	**Comments**	
	No results yet	This project is currently at the EOI stage	

Redeployable Hybrid Power

Project ID	130
Organisation	Laing O'Rourke
Organisation Type	Other
Partners	
Story	Many remote Australian communities rely on diesel generators that are expensive to run and are subject to energy uncertainty due to the volatility of fuel prices. Having to transport the fuels long distances is also costly, dangerous and subject to variable weather conditions. Laing O'Rourke has developed a redeployable hybrid power plant, consisting of a portable solar farm, a containerised integration module and traditional diesel generators. The project involves the detailed design and prototyping to provide a technical solution ready for deployment to the Australian market.
Start Date	06-03-2014
End Date	16-08-2014
Customer Segment	
Customers Involved	
Cost	AUD 820,619
Funding Source	Federal Government
Network	
Connection Point	
Location	
State	
Country	Australia
Future Plans	Yes, we are seeking to deploy the first portable solar-diesel hybrid plant in Queensland later this year. Multiple fringe-of-grid, grid-constrained and off-grid users have approached Laing O'Rourke. These include Australian and overseas users. Sectors include mining and resources, oil and gas, electricity retailers, defence and remote communities
Contact Name	Dr Will Rayward-Smith
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Contact Phone	+61427548813
Contact Link	http://arena.gov.au/project/redeployable-hybrid-power/
Background	Laing O'Rourke has developed a redeployable hybrid power plant, consisting of a portable solar farm, a containerised integration module and traditional diesel generators. The project involves the detailed design and prototyping to provide a technical solution ready for deployment to the Australian market.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The project includes the commercial feasibility of portable solar-diesel hybrid plants	Med
	2. Support the transition to an alternative electricity pricing approach	The project includes the investigation of PPA arrangements ($/kWh) in addition to traditional equipment hire lease arrangements ($/week)	Low
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The project investigates a new business model of temporary renewables as opposed to permanent renewables. A detailed design of a portable solar farm that has been patented and is undergoing prototyping.	High
	8. Establish control over, or otherwise influence, intermittent generation sources	The portable solar-diesel power plant may be used by fringe-of-grid or grid-constrained users to address this objective	Med
	10. Smooth out intermittent generation output	The portable solar-diesel power plant may be used by fringe-of-grid or grid-constrained users to address this objective	Med
	11. Alter local load profile to match a desired level	The portable solar-diesel power plant may be used by fringe-of-grid or grid-constrained users to address this objective	Med
	12. Use distributed energy solutions to address network and system constraints	The portable solar-diesel power plant may be used by fringe-of-grid or grid-constrained users to address this objective	Med
	13. Store and organise information on customer renewable energy deployments	The project involves the remote monitoring of off-grid power generation assets at two remote accommodation villages	Low

Approaches	Approach	Comments
	New product development	The project involved the technical development in conjunction with commercial feasibility such that the technical solution is commercially optimal. The Technology Readiness Level (TRL) of the technology was advanced methodically with written documentation regarding all design decisions and calculations.

Results	Result	Comments
	Built a portable solar farm	The result is the detailed design of a portable solar farm that has been patented and is undergoing prototyping.

Reforming the Energy Vision (REV)

Project ID	174
Organisation	New York Department of Public Service (NYDPS)
Organisation Type	Government
Partners	
Story	The report "Reforming the Energy Vision" by the staff of the New York Department of Public Service is the beginning process of regulatory development aimed at reconsidering the role of the distributor in an environment of extensive distributed energy resources. The report develops "the concept of the Distributed System Platform Provider (DSPP) which will create markets, tariffs, and operational systems to enable behind the meter resource providers to monetize products and services that will provide value to the utility system and thus to all customers. Resources provided could include energy efficiency, predictive demand management, demand response, distributed generation, building management systems, microgrids, and more. This framework will provide customers and resource providers with an improved electricity pricing structure and vibrant market to create new value opportunities. The DSPP will use localized, automated systems to balance production and load in real time while integrating a variety of DER, such as intermittent generation resources, and energy storage technologies. The DSPP would manage DER products and services in real time, using technologies that allow the flexible and instantaneous use of generation or demand response to meet customer and system needs." The report elaborates on the roles and regulation of the DSPP, namely:- • Specifying the products and services that can be exchanged between the DSPP and owners of DER either directly or through an ESCO and the ISO • Providing pricing structures for DER products • Serving as the local balancing authority, forecasting load and dispatching resources in real time • Developing comms networks capable of supporting a smart grid including SCADA, telemetry, distribution automation, and data backhaul
Start Date	26-12-2013
End Date	24-04-2014
Customer Segment	
Customers Involved	
Cost	
Funding Source	
Network	
Connection Point	
Location	New York
State	
Country	United States
Future Plans	
Contact Name	Mark Reeder
Contact Email	mark_reeder@dps.state.ny.us
Contact Phone	+ 518 474 1721 or 1522
Contact Link	
Background	The Commission's Order of December 26, 2013 announced a fundamental reconsideration of the regulatory paradigms and markets, examining how policy objectives are served both by clean energy programs and by the regulation of distribution utilities. With respect to our regulation of distribution utilities, the Order identified the following key questions: 1) What should be the role of the distribution utilities in enabling system wide efficiency and market based deployment of distributed energy resources and load management? 2) What changes can and should be made in the current regulatory, tariff, and market design and incentive structures in New York to better align utility interests with achieving our energy policy objectives?

Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach	The project begins a fundamental reconsideration of regulatory paradigms and markets, examining how policy objectives are served both by clean energy programs and by the regulation of distribution utilities.	Med
	4. Inform the regulatory environment for renewable energy	The project aims to consider what should be the role of the distribution utilities in enabling system wide efficiency and market based deployment of distributed energy resources and load management?	High
	6. Make the process of integrating renewable energy into the grid more cost-efficient	One of the central components of the REV vision is the concept of the utility as a Distributed System Platform Provider (DSPP). The DSPP will modernize its distribution system to create a flexible platform for new energy products and services, to improve overall system efficiency and to better serve customer needs. The DSPP will incorporate Distributed Energy Resource into planning and operations to achieve the optimal means for meeting customer reliability needs.	Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The project aims to consider what should be the role of the distribution utilities in enabling system wide efficiency and market based deployment of distributed energy resources and load management?	Med

Approaches	Approach	Comments
	Other	One of the central components of the REV vision is the concept of the utility as a Distributed System Platform Provider (DSPP). The DSPP will modernize its distribution system to create a flexible platform for new energy products and services, to improve overall system efficiency and to better serve customer needs. The DSPP will incorporate Distributed Energy Resources (DER) into planning and operations to achieve the optimal means for meeting customer reliability needs.

Results	Result	Comments
	No results yet	Project ongoing. Results too early to assess.

Regulating Distribution Transformer

Project ID	354
Organisation	Energex
Organisation Type	Government
Partners	
Story	The Project isd aimed at evaluating alternate solutions to Solar PV related voltage regulations issues on the LV network. This trial builds on previous trials aimed at identifying LV issues and alternate solutions for areas where existing regulation techniques are insufficient or more expensive. The solution type under investigation in this trial is a distribution transformer with an integrated power electronic regulator. This 100kVA product can target smaller distribution supply areas which are typically where high solar PV penetration levels (installed PV capacity / transformer rating) are more easily achieved.
Start Date	31/10/13
End Date	30/06/17
Customer Segment	Residential
Customers Involved	40
Cost	
Funding Source	Regulator-Approved Spend
Network	Energex
Connection Point	Customer Connections, Distribution Feeders
Location	Brisbane
State	QLD
Country	Australia
Future Plans	the project is about to enter the evaluation stage.
Contact Name	Aidan Roberts
Contact Email	aidanroberts@energex.com.au
Contact Phone	07 3664 5792
Contact Link	
Background	

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Voltage regulation issues at LV caused by Solar PV sometimes require expensive network augmentation solutions. This project aims to evaluate the extent to which this device can avoid the more expensive network augmentation and reduce the overall cost.	
	12. Use distributed energy solutions to address network and system constraints	The introduction of this device provides additional dynamic regulation at the distribution transformer. This may allow the network to overcome existing solar PV related voltage constraints and potentially allow higher penetrations.	

Approaches	Approach	Comments

Results	Result	Comments

Regulating Distribution Transformer

Project ID	359
Organisation	Energex
Organisation Type	Network
Partners	
Story	The project is aimed at evaluating alternate solutions to Solar PV related voltage regulations issues on the LV network. This trial builds on previous trials aimed at identifying LV issues and alternate solutions for areas where existing regulation techniques are insufficient or more expensive. The solution type under investigation in this trial is a distribution transformer with an integrated power electronic regulator. This 100kVA product can target smaller distribution supply areas which are typically where high Solar PV penetration levels (installed PV capacity / transformer rating) are more easily achieved. Voltage regulation issues at LV caused by Solar PV sometimes require expensive network augmentation solutions. This project aims to evaluate the extent to which this device can avoid the more expensive network augmentation and reduce the overall cost. The introduction of this device provides additional dynamic regulation at the distribution transformer. This may allow the network to overcome existing Solar PV related voltage constraints and potentially allow higher penetrations.
Start Date	31/10/2013
End Date	30/06/2017
Customer Segment	Residential
Customers Involved	40
Cost	
Funding Source	Regulator-Approved Spend
Network	Energex
Connection Point	Customer Connections, Distribution Feeders
Location	Brisbane
State	QLD
Country	Australia
Future Plans	Yes, the project is about to enter the evaluation stage.
Contact Name	Aidan Roberts
Contact Email	aidanroberts@energex.com.au
Contact Phone	(07) 3664 5792
Contact Link	
Background	The project is aimed at evaluating alternate solutions to Solar PV related voltage regulations issues on the LV network. This trial builds on previous trials aimed at identifying LV issues and alternate solutions for areas where existing regulation techniques are insufficient or more expensive. The solution type under investigation in this trial is a distribution transformer with an integrated power electronic regulator. This 100kVA product can target smaller distribution supply areas which are typically where high Solar PV penetration levels (installed PV capacity / transformer rating) are more easily achieved.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Voltage regulation issues at LV caused by Solar PV sometimes require expensive network augmentation solutions. This project aims to evaluate the extent to which this device can avoid the more expensive network augmentation and reduce the overall cost.	Low
	12. Use distributed energy solutions to address network and system constraints	The introduction of this device provides additional dynamic regulation at the distribution transformer. This may allow the network to overcome existing Solar PV related voltage constraints and potentially allow higher penetrations.	Med

Approaches	Approach	Comments

Results	Result	Comments

Renewable Energy Buyback Pricing

Project ID	332
Organisation	Horizon Power
Organisation Type	Network
Partners	
Story	Details of this project available on request.
Start Date	
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	
Network	Horizon Power
Connection Point	
Location	
State	WA
Country	Australia
Future Plans	
Contact Name	Scott Davis
Contact Email	Scott.Davis@horizonpower.com.au
Contact Phone	0457 784 119
Contact Link	
Background	

Areas of Relevance	Area	Comments	Relevance

Approaches	Approach	Comments

Results	Result	Comments

Renewable Islands: Setting for Success

Project ID	278
Organisation	International Renewable Energy Agency (IRENA)
Organisation Type	Government
Partners	
Story	The report – prepared by the International Renewable Energy Agency (IRENA) in support of the Global Renewable Energy Islands Network – offers case studies from the Islands of Cabo Verde, Cyprus, Fiji and Samoa, where governments have succeeded in lowering energy costs by scaling up renewables. The case studies in this report show that a wide variety of islands in different locations and at different levels of development can all attract investment in cost-effective renewable energy resources through a mix of four key ingredients: Political priority to attract investment; a market framework for investment; technical planning for investment; and capacity to implement investment. Looking at islands in oceans around the world, this report shows how these four factors have combined to create successful settings for renewable power investment. The four settings used for the case studies were Cabo Verde, Cyprus, Fiji and Samoa.
Start Date	2014
End Date	2014
Customer Segment	Industrial, Large commercial, SME
Customers Involved	
Cost	
Funding Source	
Network	
Connection Point	
Location	Islands around the world
State	
Country	Various
Future Plans	
Contact Name	IRENA
Contact Email	http://www.irena.org/Contact/
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Background	Islands around the world are heavily reliant on costly oil imports from distant locations which can burden government budgets and inhibit investment in social and economic development. Indigenous renewable energy resources such as hydropower, wind power, solar power, geothermal power, bioenergy and wave power can reduce these expensive imports and create important business and employment opportunities. But how should islands go about attracting the investment to put these resources to use?

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	Calls for a new understanding of renewable energy and highlights governments role in valuing the benefits and support the prosperity of the renewable energy market	Low
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Provides examples of island nations operating networks with distributed energy resources	Low
	4. Inform the regulatory environment for renewable energy	Provides examples and suggestion for island nations to set in place a regulatory environment which encourages the use of renewable energy	Low
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	Provides examples and suggestions of current and future process required to assist in promoting the use and investment in renewable energy	Low

Approaches	Approach	Comments
	Case Study	The report – prepared by the International Renewable Energy Agency (IRENA) in support of the Global Renewable Energy Islands Network – offers case studies from the Islands of Cabo Verde, Cyprus, Fiji and Samoa, where governments have succeeded in lowering energy costs by scaling up renewables.

Results	Result	Comments
	Distributed energy benefits from strong policy backing	To attract investment in renewable energy on an island results from a realisation by its people, its utilities and its leaders that it is paying too much money for electricity and renewable power offers a way out. To be credible and have an impact, the political priority must be clearly articulated by ministers and embodied in legislation
	Market reform is needed	Market framework for investment: ensure that the electricity market is open to participation by all types and sizes of players who could profit by installing renewable power facilities. Regulations should make it profitable for utilities to invest in cost-effective renewable power options.
	Distributed energy resources need careful planning, analysis and predictive algorithms	Technical planning for investment: ensure that investment in renewable power options is consistent with the economic interests of the island and does not impair the reliability of service.

Renewables-based Neighbor Comparisons Project

Project ID	320
Organisation	Opower
Organisation Type	Proponent
Partners	A regulated utility located on the West Coast of the United States
Story	Opower's neighbour-based insights are able to intelligently compare customers with self-generation to other customers with self-generation. The platform can also ensure that customers without renewables are compared to each other. By ensuring more accurate neighbour comparisons, it helps educate customers about their energy more effectively by providing as much context as possible for evaluating usage.
Start Date	
End Date	Ongoing
Customer Segment	Residential
Customers Involved	50,000
Cost	
Funding Source	Regulator-Approved Spend
Network	California ISO (United States)
Connection Point	Customer Connections
Location	
State	California
Country	United States
Future Plans	This is a feature set that Opower has available to all 93 clients in 9 countries, should they elect to take advantage of it.
Contact Name	Juliet Rothenberg
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Contact Phone	+1 571 483 3013
Contact Link	
Background	Opower is a customer engagement platform for utilities that helps customers engage with their energy data across print, email, IVR, SMS, and web. One of the components that Opower found most engaging for users is comparing their energy use with that of similar homes in their neighbourhood, so that they can see how their home is performing. Self-generation through renewables presents an interesting challenge for this comparison, since it is unfair and not useful to compare the net usage of customers with self-generation to those without.

Areas of Relevance	Area	Comments	Relevance
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	Opower's behavioural energy efficiency techniques take into account whether the customer utilizes distributed energy, to enable fairer and more useful insights for customers. Opower's approach addresses the objective quite well. The platform's innovativeness lies in the combination of normal peer comparison technique and distributed renewable generation feedback. which significantly improves consumer and prosumer engagement.	High

Approaches	Approach	Comments
	Energy Efficiency Measures	The project is integrated within Opower's existing utility software platform for customer engagement and behavioural energy efficiency.

Results	Result	Comments
	Information alone can have a behaviour changing effect	By ensuring accurate neighbour comparisons, Opower was able to deliver relevant energy insights to self-generating households in a meaningful way. For context, Opower's behavioural energy efficiency programs generally produce energy savings of 1.5% - 2.5%.

Residential Storage Trial

Project ID	355
Organisation	CitiPower and Powercor Australia
Organisation Type	Network
Partners	
Story	"Building a network of the future" is one of Citipower and Powercor's five key strategic focus areas. Residential energy storage will be one of the key technologies that impacts future customers consumption patterns and the functional requirements of the network of the future. Residential energy storage systems have the potential to be utilised for a variety of network, market and customer benefits. Residential energy storage systems have the potential to be utilised for a variety of networks, market and customer benefits. The project aims to build capability and unlock the customer and network benefits of residential storage to help CitiPower and Powercor design the Network of the Future.
Start Date	01/06/2015
End Date	01/06/2016
Customer Segment	Residential
Customers Involved	20
Cost	$0.5m
Funding Source	Discretionary Spend, Regulator-Approved Spend
Network	Citipower
Connection Point	Customer Connections
Location	Melbourne
State	VIC
Country	Australia
Future Plans	Yes we envisage a trial period of 1-2 years before handing over the units to customers and removing the units.
Contact Name	Leigh Chivers
Contact Email	lchivers@powercor.com.au
Contact Phone	03 9297 6066
Contact Link	
Background	

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The project will install 20 residential batteries with solar PV and be able to record and measure the benefits for the customer and the network.	Med
	2. Support the transition to an alternative electricity pricing approach	The project will be able to identify the best use cases that combine benefits for energy storage for the customer and network.	Low
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The units will be installed "beyond the meter" and be utilised for both customer and network benefits.	Low
	4. Inform the regulatory environment for renewable energy	Network benefits recorded can be scaled to provide network augmentation alternatives.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources	Records benefits will increase customer confidence to take up solar and storage solutions with networks.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Learnings from the project will be used to implement safe and practical solar and storage network integration policy.	Low
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	Learnings from the project will be used to implement safe and practical solar and storage network integration policy.	Low
	8. Establish control over, or otherwise influence, intermittent generation sources	the project will allow the peak shifting of excess PV generation into the customer and networks peaks where it is more useful to the customer and network.	Med
	9. Strengthen the network to manage higher renewable energy penetration	The project will reduce the amount of PV export, therefore, allowing for the higher levels of PV consumption in the future.	Med
	10. Smooth out intermittent generation output	The project will allow the peak shifting of excess PV generation into the customer and network peaks, limiting excess PV export and increasing PV self consumption.	Med
	11. Alter local load profile to match a desired level	The project will allow the peak shifting of excess PV generation into the customer and network peaks where it is more useful to the customer and network.	Med
	12. Use distributed energy solutions to address network and system constraints	PV generation back feed and low voltages at peak times have been identified at some locations, the distributed storage will be used to rectify these undesired characteristics.	Med
	13. Store and organise information on customer renewable energy deployments	The project will improve the networks and customers' capacity to correctly size and utilise energy storage.	Low

Approaches	Approach	Comments

Results	Result	Comments

Residential Battery Storage Trial

Project ID	241
Organisation	SP AusNet
Organisation Type	Network
Partners	
Story	The concept of using batteries for peak demand management is not new; however with the prices of battery storage dropping and with the potential entry of Electric Vehicles in the consumer market, the concept is now becoming feasible. SP AusNet is conducting a residential battery storage trial to understand impacts and benefits that can be derived from using batteries or EVs for demand management before such technologies penetrate the mass market. This trial provides an integrated residential storage solution to ten customers with their associated solar panels, inverters, metering and energy management systems. The storage system has internet connectivity so that control signals can be sent to start charging or discharging and to retrieve measurement data. Data from the trial will be collected for a period of two years.
Start Date	27-12-2012
End Date	01-04-2015
Customer Segment	Residential
Customers Involved	10
Cost	AUD 370,000
Funding Source	Discretionary Spend
Network	SP Ausnet
Connection Point	Customer Connections
Location	Various locations on SP AusNet distribution network
State	VIC
Country	Australia
Future Plans	Yes until the all the required data is gathered.
Contact Name	Terry jones
Contact Email	Terry.jones@sp-ausnet.com.au
Contact Phone	03 9695 6248
Contact Link	
Background	The concept of using batteries for peak demand management is not new; however with the prices of battery storage dropping and with the potential entry of Electric Vehicles in the consumer market, the concept is becoming feasible. In order to validate modelling and inform strategy it is important that SP AusNet conduct a residential battery storage trial to understand impacts and benefits that can be derived from using batteries or EVs for DM before such technologies penetrate the mass market. An EV is essentially a battery on wheels so SP AusNet could potentially use an EV battery for DM. However the current lack of EVs in the market coupled with the inability of existing EVs to control the charging and discharging of the battery into the home makes DM trials difficult to conduct with today's EV fleet. Therefore to simplify analysis, the Residential Battery Storage Trial uses a stationary battery connected to consumer homes that can be controlled by SP AusNet to simulate the potential characteristics of a DM enabled EV.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	Data collected via the trial has a resolution to one second intervals. This will be used to accurately quantify the benefits/costs of renewable energy	Med
	9. Strengthen the network to manage higher renewable energy penetration	Data will be used to assess the potential to integrate higher levels of distributed energy by validating the effectiveness of various algorithms	Low
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The trial will better inform the process required to install distributed energy resources	Low
	8. Establish control over, or otherwise influence, intermittent generation sources	Trial functionality will be able to assess this	Low
	11. Alter local load profile to match a desired level	Trail functionality includes a peak demand management mode	Low

Approaches	Approach	Comments
	Storage, Customer-Connected	This trial provides an integrated residential storage solution to ten customers with their associated solar panels, inverters, metering and energy management systems. The storage system has internet connectivity so that control signals can be sent to start charging or discharging and to retrieve measurement data. Data from the trial will be collected for a period of two years. The trial will: -Design a battery solution that offers peak demand management functionality at the residential level -Install solution at 10 residential homes -Use the PV/storage system as a DM solution and as a proxy for EVs -Access impact and benefits on the network using 2 years / 1 second data

Results	Result	Comments
	No results yet	All 10 residential battery storage systems are in operation and providing granular data on its performance. SPA is currently in the process of compiling the data and is accessing the effectiveness of the system.

Residential Building Energy Efficiency

Project ID	258
Organisation	CSIRO
Organisation Type	Government, Research
Partners	Department of Industry
Story	In 2006, the Building Code of Australia (BCA) set a new residential building energy efficiency standard of 5 stars, as rated by software tools accredited under the Nationwide House Energy Rating Scheme (NatHERS). To reach the 5-star energy efficiency standard, architects and builders could choose from a large variety of options, such as increasing insulation in ceilings, walls and floors; using double glazing; and redesigning house layout and orientation. To assess whether the new standard was achieving its goals, the Australian Government asked CSIRO to: i) find out whether the 5-star standards have actually reduced heating and cooling energy use of houses compared with those built to the earlier 3.5 to 4-star standard; and ii) determine the actual benefits and costs of meeting the 5-star standard. To undertake this task, CSIRO studied 414 houses in the principal centres of population of three BCA climate zones over a winter and summer period. Analysis of the household data revealed that, on average, houses in Adelaide and Melbourne with PV arrays use significantly less electricity (15 kWh) than houses without (21 kWh). However, in Brisbane, houses with PV systems use 4% more electricity than houses without a PV system. Houses with PV in Adelaide use 34% less electricity, regardless of the season. This would indicate that households that have installed a PV system are energy-saving households as well. The project also collected 30 minutely energy consumption and generation data for each house with a PV system installed. This can be used to address the match between residential energy usage patterns and PV generation profiles and see how it impacts peak energy times.
Start Date	01-08-2011
End Date	01-12-2013
Customer Segment	Residential
Customers Involved	413
Cost	AUD 1.3 M
Funding Source	Federal Government
Network	Multiple - Houses located in Melbourne, Brisbane and Adelaide
Connection Point	Customer Connections
Location	Melbourne, Brisbane and Adelaide
State	Vic, Qld, SA
Country	Australia
Future Plans	Yes. We are continuing to monitor the households and are utilising the energy data for a range of new research projects.
Contact Name	Michael Ambrose
Contact Email	michael.ambrose@csiro.au
Contact Phone	03 9252 6200
Contact Link	http://www.industry.gov.au/Energy/Pages/Evaluation5StarEEfficiencyStandardResi
Background	In 2006, the Building Code of Australia (BCA) set a new residential building energy efficiency standard of 5 stars, as rated by software tools accredited under the Nationwide House Energy Rating Scheme (NatHERS). To reach the 5-star energy efficiency standard, architects and builders could choose from a large variety of options, such as increasing insulation in ceilings, walls and floors; using double glazing; and redesigning house layout and orientation. The Regulation Impact Statement (RIS) on the 5-star standard analysed its likely impact on the energy efficiency of new houses relative to the previous standard. The RIS estimated that the 5-star standard would reduce heating and cooling energy costs, as well as greenhouse gas emissions. To assess whether the new standard was achieving its goals, the Australian Government asked CSIRO to: i) find out whether the 5-star standards have actually reduced heating and cooling energy use of houses compared with those built to the earlier 3.5 to 4-star standard; and ii) determine the actual benefits and costs of meeting the 5-star standard. To undertake this task, CSIRO studied 414 houses in the principal centres of population of three BCA climate zones over a winter and summer period.

Areas of Relevance	Area	Comments	Relevance
	4. Inform the regulatory environment for renewable energy	Although the primary aim of the project was not renewable energy, a high percentage of the volunteer households had solar PV installed: 28% of houses in Melbourne and Brisbane, and 45% of houses in Adelaide. Analysis of the data revealed that, on average, houses in Adelaide and Melbourne with PV arrays use significantly less electricity (15 kWh) than houses without (21 kWh). However, in Brisbane, houses with PV systems use 4% more electricity than houses without a PV system. Houses with PV in Adelaide use 34% less electricity, regardless of the season. This would indicate that households that have installed a PV system are energy-saving households as well.	Low
	13. Store and organise information on customer renewable energy deployments	30 minutely energy consumption and energy generation data was collected for each house with a PV system installed. This can be used to address the match between residential energy usage patterns and PV generation profiles and see how it impacts peak energy times. The data collected during this project can be used by industry.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources	Analysis of the data revealed that, on average, houses in Adelaide and Melbourne with PV arrays use significantly less electricity (15 kWh) than houses without (21 kWh). However, in Brisbane, houses with PV systems use 4% more electricity than houses without a PV system. Houses with PV in Adelaide use 34% less electricity, regardless of the season. This would indicate that households that have installed a PV system are energy-saving households as well.	Med

Approaches	Approach	Comments
	Customer Acceptance Testing	The project recruited and surveyed 414 volunteer households of different star ratings across three cities, in three different BCA climate zones. Each house was re-rated, measured inside and outside temperatures, and obtained household energy bills over the study period. A subset of 209 of these houses had detailed sub-circuit monitoring, mainly focussing on the energy used by heating and cooling appliances, but also included other circuits including PV (if installed). The study ran from June 2012 (winter) to the end of February 2013 (summer).The project calculated the average energy consumption of two cohorts of houses in each climate zone: those less than 5 star and those that were 5 stars or greater.

Results	Result	Comments
	In-home display devices help consumers understand their energy consumption	The 5-star standard significantly reduced the energy needed to maintain house temperatures in winter in the houses we studied. As well as saving energy, higher-rated houses were on average held at a temperature around 1 degree C higher than lower-rated houses during winter. The average cooling energy use in summer was greater in the higher-rated houses in Brisbane and Melbourne.
	Other	Greenhouse gas emissions were reduced in winter in higher-rated houses in all cities. However, summer emissions increased in higher-rated houses in all cities. Overall, greenhouse gas emissions were still reduced by 7% for the higher-rated houses over the year, despite the summer season increase.
	Other	Heating costs were reduced and cooling costs increased in higher-rated houses. The net annual impact was that Brisbane costs were greater in higher-rated houses, whereas Adelaide and Melbourne costs were lower for the higher-rated houses. The reductions in Adelaide were small, but in Melbourne the reduction was a significant (37% or $194 per year).
	Other	The higher-rated houses cost at least $5000 less in Adelaide and Melbourne for those elements of the building related to energy efficiency than lower-rated houses, and up to $7000 less in Brisbane. Increases in the amount of insulation and an apparent shift to more rectangular house design were the most influential aspects observed in the shift to higher-rated houses.

Residential Demand Management

Project ID	317
Organisation	Energex
Organisation Type	Government, Network
Partners	
Story	The Energex network has experienced very high levels of load growth, resulting in the need for significant capital investment. In many residential areas, this growth also resulted in the peak load times shifting from the winter to summer season, primarily due to appliances such as air-conditioners and swimming pool pumps. This project sought to establish new residential demand programs both through the roll-out of appropriate technology and extensive customer/community engagement. The project aimed to create customer awareness of peak demand and its impacts. The project also aimed to develop a better understanding of customers' abilities and desires to participate in DM programs. The project also rolled out DM program offerings that were technically and economically viable, provide reductions in peak demand, and are mutually beneficial to customers and Energex.
Start Date	2007
End Date	Ongoing
Customer Segment	Residential
Customers Involved	40,000
Cost	
Funding Source	Regulator-Approved Spend, State Government
Network	Energex
Connection Point	Customer Connections, Distribution Feeders, Subtransmission Feeders, Zone
Location	Brisbane
State	QLD
Country	Australia
Future Plans	This project has grown and evolved from originally piloting and trialling technologies and customer acceptance of the products to now being an ongoing business-as-usual offering to customers. The residential DM program is an ongoing program and funding is being sought in Energex's 2015-20 Regulatory Submission to continue the program.
Contact Name	Greg Flynn
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Contact Phone	07 3664 5758
Contact Link	https://www.energex.com.au/residential-and-business/positive-payback
Background	During the early 2000's Energex experienced very high levels of load growth in it's network, resulting in the need for significant capital investment. In many residential area, this growth also resulted in the peak load times shifting from the winter to summer season, primarily due to appliances such as air-conditioners and swimming pool pumps. This project sought to establish new residential demand programs both through the role-out of appropriate technology and extensive customer/community engagement.

Areas of Relevance	Area	Comments	Relevance
	5. Engage customers to build their and the industry's understanding of distributed energy resources	The project aimed to create customer awareness of peak demand and its impacts. The project also aimed to develop a better understanding of customers' abilities and desires to participate in DM programs. The project was successful in achieving successful results on customer and industry engagements.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Establishment of appropriate technology solutions to enable residential DM. The project also rolled out DM program offerings that were technically and economically viable, provide reductions in peak demand, and are mutually beneficial to customers and Energex.	Med

Approaches	Approach	Comments
	Demand Side Incentives	The project was initially established using a trials and pilots approach. Utilising a range of customer research and demographic information the initial program was established in a selected number of areas in partnership with local council. As these pilot programs progressed and more data was gathered, the customer offerings were refined to optimise take up rates, and the technology used was also refined prior to the program being rolled out as a broad-based residential DM program available to all customers. Primary products involved in the program include AS4755 Demand response Enabled air-conditioners, controlled/off-peak hot water systems, and controlled and/or energy efficient swimming pool pumps.
	Interviews and Surveys	Another important aspect of this project was engagement with the swimming pool industry and electrical appliance retailers (of air-conditioners).

Results	Result	Comments
	Customer engagement achieved	Customer and industry (Pool and Appliance Retailers) engagements were very successful.
	Incentives helped consumers reduce consumption during peak demand	Project has moved to a business-as-usual delivery model and planned demand reduction targets being achieved. The project's technical solutions are deployed and working, specifically AS4755 compliant air-conditioner control.

Residential Utility Support System (RUSS)

Project ID	279
Organisation	Ergon Energy
Organisation Type	Network
Partners	
Story	Residential areas of the Ergon Energy network are facing capacity and voltage regulation issues due to growth and high customer electricity demand. These problems are now being exacerbated by the dramatic increase of consumer photovoltaic (PV) installations. Traditionally Ergon Energy has dealt with such problems by upgrading Medium Voltage (MV) and Low Voltage (LV) distribution transformers, and replacing steel and other low rated conductors. These solutions do not generally solve all the issues, particularly the voltage regulation. The Residential Utility Support System (RUSS) addresses these issues by using a distributed energy storage device to support the network by discharging the battery, injecting real and reactive power at times of need, and recharging the battery during times of low electricity demand. RUSS assisted with improving voltage rise and drops on the network during both peak consumption and generation. The project has helped improve the analysis and understanding of peaks and customer load shape.
Start Date	15-03-2011
End Date	10-12-2013
Customer Segment	Residential
Customers Involved	9
Cost	AUD 495,000
Funding Source	Discretionary Spend
Network	Ergon Energy
Connection Point	Customer Connections
Location	Townsville
State	QLD
Country	Australia
Future Plans	
Contact Name	Michelle Taylor
Contact Email	michelle.taylor@ergon.com.au
Contact Phone	
Contact Link	
Background	Residential areas of the Ergon Energy network are facing capacity and voltage regulation issues due to growth and high customer electricity demand. These problems are now being exacerbated by the dramatic increase of consumer photovoltaic (PV) installations. Traditionally Ergon Energy has dealt with such problems by upgrading Medium Voltage (MV) and Low Voltage (LV) distribution transformers, and replacing steel and other low rated conductors. These solutions do not generally solve all the issues, particularly the voltage regulation. The Residential Utility Support System (RUSS) addresses these issues by using a distributed energy storage device, very similar in concept to the larger Grid Utility Support System (GUSS) product targeted for SWER lines, to support the network by discharging the battery, injecting real and reactive power at times of need, and recharging the battery during times of low electricity demand.

Areas of Relevance	Area	Comments	Relevance
	9. Strengthen the network to manage higher renewable energy penetration	The project assisted with improving voltage rise and drops on the network during both peak consumption and generation. Improved analysis and understanding of peaks and customer load shape. Improved understanding of Lithium Ion battery storage and management systems	Med

Approaches	Approach	Comments
	Storage, Customer-Connected	The Residential Utility Support System (RUSS) addresses voltage issues by using a distributed energy storage device to support the network by discharging the battery, injecting real and reactive power at times of need, and recharging the battery during times of low electricity demand.

Results	Result	Comments
	High degree of variability observed	The load shapes on all three phases were observed to exhibit a large degree of variability. This high degree of variability was essentially due to the inherently low diversity associated with the relatively low number of customers (only 33 on this network). The timing of large loads (such as irrigation pumps on 2 of the properties) strongly influences the overall load on the phase.
	Energy storage and reactive power can help control voltage	Reactive power control was observed to have a positive impact on the customer voltages.

Reward Based Tariffs Trial

Project ID	154
Organisation	Ergon Energy and Energex
Organisation Type	Network
Partners	
Story	Residential consumption accounts for less than one-third of total electricity use, it has important implications for peak demand mainly owing to increasing use of air conditioning. Demand management mechanisms are being used to address this challenge. The trial aims to understand how consumers in different regions and climatic conditions across Queensland respond to time varying tariffs to reduce electricity demand at peak times. Further to this, it endeavours to improve understanding of consumer attitudes and actions taken in response to alternate electricity pricing strategies. Households across the Queensland regions were allocated three groups: consumption group, capacity group and control group. The consumption group trialled a combination of time -of-use (TOU) pricing and dynamic peak pricing (DPP) tariff that consisted of a day rate (default residential tariff), a 20% cheaper night rate and a peak rate (applied on event days). The capacity group was asked to limit consumption below a threshold (4.5kWh) between 4pm-8pm on event days. The control group was used as a benchmark to compare responses from the other two groups. Both the survey responses and energy consumption data show participants across all three regions (Cairns, Toowoomba and Brisbane) reduced their consumption during peak times on event days. Only 15% of the participants reported that they did not change their electricity usage on event days. Reductions of 17% to 23% were achieved when comparing average energy use between 4pm-8pm on event days to that of the Control group (with the exception of the Brisbane Capacity group). Of those participants who were surveyed, 71% found it easy to respond on event days, 21% were neutral and 8% found it difficult.
Start Date	01-01-2011
End Date	01-04-2013
Customer Segment	Residential
Customers Involved	3700
Cost	
Funding Source	Commercial Partner
Network	Energex, Ergon Energy
Connection Point	Customer Connections
Location	Cairns, Toowoomba and Brisbane
State	QLD
Country	Australia
Future Plans	
Contact Name	
Contact Email	positivepayback@energex.com.au
Contact Phone	
Contact Link	https://www.yourpowerqld.com.au/rbt
Background	Although electricity costs have stabilised in recent years, from 2001 to 2006, increasing demand for electricity during peak times saw these costs rise steadily. In proportional terms, demand has increased significantly more than energy consumption. Even though residential consumption accounts for less than one-third of total electricity use, it has important implications for peak demand mainly owing to increasing use of air conditioning. Demand management mechanisms are being used to address this challenge.

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Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach	The trial aims to understand how consumers in different regions and climatic conditions across Queensland respond to time varying tariffs to reduce electricity demand at peak times.	Med
	4. Inform the regulatory environment for renewable energy	Use trial findings to guide Queensland distribution network policy development regarding further network pricing models.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources	The trial endeavours to improve understanding of consumer attitudes and actions taken in response to alternate electricity pricing strategies.	High
Approaches	**Approach**	**Comments**	
	Demand Side Incentives	Households across the Queensland regions were allocated three groups: consumption group, capacity group and control group. The capacity group was asked to limit consumption below a threshold (4.5kWh) between 4pm-8pm on event days.	
	Load Monitoring & Analysis	To see how participants responded, the meter readings of the Control group, Consumption group and Capacity group were compared. Data analysis was undertaken using interval consumption data, weather data and survey data.	
	Demand Side Incentives	Households across the Queensland regions were allocated three groups: consumption group, capacity group and control group. The consumption group trialled a combination of time -of-use (TOU) pricing and dynamic peak pricing (DPP) tariff that consisted of a day rate (default residential tariff), a 20% cheaper night rate and a peak rate (applied on event days). On event days, the peak rate applied if their electricity usage exceeded a threshold during the 4pm-8pm period. Three different peak rates were trialled. These ranged from 5 to 8 times the usual electricity rate.	

Results	Result	Comments
	Trial tariffs helped change household behaviour towards energy consumption	Both the survey responses and energy consumption data show participants across all three regions (Cairns, Toowoomba and Brisbane) reduced their consumption during peak times on event days. Only 15% of the participants reported that they did not change their electricity usage on event days. With the exception of the Brisbane Capacity group, reductions of 17% to 23% were achieved when comparing average energy use between 4pm-8pm on event days to that of the Control group. These findings are consistent with other Australian tariff trials which found average reductions in peak demand were between 13% and 40%. Of those surveyed 71% found it easy to respond on event days, 21% were neutral and 8% found it difficult. Trial tariffs provided reductions of around 0.2kW to 0.4kW per household. These reductions were in addition to those achieved from load control via retail economy tariffs.

Low income households may reduce their electricity usage during peak times	In general, all participants within all energy consumption and income bands responded to price signals on event days. Those participants in low income and low annual energy consumption groups demonstrated they were able to reduce their consumption during peak times. In some cases, they achieved the greatest kilowatt reductions of all groups.

SGSC: Active Volt-Var Control Project

Project ID	158
Organisation	Ausgrid (Lead Organisation) and consortium partners
Organisation Type	Association, Government, Network, Proponent, Research, Retailer
Partners	Energy Australia, Landis and Gyr, GE Energy, Grid Net, IBM, CSIRO, TransGrid, Sydney Water, Hunter Water, the University of Newcastle, the University of Sydney, the City of Newcastle and Lake Macquarie City Council
Story	The project aimed to quantify and explore the impact that technologies such as Customer Voltage Reduction (CVR), STATCOM and Integrated Volt Var control (IVVC) have on reduced energy consumption at different levels of voltage reduction. It also worked to quantify the measured change in power factor and detected voltage variations at customers' premises. A key focus was on Active Volt-Var Control (AVVC) technologies, seeking to quantify the potential benefits for network businesses implementing these technologies as well as understand, analyse and report how AVVC operates as part of an integrated smart grid and contributes to enhanced network efficiencies. It was found that technologies such as STATCOM are effective in suppressing voltage fluctuation at the site of an intermittent load or source, and can also assist with transient stability and power quality. This type of voltage correction technique using power electronics may play an important role in enabling greater levels of intermittent renewable sources to be connected to the distribution network. As part of AVVC, a considerable amount of control is given to an automatic algorithm which system operators need to trust and rely upon. It will take time before these systems are trusted and it makes sense to run these applications in an advisory mode for some time first. In the future, the reach and footprint of 4G communications provided by AusGrid (and 3G fills by Telcos) will potentially define the areas that are able to use AVVC.
Start Date	
End Date	01-02-2014
Customer Segment	
Customers Involved	30000 households (overall trial)
Cost	AUD 100 M
Funding Source	Federal Government
Network	Ausgrid
Connection Point	Customer Connections, Distribution Feeders, Zone Substations
Location	Port Stephens
State	NSW
Country	Australia
Future Plans	
Contact Name	
Contact Email	
Contact Phone	1300 922 746
Contact Link	http://www.smartgridsmartcity.com.au/
Background	The Smart Grid, Smart City (SGSC) Program is established to investigate, at a commercial scale, the potential benefits associated with smart grid technologies within the energy sector. Active Volt-VAr Control (AVVC) explores the use of smart grid technology to dynamically (actively) manage voltage and reactive power within a distribution network.

Areas of Relevance	Area	Comments	Relevance
	9. Strengthen the network to manage higher renewable energy penetration	The project aimed to quantify and explore the impact that technologies such as Customer Voltage Reduction (CVR), STATCOM and Integrated Volt VAr control (IVVC) have on reduced energy consumption at different levels of voltage reduction.	Med
	9. Strengthen the network to manage higher renewable energy penetration	The project aimed to quantify the measured change in power factor and detected voltage variations at the customer's premise.	Med
	9. Strengthen the network to manage higher renewable energy penetration	The project aimed to quantify and understand the potential benefits (in terms of potential capital deferral) for network businesses in implementing Active Volt-VAr Control (AVVC) technologies.	Med
	9. Strengthen the network to manage higher renewable energy penetration	The project aimed to understand, analyse and report how Active Volt-VAr Control (AVVC) technologies operate as part of an integrated smart grid and contribute to enhanced network efficiencies.	Med

Approaches	Approach	Comments
	Volt / VAR Control	Trial Integrated Volt VAr control (IVVC) - An alternative approach to controlling voltage delivery which combines the control of all actuation devices within a network segment. The benefits to voltage delivery compared to the existing independently controlled actuators will be examined.
	Volt / VAR Control	Trial Conservative Voltage Reduction (CVR) – A small heavily metered section of the network is to be fed from a voltage regulator such that benefits from voltage reduction can be accurately measured, characterised and compared to predictions.
	Electrical System Modelling	Develop an approach to load modelling and to use those load models with network and STATCOM models to assess the potential benefits of using STATCOM technology within the distribution utility context.

Results	Result	Comments
	PV voltage problems can be resolved	Technologies such as STATCOM are effective in suppressing voltage fluctuation at the site of an intermittent load or source, and can also assist with transient stability and power quality. This type of voltage correction technique using power electronics may play an important role in enabling greater levels of intermittent renewable sources to be connected to the distribution network.
	Technology used to support distributed generation is not yet fully proven	As part of AVVC, considerable amount of control is given to an automatic algorithm which system operators need to trust and rely upon. It will take time before these systems are trusted and it makes sense to run these applications in an advisory mode for some time first.
	Communications networks are needed to support distributed generation	The selection of current control feeders relies on availability of 3G communications to provide the communications infrastructure. In the future, the reach and footprint of 4G communications provided by AusGrid (and 3G fills by Telcos) will potentially define the areas that are able to use AVVC.

SGSC: Distributed Generation and Storage

Project ID	136
Organisation	Ausgrid
Organisation Type	Network
Partners	EnergyAustralia, Landis and Gyr, GE Energy, Grid Net, IBM, CSIRO, TransGrid, Sydney Water, Hunter Water, the University of Newcastle, the University of Sydney, the City of Newcastle and Lake Macquarie City Council
Story	The Smart Grid, Smart City (SGSC) Program was established to investigate, at a commercial scale, the potential benefits associated with smart grid technologies within the energy sector. The project aimed to test the ability of enhanced information to inform network owners about the impact of distributed generation at high penetration levels. In doing so, how smart grids can manage the impacts of distributed generation in a way that permits higher levels of penetration also came under investigation. By examining whether distributed storage can improve the efficiency or capability of intermittent generation sources, the project addressed the question of whether distributed storage can be used to reduce or defer capital investments in the grid network. Finally, the SGSC Program sought to understand the potential for smart grid technologies to enable improved technical and/or economic performance of distributed generation.
Start Date	
End Date	01-02-2014
Customer Segment	
Customers Involved	30000 households (overall trial)
Cost	AUD 100 M
Funding Source	Federal Government
Network	Ausgrid
Connection Point	Distribution Feeders, Zone Substations
Location	Newcastle, Sydney and Upper Hunter
State	NSW
Country	Australia
Future Plans	
Contact Name	
Contact Email	
Contact Phone	1300 922 746
Contact Link	http://www.smartgridsmartcity.com.au/
Background	The Smart Grid, Smart City (SGSC) Program is established to investigate, at a commercial scale, the potential benefits associated with smart grid technologies within the energy sector.

Areas of Relevance	Area	Comments	Relevance
	13. Store and organise information on customer renewable energy deployments	The project aimed to test the ability of enhanced information to inform network owners about the impact of distributed generation at high penetration levels.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources.	The project aimed to investigate how smart grids can manage the impacts of distributed generation in a way that permits higher levels of penetration.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The project aimed to understand the potential for smart grid technologies to enable improved technical and/or economic performance of distributed generation.	Med
	12. Use distributed energy solutions to address network and system constraints	The project aimed to investigate whether distributed storage can be used to reduce or defer capital investments in the grid network.	Med
	11. Alter local load profile to match a desired level	The project aimed to examine whether distributed storage can improve the efficiency or capability of intermittent generation sources.	Med

Approaches	Approach	Comments
	Customer Acceptance Testing	Trials have been planned, designed and conducted to address data priorities and prove or disprove the energy resource management trial's hypotheses. Mainly, passive and active trial analyses, grid simulations, and desktop studies of technology and economic models.

Results	Result	Comments
	Storage devices need careful planning, analysis and predictive algorithms	In the field trial, it was observed that the distributed storage devices were scheduled to discharge between 4 pm and 9 pm, which was probably too wide a time range and diluted the peak shaving effect of the batteries. There is a risk that the battery charging cycles will create a new peak demand spike, if a larger number of batteries are installed.
	Storage devices need careful planning, analysis and predictive algorithms	Distributed storage devices need more careful planning, analysis and predictive algorithms to operate during a peak event due to the lead time to fully charge the device and the limited discharge time available.

Storage devices need careful planning, analysis and predictive algorithms	Benefit to customers depends heavily on exploiting the arbitrage opportunity between off-peak charging and peak discharging (with all discharged energy used by the customer), and therefore it is not economical to operate on a weekend or public holiday (where there is no peak tariff). If batteries were operated on weekend days, there would have been a significant customer cost.
Storage devices need careful planning, analysis and predictive algorithms	The design of the batteries means that, once charged, they must operate in a float mode which consumes roughly 300 W of power, until discharged. This battery "float" power consumption during non-discharge periods add costs rather than reduce cost. Therefore, consideration for the discharge patterns require to be finely tuned with the tariff periods to obtain maximum benefit.
PV, if uncontrolled, can create voltage problems for the network	With increased penetration of distributed generation and distributed storage there are negative impacts on the network if the network distributor does not monitor and adjust the network grid.
PV, if uncontrolled, can create voltage problems for the network	The combination of distributed generation and storage has been shown to be able to provide sufficient energy for a period of time on a feeder spur.
PV alone does not reduce peak demand	The current configuration of photovoltaic distributed generation has negligible impact on peak shaving. The fuel cell distributed generation does reduce the peak demand in a reliable and predictable manner. Wind turbine generation distribution is not a reliable or predictable source of energy to reduce the peak load.
PV voltage problems can be resolved	Photovoltaic, wind turbines, fuel cells and the discharge cycle of batteries, all these forms of distributed generation does not impact the quality of power with the exception of voltage. However, the voltage can be managed by smart technologies.
Storage devices need careful planning, analysis and predictive algorithms	When distributed storage and distributed generation is used in conjunction it has the potential benefit to minimise customers' energy bills only if a number of conditions and technologies are optimise for individual consumer demand patterns. This would require in using a flexible control approach, which would take into account expected customer demand, day of week (and tariffs).

SGSC: Newington Grid Battery Trial

Project ID	300
Organisation	Ausgrid
Organisation Type	Network
Partners	
Story	The Newington grid battery project is a Demand Management Innovation project where a 60kVA/120kWh Lithium Ion battery has been connected to the grid side of the low voltage network at a site location in the Sydney suburb of Newington. The project aims to investigate the benefit of a battery storage system under multiple scenarios including grid and customer side connection. The project commenced in October 2013 and followed on from the work performed under the Smart Grid Smart City project which experienced difficulties in securing a suitable site location within the project timeframe. The low voltage distributor where the battery is connected also has a large solar PV array (64kWp) located at a single customers premise which allows testing of the solar storage and renewable smoothing functions of the battery. In addition to utilising the battery's low voltage network monitoring and control functions, a dedicated monitoring device has been installed to measure the 11kV distribution feeder load in order to conduct automated network peak reduction trials using the local feeder load. At this stage no detailed analysis and results have been released.
Start Date	01-10-2013
End Date	31-03-2015
Customer Segment	SME
Customers Involved	1
Cost	
Funding Source	Regulator-Approved Spend
Network	Ausgrid
Connection Point	Customer Connections, Distribution Feeders
Location	Newington, Sydney
State	NSW
Country	Australia
Future Plans	This project is planned to continue until March 2015. All data that has been collected so far and future data will be analysed.
Contact Name	Paul Myors
Contact Email	pmyors@ausgrid.com.au
Contact Phone	02 9269 7316
Contact Link	www.smartgridsmartcity.com.au
Background	The Newington grid battery project is a Demand Management Innovation project where a 60kVA/120kWh Lithium Ion battery has been connected to the grid side of the low voltage network at a site location in the Sydney suburb of Newington. The project commenced in October 2013 and followed on from the work performed under the Smart Grid Smart City project which experienced difficulties in securing a suitable site location within the project timeframe. The project aim is to test a range of potential benefits of a battery storage system in an urban environment.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The project aims to investigate the benefit of a battery storage system under multiple scenarios including grid and customer side connection. 1. Peak reduction network benefits: to trial the control and scheduling methodology of the grid battery to reduce peaks in the local area. 2. Solar PV smoothing: using the battery to store renewable energy generation from the local solar PV systems during the day to decrease potential impacts on the network or customers. 3. Power quality issues: to further test the power quality benefits of installing a grid battery in an urban network. 4. Customer benefits: to test the potential customer benefits of installing a larger battery to reduce customer energy bills.	Med
	10. Smooth out intermittent generation output	One of the project objectives is to use the grid battery to absorb and store solar PV generation during the middle of the day when generation was at its maximum thus reducing the potential for reverse power flows. The stored energy is later used to supply the customer load when solar generation was not available or to reduce local network peak demand. The project aims to use storage to implement renewable smoothing, limiting the rate of change of load experienced by the local network due to intermittent solar PV generation, thereby reducing the impacts of the intermittent generation on grid power quality.	Med
	9. Strengthen the network to manage higher renewable energy penetration	The project investigated the ability of the grid battery to regulate network voltages by injecting/absorbing Vars	Med
	11. Alter local load profile to match a desired level	The project aims to alter the local load profile in two main ways: 1. Store solar PV energy during the day and discharge at times of local peak demand (early evening) to reduce peaks and improve load utilisation factors. 2. Operate the battery based on local customer loads to simulate customer operation and potential customer energy bill reduction benefits.	Low

Approaches	Approach	Comments
	Storage, Grid-Connected	The project has involved the leasing of a 60kVA/120kWh Lithium Ion battery system from Zen Energy Systems, and the system is self-contained in a standard shipping container. The battery has been connected on the grid side of the low voltage network in a site location adjacent to the Sydney suburb of Newington which has a high penetration of residential solar photovoltaic systems. The low voltage distributor where the battery is connected also has a large solar PV array (64kWp) located at a single customers premise which allows testing of the solar storage and renewable smoothing functions of the battery. In addition to utilising the battery's low voltage network monitoring and control functions, a dedicated monitoring device has been installed to measure the 11kV distribution feeder load in order to conduct automated network peak reduction trials using the local feeder load.

Results	Result	Comments
	No results yet	At this stage no detailed analysis and results have been released.

SGSC: Smart Grid, Smart City Project (Overall)

Project ID	186
Organisation	Ausgrid
Organisation Type	Network
Partners	EnergyAustralia, ARUP, Energeia, Sustainable Futures Institute, GE Australia, IBM, Landis+Gyr, Grid Net, CSIRO, TransGrid, the University of Newcastle, the University of Sydney, Newcastle City Council, City of Lake Macquarie, Hunter Water, Sydney Water….
Story	Smart Grid, Smart City was a $100 million Australian government funded project, led by AusGrid and supported by our consortium partners. The project tested a range of smart grid technologies; gathering information about the benefits and costs of implementing these technologies in an Australian setting. Up to 30,000 households will participate in the project which runs between 2010 and 2014. AusGrid lead a consortium of partners working together on this trial. EnergyAustralia, the Smart Grid, Smart City retailer partner, tested innovative technology and pricing offers. These products also made the most of new smart meters and were designed to give homes greater choice and control over their bills. Building a smart grid involves transforming the traditional electricity network by adding a chain of new smart technology. Technologies include smart sensors, new back-end IT systems, smart meters and a communications network. Technologies and products are being tested on both the electricity network and within households. The Smart Grid, Smart City consortium partners come from government, industry, and education industries.
Start Date	01-10-2010
End Date	30-06-2014
Customer Segment	Residential
Customers Involved	More than 7,000
Cost	AUD 500 M
Funding Source	Federal Government
Network	
Connection Point	Customer Connections, Distribution Feeders, Subtransmission Feeders, Zone
Location	
State	NSW
Country	Australia
Future Plans	Most of the technologies were early demonstration models and so decommissioned at the end of the trial. Some technologies with immediate network benefits, such as distribution monitoring and distributed temperature sensing on cables and automated switching remain part of Ausgrid's ongoing technology strategy.
Contact Name	Paul Myors
Contact Email	pmyors@ausgrid.com.au
Contact Phone	02 9269 7316
Contact Link	https://ich.smartgridsmartcity.com.au/
Background	The Australian Government commissioned a background report, "Smart Grid, Smart City: A New Direction for a New Energy Era" that identified significant potential benefits from a wide range of smart grid technologies. The Smart Grid, Smart City Project tender requested a program of technology trials to demonstrate an operational smart grid and to provide data that would inform the business cases of Australian utilities and guide policy makers' decisions.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The project quantified the benefits to customers of solar photovoltaics, small wind turbines, and Solid Oxide fuel cells powered by natural gas. It measured the costs of the technology for the devices trialled. The project undertook trials with these technologies to investigate the potential benefits for distribution network service providers, for example peak load reduction and impacts on power quality.	High
	2. Support the transition to an alternative electricity pricing approach	The project trialled a range of innovative tariffs that were enabled by the smart meter trial. For the retail trial of smart meters, refer to http://www.smartgridsmartcity.com.au/EnergyAustralia-trial/PowerSmart-solutions.aspx . BudgetSmart rewarded paying in advance, FlowSmart controlled the compressor of an air conditioner, PriceSmart reduced typical tariffs, but increased them during a peak event, and SeasonSmart was a seasonal tariff alongside education to help customers reduce their usage during summer and winter.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The final reporting outlines regulatory and business model impacts due in part to changing generation patterns.	Low
	4. Inform the regulatory environment for renewable energy	Economic analysis considered the benefits, costs, and lessons learnt from the distributed generation and distributed storage trials. The results of this work are in the final reports provided to the Australian Government.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources	Batteries and fuel cells were deployed into households and their behaviour and usage of the technology was reported on.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Power quality issues experienced during the trial were considered as part of the PS-EDGE modelling work to inform the types of distribution networks that are most likely to experience similar issues. These results can be used to reduce the cost of integrating renewable energy into the grid as resources can be allocated more effectively.	Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The deployment of a range of batteries and storage devices along with wind turbines were a first for our utility - hence their deployment assisted improving internal practices.	High
	8. Establish control over, or otherwise influence, intermittent generation sources	We deployed batteries and other generation systems and also control systems to enable/disable and tailor their charge / discharge / rates according to various objective functions as part of the trial.	Med

9. Strengthen the network to manage higher renewable energy penetration	Identification of the types of distribution networks that are likely to experience problems can help to focus investment. The active volt-VAr control trial demonstrated how centralised control of voltage regulators and capacitor banks can assist with the management of power quality issues.	High
10. Smooth out intermittent generation output	Distributed storage was trialled alongside intermittent, uncontrolled generation to demonstrate how the output could be smoothed out.	Med
11. Alter local load profile to match a desired level	Distributed generation and distributed storage were operated to achieve a peak load reduction objective, changing the local load profile.	Med
12. Use distributed energy solutions to address network and system constraints	Demonstrated how distributed generation and/or distributed storage could be used to address capacity constraints.	Med
13. Store and organise information on customer renewable energy deployments	An investigation into the operation of solar photovoltaic systems in Newington was conducted. Data regarding solar penetrations in each of the trial areas was investigated and provided in the final reports.	Med
14. Improve techniques for forecasting renewable energy output	PS-EDGE modelling investigated the use of historical solar radiation data to predict the impact on voltages and consumption of varying levels of solar penetration across a year.	Med

Approaches	Approach	Comments
	Customer Acceptance Testing	The project used field trials, modelling and simulation trial elements to inform the objectives. The field trial results were used to validate the models and gain insights into the commercial-scale deployment of these technologies. The advance modelling and field simulations provided additional analysis tools for different penetrations of DSDG devices which are not commercially and physically possible in the field trial.

Results	Result	Comments
	No results yet	The economic analysis provided a map of when each technology becomes economically viable for installation. Significant reporting for the Smart Grid, Smart City Trial is due to be released in July and the results and outcomes are best taken from that reporting.

SGSC: Substation and Feeder Monitoring

Project ID	159
Organisation	Ausgrid and consortium partners
Organisation Type	Association, Government, Network, Proponent, Research, Retailer
Partners	EnergyAustralia, Landis and Gyr, GE Energy, Grid Net, IBM, CSIRO, TransGrid, Sydney Water, Hunter Water, the University of Newcastle, the University of Sydney, the City of Newcastle and Lake Macquarie City Council
Story	AusGrid has already deployed a fibre optic communications network between substations, wireless communications, and back-end information technology systems as an infrastructure platform to build a smart grid. The Substation and Feeder Monitoring (SFM) project investigates how such a platform can act as a strategic enabler for the deployment of different monitoring technologies, at a reduced incremental cost. The Substation and Feeder Monitoring project closely assessed the potential grid impacts of energy efficiency actions by customers (for example, the impact of increased solar PV installations). The project aimed to quantify and understand the potential of reduced operating costs and improved energy efficiencies associated with substation and feeder monitoring by monitoring distribution level power flows. The project is still underway, and a number of technical outcomes have been recorded.
Start Date	
End Date	01-02-2014
Customer Segment	
Customers Involved	30000 households (overall trial)
Cost	AUD 100 M
Funding Source	Federal Government
Network	Ausgrid
Connection Point	Distribution Feeders, Zone Substations
Location	Sydney
State	NSW
Country	Australia
Future Plans	
Contact Name	
Contact Email	
Contact Phone	1300 922 746
Contact Link	http://www.smartgridsmartcity.com.au/
Background	A number of decisions today are made based on gut feel, approximations or assumptions. Once these new technologies are incorporated in BAU activities, it will provide data to make improved business decisions.

Areas of Relevance	Area	Comments	Relevance
	9. Strengthen the network to manage higher renewable energy penetration	More closely assess the potential grid pacts (for example, the impact of increased solar PV installations).	Med
Approaches	**Approach**	**Comments**	
	Network Monitoring & Analysis	The project aimed to quantify and understand the potential of reduced operating costs and improved energy efficiencies associated with substation and feeder monitoring by monitoring distribution level power flows.	
Results	**Result**	**Comments**	
	No results yet	The project is still underway, and a number of technical outcomes have been recorded. However, no clear lessons as yet.	

Shanghai World Expo

Project ID	179
Organisation	State Grid Corporation of China (SGCC)
Organisation Type	Government, Network, Research, Retailer
Partners	
Story	The 2010 Shanghai World Expo Demonstration is China's first public smart grid demonstration project that has been put into operation. The demonstration project includes new energy access (the East China Sea Bridge wind farm, Chongming solar PV, solar PV Expo venues), energy storage systems, intelligent substation, distribution automation, fault repair management system (TCM), power quality monitoring, information collection, intelligent buildings and intelligent home electric, electric vehicle charging and discharging.
Start Date	2010
End Date	2010
Customer Segment	Residential
Customers Involved	
Cost	
Funding Source	Regulator-Approved Spend
Network	Other
Connection Point	Zone Substations
Location	Shanghai
State	
Country	China
Future Plans	
Contact Name	
Contact Email	
Contact Phone	
Contact Link	
Background	Shanghai World Expo is the first official presentation of the "low carbon" concept Expo of China. There is large-scale implementation of solar energy, new energy vehicles, smart grid, LED lighting demonstration application.

Areas of Relevance	Area	Comments	Relevance
	8. Establish control over, or otherwise influence, intermittent generation sources.	The demonstration managed to coordinate and utilize various distributed energy resources as power supply. SGCC used PQ visualization software to monitor and analyse the network condition. The purpose of the demonstration is to deploy close to 100% renewables and distributed energy resources at district level. It created a scenario of network control and operation when only renewables and distributed energy resources are used for energy supply with traditional generation.	Med
	9. Strengthen the network to manage higher renewable energy penetration	The project deployed distributed power grid connection, energy storage system, smart transformer station, automatic power distribution, trouble call management system (TCM) and power use information collection system. The project integrated a wide range of power management systems to ensure stable power supply for the Expo. Its fundamental objective can be similar to Australian context. However, the technical configurations and the technologies in action may be different, since the demonstration in Shanghai is not commercial-oriented.	Med

Approaches	Approach	Comments
	Distributed Energy Solutions	The project has also integrated distributed power grid connection, energy storage system, smart transformer station, automatic power distribution, trouble call management system (TCM), power quality monitoring, power use information collection system, smart power-use buildings/homes, as well as new energy vehicles charging/discharging and grid access technology.
	Demonstration Project	The Demonstration Project is located in the World Expo Park, a 110kV intelligent substation in the B1 of State Grid Pavilion supplies electric power for the whole Park. With low-carbon and green concept, this substation is using ground source heat pump, heat collection, ice storage and other new technologies to achieve energy recycling.

Results	Result	Comments
	No results yet	There is no official disclosure.

Smart City Búzios

Project ID	328
Organisation	Ampla Energia e Serviços
Organisation Type	Proponent
Partners	Enel, Landis y Gyr, Synapsis, West Internet, Telefônica, Kyocera, ICF Interncional, Daimon, Globalsul, Cefen, Coppetec, Lactec, UFF, Cieds, FGV
Story	The project aims to study the case of Smart Grid from the implementation of a smart city aiming to learn relating to operation, infrastructure, and costs as well the assessment of economic, environmental and service quality impacts. It is the pioneer project in Brazil. The project establish the country as one of the main technology centres in the world, initiating an innovative and large scale project to raise the level of the model in that of comparable cities and Intelligent networks. Smart City Búzios involves a quest for some objectives that are intended to encourage technological and sustainable development in Brazil (and even in Latin America) by aiming at the improvement of the power distribution sector. The objectives are related to the automation of networks, smart metering, street lighting and alternative sources (wind / solar) installed, providing social integration, putting the customer at the centre of the design.
Start Date	2011
End Date	2014
Customer Segment	Residential
Customers Involved	10,363 (13 industries, 1,515 businesses and services, 8,832 residential customers)
Cost	AUD 20 M
Funding Source	Commercial Partner, Regulator-Approved Spend
Network	Ampla Energia e Serviços
Connection Point	Customer Connections, Distribution Feeders, Zone Substations
Location	Búzios
State	Rio de Janeiro
Country	Brazil
Future Plans	During the last phase of the project, the management of each block will be directed by those already responsible for smart metering, telecommunications and systems, distributed generation, network automation and public lighting. The technical knowledge and expertise will be transferred, because the implementation is carried out jointly between those people and the professionals directly involved managing the Project Smart City Búzios.
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Background	The project aims to study the case of a smart grid as part of the implementation of a Smart City in order to learn about operational issues, infrastructure, and costs as well the assessment of economic, environmental and service quality impacts. It is the pioneer project in Brazil.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	the benefit of renewable energy is providing a sustainable approach to generation. In Búzios there are 9 photovoltaic panels of 9KW of which 3 are installed in municipal schools they are saving Au$500 / month. Also, the city has 4 wind generators of 2KW each.	Med
	2. Support the transition to an alternative electricity pricing approach	Búzios has 6,000 smart meters installed and will install another 4,000. They offer the possibility of applying new electricity pricing structures and tariff design.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Bidirectional meters were developed to support the distributed generation. Thus generation by customers with solar panels or wind generation will be transmitted to the network to reduce the electric bill. The two way meters will facilitate the introduction of PV and wind generation.	Med
	4. Inform the regulatory environment for renewable energy	By Resolution No. 482/2012 of the regulator ANEEL, Brazilian consumers can generate their own electricity from renewable sources and export any excess to the distribution network creating an "energy credit" that will later be used to reduce their bills.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The incentives for distributed generation are justified by the potential benefits that it can provide for the electrical system including 1) postponing investments in expansion of transmission and distribution systems,; 2) low environmental impact; 3) reducing the load of networks; 4) the minimization of losses; and 5)diversification of the energy supplies. Incentives are provided for prosumers to self-generate and to export energy.	Med
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The standards described in the ETA 020 and 482 Resolution rules are followed. The customer who has a distributed micro generator generates energy for his own residence and reduces supply by the network. If the customer generates an excess of energy generated, this is exported to the network and the client receives kWh credits that can be used within 3 years for any residence registered by the same Individual Taxpayer Registration (ITR). Incentives are provided for prosumers to self-generate and to export energy.	Med
	9. Strengthen the network to manage higher renewable energy penetration	The smart meters implemented in Búzios communicate by fibre optic cable with the Ampla operation centre to control the energy consumption and facilitates possible the remote repair of technical faults.	Med
	13. Store and organise information on customer renewable energy deployments	The project are currently developing a system, which will store and organise information on customer renewable energy deployments. At this stage, the specifications of the system is unknown. Further information is required for evaluation.	Low

	5. Engage customers to build their and the industry's understanding of distributed energy resources	The objectives are related to the automation of networks, smart metering, street lighting and alternative sources (wind / solar); providing social integration; and putting the customer at the centre of the design. The project is divided into blocks defined for the project. The stakeholders - the government, local society, new technology providers and academia - are engaged in research, development, dissemination and implementation of the project.	Med

Approaches	**Approach**	**Comments**
	Energy Efficiency Measures	The project establishes the country as one of the main technology centres in the world, initiating an innovative and large scale project to the level of comparable cities and Intelligent networks. Approximately 10,000 electronic meters are being installed, 2 electric stations trickle chargers, and 130 points of LED lighting, plus 48 KW distributed generation, 17 points of network automation, and intelligent buildings and other technologies, which will cover about 10,363 consumers in the residential, commercial and industrial sectors. The project will take four years, beginning November 2011. The project has already been widely recognized by the media and scientific community as a relevant and high impact technological initiative. For example, recently the project was considered one of the 100 most important infrastructure initiatives in world cities by KPMG. It was the only project in Brazil to be among the 10 most relevant and was chosen as number one among the initiatives focused on urban energy infrastructure. Smart City Búzios intends to encourage technological and sustainable development in Brazil (and even in Latin America) by aiming at the improvement of the power distribution sector.

Results	Result	Comments
	Customer engagement achieved	The objectives are related to the automation of networks, smart metering, street lighting and alternative sources (wind / solar); providing social integration; and putting the customer at the centre of the design. The project is divided into blocks defined for the project. The stakeholders - the government, local society, new technology providers and academia -are engaged in research, development, dissemination and implementation of the project.
	Enables energy efficiency in smart cities	The project is aimed at developing knowledge to enable the interconnection of new generation sources to a highly automated and fully integrated network as a result of deploying a monitoring centre which facilitates the possibility of diagnosing problems and repairs that can be performed efficiently and rapidly due to investment in the distribution network. Another concept that can benefit from the installation of smart meter technology is the evaluation of new tariff structure. The project is a "living laboratory" for testing and evaluation of a technological concept - a smart city – that is being done in Brazil.

Smart Country

Project ID	166
Organisation	RWE Deutschland AG
Organisation Type	Network
Partners	ABB, Consentec, Technical University of Dortmund
Story	With significant levels of wind and solar installed in the countryside which network companies are obliged to connect often in weak networks, there is a problem of ensuring the networks can accommodate the power flows. The project, which is undertaken along a single 40km 20kV line where the wind and PV generation exceeds consumption, aims to develop economic integration techniques. It is using prototype "mobile" MV and LV voltage regulations designed to increase the capacity of lines, and "sectionalisers" which provide an easy and cheap switch as an alternative to a normal circuit breaker. Also cogeneration units are used to smooth the flow of power in the MV line.
Start Date	2009
End Date	2014
Customer Segment	Residential, SME
Customers Involved	5400
Cost	AUD 8 M
Funding Source	Commercial Partner, Discretionary Spend, Federal Government
Network	Other
Connection Point	Customer Connections, Distribution Feeders, Subtransmission Feeders, Zone
Location	The Eifel national park near the border with Belgium
State	
Country	Germany
Future Plans	The Smart Country project is followed from other projects like Smart Operator, Ampacity, Grid 4 EU, Discern and others.
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Contact Link	
Background	By the end of 2013 Germany had installed about 35GW of wind and 35GW of photovoltaic (PV) solar. Unlike many other countries a majority of the wind capacity has been developed by syndicates of local people – especially farmers - rather than by "professional" developers. In the countryside many houses, barns, and shops are covered with solar panels on south facing roofs. RWE considers that its main network challenge is in the country where renewables are causing difficulties in sparse networks. The regulations require a network company to accept wind and PV

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	With significant levels of wind and solar installed in the countryside which network companies are obliged to connect often in weak networks, there is a problem of ensuring the networks can accommodate the power flows. The project, which is undertaken along a single 40km 20kV line where the wind and PV generation exceeds consumption, aims to develop economic integration techniques.	Med
	10. Smooth out intermittent generation output	Cogeneration units are used to smooth the flow of power in the MV line.	Med
	12. Use distributed energy solutions to address network and system constraints	The project is using prototype “mobile” MV and LV voltage regulations designed to increase the capacity of lines, and “sectionalisers” which provide an easy and cheap switch as an alternative to a normal circuit breaker.	Med

Approaches	Approach	Comments
	Electronic Sectionaliser	An electronic sectionaliser has been adapted to provide an easy and cheap switch as a supplement to a normal circuit breaker. If there is a fault in a line the sectionaliser cuts off only the part of the line with the fault rather than the whole line which a circuit breaker would do. The sectionaliser trips after the circuit breaker has interrupted the fault current and before it automatically recloses a few milliseconds later. It thus helps maintain reliability.
	Other	A very interesting feature of the project is the use of biogas/cogeneration plant as a storage mechanism. A (smart) farmer has exploited the feed-in-tariff for biogas production by turning his 450 acre farm into a biogas production unit. He owns 70 cows which produce milk and muck; they require 75 acres to produce feed for the cows. The remaining 375 acres grows corn which combined with the cow’s muck goes into the digesters which produce enough gas to drive two cogenerator units of 190kVA and 220kVA. The heat is used all the year to heat the digesters and in the winter to heat the farmer’s house and the cows. (The residue from the digester is spread back in the fields).

Results	Result	Comments
	PV voltage problems can be resolved	The stabilization of low voltage at a substation shows that the demand is low at midnight, then increases and the voltage drops. Come the morning and the sun shines and the voltage increases due to the PV, which tails off in the afternoon and the voltage drops. But all the time the output level is stable.
	Biogas facility can be used to provide storage	RWE uses the biogas facility to effectively provide storage of 3.2MWh(e) by controlling the output of production from the cogenerators to offset the changes in local production from PV and wind.

Smart End-Use Energy Storage and Integration of Renewable Energy Pilot (EnerNOC BPA Pilot)

Project ID	288
Organisation	EnerNOC
Organisation Type	Proponent
Partners	Bonneville Power Administration, Ecofys US
Story	Bonneville Power Administration's (BPA) recent technology-enabled demand response pilot is a good example of integrating two concepts, energy efficiency and load control together. Although, historically, these two concepts have required only minimal overlap, in large part due to the manual, infrequent nature of load control events, according to EnerNOC, this is changing. The BPA pilots are a great example of industrial customers leveraging the same control systems that drive energy efficiency to provide additional value to the electric grid in the form of demand response. Importantly, these pilots provide a snapshot of the technology-enabled load control opportunities that will be available to industrial customers in future programs throughout the Northwest and beyond, opportunities that will be best served as industrial customers, their utilities, and third-party vendors work to integrate demand response and energy efficiency activities.
Start Date	Sep 2010
End Date	Sep 2012
Customer Segment	Industrial
Customers Involved	5
Cost	
Funding Source	Commercial Partner, Federal Government
Network Connection Point	Bonneville Power Balancing Area
Location	Richland, WA; Forest Grove, OR; Albany, OR; Eugene, OR
State	Oregon and Washington
Country	United States
Future Plans	The project partners will continue to pursue pilots and commercial scale projects in order to help expand the capabilities of demand response as a balancing reserve resource.
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Contact Link	
Background	BPA uses the hydro projects in the Columbia River Basin for balancing reserves in addition to baseload, as hydro represents a fast and inexpensive resource. BPA schedules on the hour and uses balancing reserves to correct second-by-second imbalances (regulation), ten-minute-by-ten-minute imbalances (load following), and hour-by-hour imbalances (reserves). Because each of these balancing reserves is bi-direction, they are known as "INCs" (generation increases) and "DECs" (generation decreases). The hydro system can provide approximately 1,000 MW of INCs and 1,000 MW of DECs to ensure grid stability, and is approaching its limit. As new intermittent generation is connected, BPA will require additional sources of balancing reserves. As a result, BPA is committed to finding new sources for balancing reserves, including solutions on the demand side such as those explored for this project. As BPA discovers cost-effective options, it will repurpose some of the existing hydro resource for other uses.

Areas of Relevance	Area	Comments	Relevance
	11. Alter local load profile to match a desired level	This project demonstrated the potential and performance characteristics of refrigerated warehouse customers to provide balancing services in the BPA control area and meet utility demand response objectives. In addition, the project helped identify potential barriers to widespread adoption of this type of resource and potential solutions to those barriers. The project has a very clear focus on combining energy efficiency and load control to improve load balancing, which is an innovative approach, and worth further researched for the potential application in Australia.	Med

Approaches	Approach	Comments
	Demand Side Incentives	The project team engaged five cold storage customer sites and provided financial incentives in exchange for their participation in the pilot.
	Smart Meters and In-Home Displays	Customers were enabled with metering technology to measure their usage in near real-time (minute to minute), and outfitted with remote load control such that the project team could initiate demand response events and control customer systems in response to a system need.
	Network Monitoring & Analysis	Customers were enabled with metering technology to measure their usage in near real-time (minute to minute), and outfitted with remote load control such that the project team could initiate demand response events and control customer systems in response to a system need. Over the course of 2011 and 2012 the project team initiated 51 load control events (controlling loads both up and down) to demonstrate capabilities.

Results	Result	Comments
	Load control events on average led to load decreases	Fifty-one load control events were dispatched across the five participating sites, with between two and four sites participating in each dispatch. Twenty-three of the dispatches called for load decreases (INCs) while 28 of the dispatches called for load increases (DECs). Between August 2011 and May 2012, the portfolio delivered 269 kW of average INC capability per site and 165 kW of average DEC capability per site. Between June and August 2012, the portfolio delivered 144 kW of average INC capability per site and 59 kW of average DEC capability per site. Decreased capacity during the summer months was both a function of increased operational activity in the facilities during the summer months, leaving less load available for control, and the fact that only three of five facilities were available for participation (one site was unavailable due to ongoing maintenance, another moved into a separate BPA pilot activity). Further compounding summer performance was a programming change at one of the participating facilities that negatively impacted DEC performance.

Smart Grid and Electric Vehicle Integration Project

Project ID	321
Organisation	SGCC
Organisation Type	Government
Partners	
Story	The Chinese government attempts to include smart grid construction in "National Science and Technology Development Plan", and build strategic alliances of smart grid technologies. In the 13th Five-Year Plan, the Chinese government is addressing on the key smart grid technologies including energy storage, electric vehicles, intelligent deployment of distributed power, gradually making China a leading force in smart grid technology development. It is estimated that China alone will spend USD 60 billion (AUD 63.99 billion) over the next decade to reinvent its power transmission and distribution system into a modernized, smart grid. In the Smart Grid and Electric Vehicle Integration Project, the electrification of transport and its smart integration with the electricity grid reduced urban pollution and reduced reliance on crude oil. Electricity supply can be "greenified" by integrating renewables into the grid and enhancing SGCC's capability in efficient use of distributed energy resources in the network.
Start Date	2012
End Date	
Customer Segment	Residential
Customers Involved	
Cost	AUD 3.05 M (USD 2.85 M)
Funding Source	Regulator-Approved Spend
Network	SGCC's network in Shanghai
Connection Point	Customer Connections, Distribution Feeders
Location	Shanghai
State	
Country	China
Future Plans	Yes, the finding of the project will be used for national planning of introducing EV, Charging Station and the integration into the Smart Grid.
Contact Name	Confidential information
Contact Email	
Contact Phone	
Contact Link	
Background	To meet the exponential increase in electricity demand and alleviate environmental degradation caused by fossil fuel-based power generation, China has made great efforts in constructing a smart grid as a substitution of traditional energy intensive power grid. In the 13th Five-Year Plan in particular, it was stated that emphasis should be placed on the development of renewable energy and smart grids. This project focuses on developing Electric Vehicles (EVs) and integrating the charging / discharging of EV batteries efficiently and smartly with the electricity grid.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	The project measures the cost and benefit of integrating Electric Vehicles as mobile energy into the smart grid. One of the key focuses of the project is to measure the cost and benefit of the integrating EV into the grid. The learning of this pilot project will be used for the future introduction of EV at national level. The specific measures and actions taken may not be the same as in Australia. However, the ultimate purpose and goal of cost/benefit analysis could be in-line with Australia's concern on renewables integration.	Med
	4. Inform the regulatory environment for renewable energy.	The project is initiated and managed by the State Grid of China. The project receives the support from the State Grid and Chinese Government. On the other hand, the project findings will help to guide the policy making of the Ministry. This is yet to be explored further from an Australian context.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	Customer engagement and education is part of the project. The project addresses this objective quite well, it shows that State Grid is giving priority on the citizen engagement to facilitate the introduction of EV in China.	Med
	10. Smooth out intermittent generation output	Increased proportion of intermittent generation can be supported. Similar to other regions, State Grid in China considers EV as an important distributed energy resource that could have great impact on the electricity grid, therefore the effective use of such resource in the network is given great importance, although the technical specifications may be different.	Med
	12. Use distributed energy solutions to address network and system constraints	The project addresses the integration of EV storage as well as the use of Solar PV as sources of distributed energy supply. The integration of distributed energy resources is researched in this project, including Solar PV and EV storage.	Med

Approaches	Approach	Comments
	Distributed Energy Solutions	The programme is innovative in energy supply, energy security and sustainable development. This can be measured by how much more renewables can be added to the grid and/or the increased proportion of intermittent generation that can be supported in the network.

Results	Result	Comments
	Other	Achieved reduction of 20% in annual operating costs for this programme.

Smart Grid Gotland

Project ID	180
Organisation	Vattenfall
Organisation Type	Proponent
Partners	Gotland Energi, ABB, Svenska Kraftnat, Schneider Electric, Energymyndigheten, The Royal Institute of Technology
Story	Gotland is an island located some 90 kms off the east coast of Sweden in the Baltic. The population is nearly 60,000 of which about 22,000 live in the town of Visby. South of Visby the island is connected to the mainland via a bipolar HVDC link. Vattenfall wants to ensure that future demands on the electricity distribution infrastructure are met as economically as possible. The demands include a change in the structure of consumption of electricity (e.g. from electric vehicles) to increase expectations of the quality of supply as well as the challenge of increasing wind power production (in order to meet the European Union's 20% renewables target for 2020). The overarching objective of the project is to find efficient and cost-efficient solutions both from the technological and administrative perspectives. One of the project's (three) main objectives is to enable customers to participate actively on the electricity market. The idea was that these (approx. 2000) customers, by adjusting their consumption to price signals, should be able to balance the production from distributed energy resources installed in the test area. The second and third main operational objectives of the project are to increase the hosting capacity of wind power on the island by 5MW, while improving the power quality The project is being implemented by upgrading present distribution system with new Smart Grid technology and provide improved system support for advancements in system control and monitoring of LV/MV systems, including so-called last-mile-SCADA to facilitate raising the hosting capacity of renewable energy sources, even at lower voltage levels. Smart meters for monitoring the LV-network will be tested in the project. This is especially interesting in LV-networks with small scale PV-production, where the smart meter will be used both for billing and to ensure that the voltage is maintained within acceptable levels
Start Date	01-09-2012
End Date	1-12-2016
Customer Segment	Residential, SME
Customers Involved	1500
Cost	AUD 22 M
Funding Source	Commercial Partner, Federal Government
Network	Other
Connection Point	Customer Connections, Distribution Feeders, Subtransmission Feeders, Zone
Location	Gotland
State	
Country	Sweden
Future Plans	
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Contact Phone	00 488 739 7515
Contact Link	http://www.smartgridgotland.com/eng/
Background	Vattenfall wants to ensure that future demands on the electricity distribution infrastructure are met as economically as possible. The demands include a change in the structure of consumption of electricity (e.g. from electric vehicles) to increase expectations of the quality of supply as well as the challenge of increasing wind power production (in order to meet the European Union's 20% renewables target for 2020). Part of the project focuses on network technology which is being run by Vattenfall's network subsidiary, and part run by Vattenfall's retailing subsidiary, which focuses on customer behaviour and which is being explored entirely on a commercial basis, i.e. no subsidies and not telling customers that they are involved in a special trial. A major objective of the project is to find efficient and cost-efficient solutions both from the technological and administrative perspectives.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The project has an activity called “standardized connection of wind power”.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	One of the project’s (three) main objectives is to enable customers to participate actively in the electricity market. The idea was that these (approx. 2000) customers, by adjusting their consumption to price signals, should be able to balance the production from distributed energy resources installed in the test area.	High
	4. Inform the regulatory environment for renewable energy	Although not a main objective of the project, an issue that has to be handled since the project became active is the interface between the distribution system operator (monopoly) and the electric sales company (free market).	Low
	8. Establish control over, or otherwise influence, intermittent generation sources	The second and third main objectives of the project are to increase the hosting capacity of wind power on the island by 5MW, while improving the power quality.	Med
	10. Smooth out intermittent generation output	Mainly by using the response of active customers. Other methods, such as artificial inertia, using excess production to heat tap water and different market models for sales of wind power production, are being studied theoretically in the project.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources	One of the project’s (three) main objectives is to enable customers to participate actively on the electricity market. The idea was that these (approx. 2000) customers, by adjusting their consumption to price signals, should be able to balance the production from distributed energy resources installed in the test area.	Med

Approaches	Approach	Comments
	Network Monitoring & Analysis	Upgrading present distribution system by implementing new Smart Grid technology and provide improved system support for advancements in system control and monitoring of LV/MV systems, including so-called last-mile-SCADA, for adding significant betterment in system management and consequently facilitate raising the hosting capacity of renewable energy sources even at lower voltage levels.
	Storage, Grid-Connected	Demonstrating the ability to support introduction of additional wind power generation in the distribution network by integrating a battery energy storage facility in combination with a static VAr compensator providing the possibility to control active and reactive power injected into or retrieved from the system. The Energy Storage will be one important part in a system actively balancing the local production, typically wind generation, and local loads.
	Demand Side Incentives	It is important to test the future potential for demand participation and energy efficiency from different customer segments, and to identify the benefits from demand response for other actors namely the network operator, suppliers and balance responsible parties. Also the potential benefits for aggregators are of interest. The aim is to enrol 2000 households with smart meters and 30 companies in a series of market tests to get more information about the demand response potential based on how real customers reacts and how that can affect the electrical power systems. The households will be offered spot prices which relate to wind production and will be provided with visualization of prices, and also direct control of appliances. The companies will receive energy efficiency consultancy focused on arrangements to save energy and shift load.

Results	Result	Comments
	No results yet	Too early for a definitive assessment but generally looking good.

Smart Melit

Project ID	178
Organisation	Toyota City
Organisation Type	Government
Partners	Toyota Motor Corporation, Fujitsu Limited, Toshiba Corporation and others
Story	The Smart Melit seeks to envision the home environment in ten years' time, when renewable energy in introduced, and various energy-saving and energy storage devices are more extensively used. The power transfer patterns of a variety of devices, including next-generation vehicles, will be integrated and controlled by home energy management systems, enabling users to enjoy a pleasant and convenient low-carbon lifestyle without waste and without effort. By advancing the introduction of next-generation mobility modalities, the building of public transport infrastructure, and the presentation of new forms of transport use, Smart Melit Project is aiming to become the city with the world's highest level of harmony between cars and people. The project will use a range of energy sources including city gas and biomass, and make full use of heat and electricity. The city will offer a variety of incentives to encourage citizens to engage in their own carbon-reduction activities, at the same time as making energy use visible, providing support for action, and enabling control of energy use through familiar terminal devices, making it possible to select from an optimal menu of low-carbon activities for the entire living environment with a minimum of effort.
Start Date	2010
End Date	2014
Customer Segment	Residential
Customers Involved	227 Households (67 new and 160 existing)
Cost	
Funding Source	Commercial Partner, Local Government, Regulator-Approved Spend
Network	
Connection Point	Customer Connections, Distribution Feeders, Subtransmission Feeders, Zone
Location	Toyota City
State	
Country	Japan
Future Plans	
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Contact Phone	
Contact Link	
Background	Toyota is the largest city of Aichi Prefecture with a total population of 422,830 (April 2012). Chubu Electric Power Company is responsible for electricity distribution in the city. The government has taken a number of initiatives to implement the concept of 'hybrid city' in which residents, environmental considerations and technology come together and work towards Green growth. The city has also been selected as the eco-model city by the Government of Japan. Some of the initiatives of the government are forming a eco-management network for small- and medium scale industries, low-carbon society model, an Eco Points programme, establishment of a forest development council, and the Toyota City Low-carbon Society Verification Project (Smart Melit). The Smart Melit Project was initiated by METI in conjunction with few private enterprises. It covers two districts – Higashiyama and Takahashi (67 households for demonstration of HEMS) — and Toyota city as a whole for trials of a low-carbon transport system and demand response programme (160 households across the city). The broad objective of this project is to build and demonstrate "Smart Mobility and Energy Life" in Toyota city for creation of consumer-oriented low-carbon communities. It aims at 30% reduction in CO_2 emissions by 2014 (as compared to the 2005 level). The project focuses on the household sector (residences and transport), the project seeks to identify medium-term technological issues based on an image of the household in ten years' time, when, for example, photovoltaic (PV) generation will be widespread and grid parity will have been established. Without rushing to raising the social cost, Smart Melit Project aims to develop low-carbon systems that present the overall optimum at the level of the community as a whole.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	Targeting at 61.2% rate of renewable energy, 4,000 next-generation vehicles. The project has an ambitious goal to increase the adoption of renewables citywide.	Med
	13. Store and organise information on customer renewable energy deployments	The project aims to establish a system in which citizens obtain data on personal energy consumption. The project addresses the renewable adoption from demand side, by providing consumption information to the consumers, while collecting data on consumers' behaviour.	Med
	2. Support the transition to an alternative electricity pricing approach	The project offers highly convenient and satisfying incentives (such as "eco points"). The project has a unique idea of providing eco points to encourage the citizens to cooperate with the project consortium.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources	Smart Melit project offers various incentives to encourage and engage citizens to contribute to saving energy, reducing the load on the power system and making effective use of green power. Apart from various devices and systems, personal usage and behaviour feedback is an important focus.	High

Approaches	Approach	Comments
	Energy Efficiency Measures	In this project, renewable energy are introduced, and various energy-saving and energy storage devices are more extensively used. The power transfer patterns of a variety of devices, including next-generation vehicles, will be integrated and controlled by home energy management systems, enabling users to enjoy a low-carbon lifestyle.
	Storage, Grid-Connected	In this project, renewable energy are introduced, and various energy-saving and energy storage devices are more extensively used. The power transfer patterns of a variety of devices, including next-generation vehicles, will be integrated and controlled by home energy management systems, enabling users to enjoy a low-carbon lifestyle.
	Demand Side Incentives	The project offer incentives (such as "eco points") for activities conducted by citizens that contribute to reducing carbon (saving energy, reducing the load on the power system, making effective use of green power, etc.) in order to study the change in citizens' behaviour and the magnitude of its impact. In terms of effective incentive design, in addition to introducing various devices and systems to the city, the project also aims to establish a system in which citizens obtain data on personal energy consumption and behaviour to enable the project to reduce carbon at the same time as ensuring the satisfaction of citizens.
Results	**Result**	**Comments**
	No results yet	Project is ongoing

Smart Voltage Regulator

Project ID	150
Organisation	Ergon Energy
Organisation Type	Network
Partners	
Story	Ergon Energy has PV related and demand issues on its network and was interested in testing the Smart Voltage Regulator (SVR) for application in its network through a structured laboratory testing program. This test aimed to determine the effectiveness of three phase SVRs in maintaining distribution network power quality in light of increasing penetration of renewable generation. The SVR unit proved its ability to regulate voltage, however the reverse power testing was inconclusive as it only ran at a low power. Further testing is required with PV generators on the secondary side of the device to fully prove the reverse power capability.
Start Date	01-04-2012
End Date	01-11-2013
Customer Segment	
Customers Involved	
Cost	
Funding Source	Discretionary Spend
Network Connection Point	
Location	
State	QLD
Country	Australia
Future Plans	
Contact Name	Michelle Taylor
Contact Email	michelle.taylor@ergon.com.au
Contact Phone	
Contact Link	
Background	Ergon Energy has PV and demand issues and is interested in testing the SVR for application in its network through a structured testing program

Areas of Relevance	Area	Comments	Relevance
	12. Use distributed energy solutions to address network and system constraints	The Smart Voltage Regulator (SVR) Validation project will laboratory test the effectiveness of three phase SVRs in maintaining distribution network power quality in light of increasing penetration of renewable generation.	Med
Approaches	**Approach**	**Comments**	
	Volt / VAR Control	A staged process is proposed to effectively assess the SVR and enable an informed commercial decision to be made: 1. A full functional test of the SVR will be firstly conducted by QUT at their Banyo test laboratory. 2. A network model of the SVR be developed by QUT suitable for use within Ergon Energy Network Modelling tools 3. If the above mentioned laboratory testing shows that the SVR's performance is suitable, a study will be performed to compare cost/benefit/performance against other competitor technologies (such as the regulating transformer, STATCOM etc.)	
Results	**Result**	**Comments**	
	Smart Voltage Regulator can regulate voltage	The SVR unit proved its ability to regulate voltage, however the reverse power testing was inconclusive as it only ran at a low power. Further testing is required with PV generators on the secondary side of the device to fully prove reverse power capability.	

SoLa Bristol

Project ID	172
Organisation	Western Power Distribution
Organisation Type	Network
Partners	Siemens and University of Bath
Story	The project will aim to: - solve the network problems which arise when a number of customers in a local area connect PV solar panels to their house - investigate how a battery installed in the home can help customers to manage their energy usage and save money on their bills - test how customers respond when offered different electricity tariffs throughout the day - explore the benefits of utilising direct current (DC) in the home run off the PV and a battery from which products that require DC can be run.
Start Date	2012
End Date	2016
Customer Segment	Residential
Customers Involved	41
Cost	AUD 4 M
Funding Source	Local Government, Regulator-Approved Spend
Network	Other
Connection Point	Customer Connections, Distribution Feeders
Location	Bristol
State	
Country	United Kingdom
Future Plans	Analysis is due to commence in Sept 2014. This is a true R&D project, so adoption into BaU will depend on the results seen.
Contact Name	Mark Dale
Contact Email	mdale@westernpower.co.uk
Contact Phone	+44 1179 332 236
Contact Link	http://www.westernpowerinnovation.co.uk/Documents/So-La-Bristol-Project-
Background	The project will aim to: - solve the network problems which arise when a number of customers in a local area connect PV solar panels to their house - investigate how a battery installed in the home can help customers to manage their energy usage and save money on their bills - test how customers respond when offered different electricity tariffs throughout the day - explore the benefits of utilising direct current (DC) in the home run off the PV and a battery from which products that require DC can be run.

Areas of Relevance	Area	Comments	Relevance
	11. Alter local load profile to match a desired level	Variable tariff should encourage demand side management	Low
	2. Support the transition to an alternative electricity pricing approach	University of Bath have researched, designed and implemented a Time of use/variable tariff	Med
	4. Inform the regulatory environment for renewable energy	As part of the LCNF, project results will be disseminated throughout industry and the regulatory bodies.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources	Local area network control of the stored energy held within the customers battery. To assist the network at times of need.	Med
	10. Smooth out intermittent generation output	Using a battery store within each home to enable the PV generation to be stored for use at non sola times.	Med
	12. Use distributed energy solutions to address network and system constraints	High demand periods, the network can request discharge of customers batteries to supplement the local network	Med
	Other	Solve problems with installing PV and trial DC. Help customers reduce consumption. Analyse the efficiency of AC Vs DC	
	5. Engage customers to build their and the industry's understanding of distributed energy resources	The project aims to test how customers respond when offered different electricity tariffs throughout the day. Thirty houses, ten schools and an office will have solar PV and a battery installed.	Low

Approaches	Approach	Comments
	Storage, Customer-Connected	The trial uses in-home battery storage to provide benefits to customers and aid the DNO with network management. Thirty houses, ten schools and an office will have solar PV and a battery installed. The solar PV will be connected directly to the battery using a DC converter.
	Communications Network	The AC lighting circuits in the premises will also be converted to DC to enable customers to run small appliances on DC directly from the PV/battery. The battery will be "shared" between the customer and the DNO. The customer will be provided with a variable tariff to encourage electricity use at times of high PV generation and to use electricity stored by the battery when the network is heavily loaded. The DNO will be able to communicate with the battery to charge and discharge it to help with network management.

Results	Result	Comments
	Home DC network with PV successfully implemented	The DC Network has been successfully demonstrated since the 14 December 2012, supplying DC lighting and DC sockets. The load and voltage drop across the DC network is not an issue. The power consumption of the DC lighting is approximately 50% of the datasheet. i.e. the 6w LED's were seen to be drawing around 3w.
	No results yet	Project in progress. Results relating to other objectives not available yet.

Solar Energy Management System (SEM) for Utilities

Project ID	132
Organisation	CSIRO
Organisation Type	Government, Research
Partners	GWA Group, Ergon Energy
Story	Renewable energy solutions can benefit the homeowner while helping to reduce pressure on the electricity grid and ensuring customer comfort. To achieve this, CSIRO are developing a Solar Energy Management (SEM) controller that seeks to demonstrate how solar air conditioning can be used to help reduce peak demand on Australia's electricity networks while providing comfort in addition to conventional energy, cost and greenhouse gas savings for customers. The SEM controller monitors the operation of conventional electrical air-conditioning, manages the solar air conditioner and responds to requests from the electricity grid operator when the grid is under stress. If a request is received, the SEM controller can switch from using conventional cooling to solar-powered air-conditioning (supported by gas back-up if required), using CSIRO's solar cooling technology. This switch occurs automatically and does not require intervention from the resident. This project is ongoing, however a new solar air conditioning prototype has been developed, tested at CSIRO facilities and installed at three residential sites in Queensland, Australia.
Start Date	01-07-2012
End Date	31-10-2014
Customer Segment	Large commercial, Residential
Customers Involved	
Cost	AUD 570,430
Funding Source	Commercial Partner, Federal Government
Network	Ergon Energy
Connection Point	Customer Connections
Location	Townsville
State	QLD
Country	Australia
Future Plans	
Contact Name	Daniel Rowe
Contact Email	daniel.rowe@csiro.au
Contact Phone	0249606000
Contact Link	http://arena.gov.au/project/solar-energy-management-system-for-utilities/
Background	This trial seeks to demonstrate how solar air conditioning can be used to help reduce peak demand on Australia's electricity networks while providing comfort in addition to conventional energy, cost and greenhouse gas savings for users

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	This trial aims to identify how solar air conditioning can be used to help reduce peak demand. Three residential trial sites have been established and are currently being monitored.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	Three residential trial sites have been established. This trial seeks to demonstrate how solar air conditioning can be used to help reduce peak demand on Australia's electricity networks while providing comfort in addition to conventional energy, cost and greenhouse gas savings for users.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The developed solar air conditioning Technology is integrated with utility peak signalling via a solar energy management (SEM) control system.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources.	Solar thermal energy variability is addressed using a backup heat source and a backup conventional air conditioner. These are controlled by the SEM system.	Low
	10. Smooth out intermittent generation output	Solar thermal energy variability is addressed using a backup heat source and a backup conventional air conditioner. These are controlled by the SEM system.	Low
	11. Alter local load profile to match a desired level	This project addresses distributed residential air conditioning peak demand management and focuses on the reliable reduction of air conditioning electrical network load during times of network stress.	Med
	12. Use distributed energy solutions to address network and system constraints	This project addresses distributed residential air conditioning peak demand management and focuses on the reliable reduction of air conditioning electrical network load during times of network stress.	High

Approaches	Approach	Comments
	Direct load control	The project has developed a SEM controller which monitors the operation of conventional electrical air-conditioning, manages the solar air conditioner and can respond to requests from the electricity grid operator for help when the grid is under stress. If a request is received, the SEM controller can switch from using conventional cooling to solar-powered air-conditioning (supported by gas back-up if required),using CSIRO's solar cooling technology. This switch occurs automatically and does not require intervention from the resident.

Results	Result	Comments
	Solar air conditioning prototype developed and tested	This project is ongoing, however a new solar air conditioning prototype has been developed, tested at CSIRO facilities and installed at three residential sites in Queensland, Australia.

Solar Resource Mapping for High Prospectively Regions

Project ID	270
Organisation	Geoscience Australia
Organisation Type	Government
Partners	Bureau of Meteorology
Story	The solar industry needs better and more accessible data to help identify the regions in Australia best suited for further detailed investigation and potential development of solar energy generation. To achieve this, the project produced solar resource data, to be used by solar researchers and the Australian solar power industry. The specific aim being to allow identification regional scale prospectivity areas through provision of resource and infrastructure information and access. This project contributed to the creation of the Australian Solar Energy Information System, funded the development of better satellite models for depicting solar radiation, and funded eight additional solar radiation ground monitoring stations. The project has improved the availability and quality of solar radiation data across Australia, which is also available more cheaply and in a greater range of formats as a result of this project.
Start Date	18-11-2010
End Date	30-06-2013
Customer Segment	Industrial
Customers Involved	
Cost	AUD 5.5 M
Funding Source	Federal Government
Network Connection Point	None
Location	
State	
Country	Australia
Future Plans	We will maintain the website for a number of years. We however do not have current funding to develop, improve the resource.
Contact Name	Graham Hammond
Contact Email	Graham.Hammond@ga.gov.au
Contact Phone	0262499661
Contact Link	http://www.ga.gov.au/scientific-topics/energy/resources/other-renewable-
Background	The Project produced solar resource data, to be used by solar researchers and the Australian solar power industry. The specific aim being to allow identification regional scale prospectivity areas through provision of resource and infrastructure information and access.

Areas of Relevance	**Area**	**Comments**	**Relevance**
	13. Store and organise information on customer renewable energy deployments	The project produced solar resource data, to be used by solar researchers and the Australian solar power industry. The specific aim being to allow identification regional scale prospectivity areas through provision of resource and infrastructure information and access. This project contributed to the creation of the Australian Solar Energy Information System, funded the development of better satellite models for depicting solar radiation, and funded eight additional solar radiation ground monitoring stations.	High
	14. Improve techniques for forecasting renewable energy output.	This project developed the Australian Solar Energy Information System which is an online and hard drive product. Increased quality and quantity of solar exposure data is supplied by the Bureau. This project contributed to the creation of the Australian Solar Energy information System, funded the development of better satellite models for depicting solar radiation, and funded eight additional solar radiation ground monitoring stations.	High
Approaches	**Approach**	**Comments**	
	Renewable Energy Resource Mapping	The project had two approaches that complimented each other. Significantly the first being to improve the solar exposure data collection and modelling processes undertaken at the Bureau of meteorology. Through a doubling of the ground stations used for modelling. The send was to develop interfaces to provide easier access to resource data and infrastructure data for solar prospectivity decisions through a web interface portal.	
Results	**Result**	**Comments**	
	Produced information resources	Increased quality and quantity of solar exposure data supplied by the Bureau. The development of the Australian Solar Energy Information System (online and hard drive product).	

Staged Development of an Interactive Australian PV Solar Mapping Resource

Project ID	114
Organisation	Australian PV Institute (APVI)
Organisation Type	Research
Partners	
Story	An interactive PV mapping tool has been established to track the uptake, performance and impact of PV on electricity systems across different regions of Australia. These types of data are required to inform investment and system design decisions, and for the management of and planning for distributed energy. A live solar map visually conveys, by state, key information on estimated PV output as a percentage of maximum capacity (performance), estimated percentage of electricity demand being met by photovoltaics (contribution), and total electricity demand combined with the amount generated by PV (total demand + PV generation).Through its mapping solution, this project endeavours to increase confidence and information regarding PV capacity and performance. It provides access to data, useful for conducting research on photovoltaics markets, performance, reliability
Start Date	01-09-2012
End Date	01-09-2014
Customer Segment	None
Customers Involved	
Cost	AUD 436,478
Funding Source	Federal Government ARENA
Network	None
Connection Point	None
Location	Multiple locations across Australia
State	NSW, NT, QLD, SA, TAS, VIC, WA
Country	Australia
Future Plans	
Contact Name	Dr Muriel Watt
Contact Email	chair@apvi.org.au
Contact Phone	+61 427 727 368
Contact Link	http://pv-map.apvi.org.au/
Background	An interactive PV mapping tool has been established to track the uptake, performance and impact of PV on electricity systems across different regions of Australia. These types of data are required to inform investment and system design decisions, and for the management of and planning for distributed energy.

Areas of Relevance	Area	Comments	Relevance
	14. Improve techniques for forecasting renewable energy output.	This project involves the development of an interactive PV mapping tool for tracking the uptake and impact of PV and disseminating information to facilitate investment and research.	High
	13. Store and organise information on customer renewable energy deployments	This project will provide increased awareness, confidence and information about PV capacity and performance. It will provide access to data that can be used to conduct high quality research related to photovoltaics markets, performance, reliability and integration with energy markets and networks.	High
Approaches	**Approach**	**Comments**	
	Renewable Energy Resource Mapping	An interactive PV mapping tool has been established to track the uptake, performance and impact of PV on electricity systems across different regions of Australia. These types of data are required to inform investment and system design decisions, and for the management of and planning for distributed energy. The map provides key information on estimated photovoltaic output as a percentage of its maximum capacity in each state; estimated percentage of electricity demand being met by photovoltaics in each state; and total electricity demand in each state combined with the amount generated by PV.	
Results	**Result**	**Comments**	
	No results yet	The mapping tool data is live and the project is currently ongoing.	

Stockholm Royal Seaport Project

Project ID	225
Organisation	Stockholm Municipality
Organisation Type	Government
Partners	ABB, Fortum, Ericsson, Envac, Swedish ICT and others
Story	Stockholm Royal Seaport is one of the largest urban development projects in Europe. Sustainability is embedded in the entire project from organisation and planning to turnkey homes and premises. The City of Stockholm has decided that the district is to be built to high environmental standards to create a world-class sustainable district. Stockholm Royal Seaport will also be a showcase for sustainable urban development, offering one of the most attractive and modern environments in which to live in Europe. Dwellings, workplaces, parks and squares will employ modern, sustainable solutions. The project includes building a complete operating environment will be created for full-scale testing of smart grid applications based on Network Manager SCADA/DMS, pioneering on new grid design to reduce losses and improves the grid's power quality as well as creating new business model and a set of rules and regulations that makes it possible for consumers to get more involved in the energy market. An environmental database is being built to follow up the objectives. This work will be carried out within the remit of a research and development project to develop an interactive real-time database and is a collaboration between the City, academia, developers, technology development companies and research institutions.
Start Date	2010
End Date	2030
Customer Segment	Large commercial, Residential, SME
Customers Involved	12,000 homes
Cost	
Funding Source	Commercial Partner, Local Government
Network Connection Point	Customer Connections
Location	Stockholm
State	
Country	Sweden
Future Plans	The project is on-going
Contact Name	Clinton Davis
Contact Email	
Contact Phone	
Contact Link	
Background	The City of Stockholm is building a world-class environmentally friendly city district at Stockholm Royal Seaport. This city district is also one of the projects supported by the Clinton Climate Initiative Program. Some of the climate and environmental goals for the project are for to become climate positive and fossil-fuel-free by 2030. At the same time, carbon emissions should be less than 1.5 tons per person.

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Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach	Influence how people use electricity and adapt their energy consumption to times of day when there is an ample supply of less expensive, green electricity.	Low
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Creating a business model and a set of rules and regulations that makes it possible for consumers to get more involved in the energy market.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources	Example of the control components are:- Medium and low voltage switchgear, as well as transformer stations with extensive monitoring and control.- Cable cabinets with control and monitoring.- Centralized energy storage.- Integration of charging stations for electric cars.	Med
	12. Use distributed energy solutions to address network and system constraints	Charge electric cars at their own charging stations. The smart grid adapts charging to periods during the day when the price of electricity is low and there is low environmental impact. Furthermore, it could be possible in the future for electric car batteries to provide an effective power reserve for the city district in the same manner as permanent energy storage units.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources	The project aims to create a market model that makes it easier for consumers to participate in the energy market.	Med

Approaches	**Approach**	**Comments**
	Electrical System Modelling	The Smart Grid Lab A complete operating environment will be created for full-scale testing of smart grid applications based on Network Manager SCADA/DMS.
	Standards Development	Market concept: This involves, among others, creating a business model and a set of rules and regulations that makes it possible for consumers to get more involved in the energy market. Examples include: – Identifying test scenarios and test hypotheses. – Creating a market model that makes it easier for consumers to participate in the energy market. – Creating a market model and a set of rules and regulations for network operation of the smart grid.
	Other	Connections for ships to the local grid Development of a flexible, cost-effective solution that allows ships in port to connect to the local grid, no matter what frequency is used on board.
	Electrical System Modelling	Grid development This involves research on new grid design, which, among others, reduces losses and improves the grid's power quality.
	Storage, Customer-Connected	The project involves producing energy customers' own electricity from solar panels installed on the rooftops. The smart grid also makes it possible to store electricity in local storage units, or feed it back into the grid – for either own consumption or sale. The goal is for the properties to produce 30 percent of their electricity locally using solar power, wind power or by utilizing surplus energy in various ways, as follow:
Results	**Result**	**Comments**
	No results yet	The project is on-going

Summer Energy Demand Trial

Project ID	295
Organisation	United Energy
Organisation Type	Network
Partners	
Story	The use of heavy air-conditioners and appliances on hot days especially during peak demand times adds stress to the network. This trial aims to understand whether customers could consistently reduce their consumption on peak demand "event days" to curb peak demand. One of the main goals of the trial is to raise awareness in customers of their appliance use and the impact on the network. Through this engagement and education process, UE seeks to understand the level of assistance and incentive that is required for customers to modify their behaviour and reduce peak demand. From data captured in the first summer period of this project, participating consumers on average managed to reduce their peak demand by 30-45% during peak event periods compared to a similar day.
Start Date	2014-02-07
End Date	2016-03-31
Customer Segment	Residential
Customers Involved	30
Cost	
Funding Source	Regulator-Approved Spend
Network	United Energy
Connection Point	Distribution Feeders, Zone Substations
Location	Bulleen/Lower Templestowe
State	VIC
Country	Australia
Future Plans	This project is ongoing with the intention of running the trial for a minimum of 3 years.
Contact Name	Sharon Tissai-Krishna
Contact Email	sharon.tissai-krishna@ue.com.au
Contact Phone	03 8846 9828
Contact Link	http://unitedenergy.com.au/customers/your-electricity/summer-energy-demand-trial.aspx
Background	Heavy air conditioner use in hot weather has led to high growth in peak demand. Four 11kV feeders in the Bulleen/Lower Templestowe area will require upgrade in 2017/18. The trial is aimed at understanding whether customers could consistently reduce their consumption on peak demand "event days" to curb peak demand.

Areas of Relevance	Area	Comments	Relevance
	5. Engage customers to build their and the industry's understanding of distributed energy resources	One of the goals of the trial was to raise awareness in customers of their appliance use and the impact on the network. Through this engagement and education process, UE seeks to understand the level of assistance and incentive that is required for customers to modify their behaviour and reduce peak demand	Med
	11. Alter local load profile to match a desired level	Through awareness and education the trial sought to incentivise customers to reduce their peak demand on peak demand and smooth the demand profile.	Med
	12. Use distributed energy solutions to address network and system constraints	The resulting demand reduction is expected to reduce stress on the network during peak demand periods and help alleviate network constraints.	Med
Approaches	**Approach**	**Comments**	
	Demand Side Incentives	The trial seeks to understand if consumers can be assisted and incentivised on peak demand days to reduce their peak demand, resulting in the load profile being reshaped on the distribution network and at the local premises.	
Results	**Result**	**Comments**	
	Incentives helped consumers reduce consumption during peak demand	From data captured in the first summer period, participating consumers on average managed to reduce their peak demand by 30-45% during peak event periods compared to a similar day.	

Survey of likely take-up of a voluntary residential capacity based tariff

Project ID	303
Organisation	SA Power Networks
Organisation Type	Network
Partners	
Story	The Australian Government and Regulators are encouraging a transition toward cost reflective network tariffs to improve economic efficiency and reduce cross-subsidies between some customer segments. A market research company was engaged to survey customers as to their likelihood of taking up a voluntary capacity based tariff as well as gathering supplementary information regarding how they might practically respond to such a tariff by altering their energy usage patterns. During the research, opportunities also arose to better understand customer knowledge and behaviour as it related to demand on the network, attitudes to electricity charging, and potential for altering demand habits in various socio-economic and age groupings during peak demand periods. Customers indicated strong interest in having more control over what they paid for electricity. A critical result was that only 6% of those surveyed were AGAINST such a tariff when the reasons for its introduction were set out for them. SA Power Networks is currently finalising its approach to the introduction of capacity based tariffs. At this stage, an opt-in tariff has been published within SA Power Networks' 2014/15 Pricing Proposal and detailed planning is underway which may lead to broader introduction.
Start Date	01-07-2012
End Date	30-06-2014
Customer Segment	Residential
Customers Involved	
Cost	
Funding Source	Discretionary Spend
Network	SA Power Networks
Connection Point	
Location	Metropolitan Adelaide
State	SA
Country	Australia
Future Plans	SA Power Networks is currently finalising its approach to the introduction of capacity based tariffs. At this stage, an opt-in tariff has been published within SA Power Networks' 2014/15 Pricing Proposal and detailed planning is underway which may lead to broader introduction.
Contact Name	Mark Vincent
Contact Email	mark.vincent@sapowernetworks.com.au
Contact Phone	0427 580 119
Contact Link	
Background	The Australian Government and Regulators are encouraging a transition toward cost reflective network tariffs to improve economic efficiency and reduce cross-subsidies between some customer segments. This is in response to a number of key issues including (historically) significant peak demand growth and reducing load factor in the NEM, the significant uptake of small scale embedded generation, particularly solar PV, and the likely near-term take-up of residential battery storage and electric vehicles. This combination of circumstances has led SA Power Networks to research and develop plans to introduce residential capacity based tariffs. Within this environment, it was considered critical to understand customers' receptiveness to such tariffs, potential impediments to their introduction, and what level of voluntary customer take-up of such tariffs might be experienced, should they be offered broadly to residential customers.

Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach	The end customer response to a voluntary capacity tariff was important to gain a better understanding of the issues involved in introducing an alternative electricity pricing approach	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The introduction of a capacity tariff is the foundation of any new business model which caters for the shift toward distributed energy resources. The research was critical to inform how best for the business to proceed with the introduction of such tariffs as well as gaining political and regulatory support.	Med
	5. Engage customers to build their and the industry's understanding of distributed energy resources	The end customer research was pertinent in further building SA Power Networks' understanding regarding how little customers actually know and understand about the issues, value and management of distributed energy. It was also an excellent avenue to attempt to better educate those involved and ascertain what may need to be involved in a broader education campaign.	High

Approaches	Approach	Comments
	Interviews and Surveys	A market research company was engaged to survey customers as to their likelihood of taking up a voluntary capacity based tariff as well as gathering supplementary information regarding how they might practically respond to such a tariff by altering their energy usage patterns. This follows from prior work undertaken by SA Power Networks to trial capacity style tariffs over two summers in North Adelaide and also undertake focus groups to understand issues and impediments associated with the introduction of such a tariff approach. During the research, opportunities also arose to better understand customer knowledge and behaviour as it related to demand on the network, attitudes to electricity charging, and potential for altering demand habits in various socio-economic and age groupings during peak demand periods.

Results	Result	Comments
	Demand charges improve customer equity	The on-line survey research undertaken in 2014 confirmed understandings gained from previous work including the focus groups of August/September 2012. In particular, customers indicated strong interest in having more control over what they paid for electricity. This was across the spectrum of annual spend. One in 10 customers indicated they were willing to sign up for a capacity based tariff after completing the on-line survey. Likely early adopters were more highly represented by those that were university educated, living in high density accommodation and already economising on energy spend (as opposed to demand).56% of those surveyed said they could be interested in considering such a tariff with more information. More than half of those surveyed were not looking for massive savings from moving to such a tariff, stating they would be willing to accept $40 a quarter saving or lower, noting that customers were told that this tariff would not deliver savings to everyone. A critical result was that only 6% of those surveyed were AGAINST such a tariff when the reasons for its introduction were set out for them. This was a positive result should the tariff be both voluntary for anyone who wishes, but also potentially mandatory for new homes or after major alterations to supply at a residential premises - a pathway currently under consideration.

SYSERWIND – System Services Provided by wind farms

Project ID	161
Organisation	Iberdrola
Organisation Type	Proponent
Partners	Gammesa, Red Electrica de Espana, University of Comillas
Story	The aim is to develop new control algorithms and systems in order to allow wind farms to provide secondary frequency regulation services and voltage control in the transmission grid. The project was carried out at 15 of Iberdrola's wind power facilities, which have a combined installed capacity of over 480MW and are connected to three nodes in a 350km long 400 kV transmission line. They were equipped with systems allowing coordinated control of the power generated and altering the voltage in the grid. New controllers were developed to make 240 wind turbines work in a coordinated way in order to control the voltage along the line. Also a very short term wind forecasting algorithm was developed in order to provide a secondary frequency regulation band with the necessary precision. In the voltage control trial all the wind farms control their reactive power generation and consumption in a coordinated fashion, thus modifying the voltages in the 400 kV nodes in a controlled way. In the regulation trial the active power provided by the 15 wind farms was successfully controlled in a coordinated way in order to allow wind generators to provide secondary frequency control services.
Start Date	2010
End Date	2013
Customer Segment	None
Customers Involved	
Cost	Part of AUD 84M European Commission sponsored Twenties Project
Funding Source	Commercial Partner, Discretionary Spend, European Commission
Network	Other
Connection Point	
Location	Multiple cities
State	
Country	Spain
Future Plans	The project has been successfully finished with positive and validated results, but the continuation and actual implementation of the solutions will depend on the regulatory framework in order to allow the wind energy to perform the proposed ancillary services, and the remuneration for the producer which should make the provision of the service profitable.
Contact Name	Sr. Roberto Veguillas
Contact Email	rvegullas@iberdrola.es
Contact Phone	
Contact Link	http://www.twenties-
Background:	Currently conventional generators provide key services to the electric system that wind generators are not able to provide, namely voltage control in the transmission grid and secondary frequency control. As wind penetration increases, reducing the conventional generation's share of the power supply, it becomes more important for this technology to support the system with such services. The aim is to develop new control algorithms and systems in order to allow wind farms to provide secondary frequency regulation services and voltage control in the transmission grid, and to do so while minimising equipment modifications in the wind turbines and substations.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The aim is to develop new power-frequency and voltage control equipment and systems to optimise the connection between wind farms and electricity transmission grids. The control system developed in this project makes it more efficient to connect wind farms to the TSO and reduces losses in the transmission network.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources	The project demonstrates that it is possible to coordinate a large number of WTGs to provide voltage and frequency control services.	High
	9. Strengthen the network to manage higher renewable energy penetration	Voltage control in the transmission grid makes it possible to connect more wind farms before reaching technical constraints.	Med
	10. Smooth out intermittent generation output	The active power controllers developed in this project make it possible to modify high amounts of combined wind power in a controlled way to smooth the output.	Med
	14. Improve techniques for forecasting renewable energy output	The wind forecasting tools have been updated to provide more accurate forecasts, which is a critical issue in secondary frequency control.	Low

Approaches	Approach	Comments
	Weather Forecasting	A very short term wind forecasting algorithm was developed in order to provide a secondary frequency regulation band with the necessary precision. Most importantly, these tools are fully integrated into the system operation and the TSO tools.
	Demonstration Project	The demonstration was divided into two trials: a voltage control trial and a secondary frequency control trial. In the first trial all the wind farms control their reactive power generation and consumption in a coordinated fashion, thus modifying the voltages in the 400 kV nodes in a controlled way. In the second trial the active power provided by the 15 wind farms was controlled in a coordinated way in order to allow wind generators to provide secondary frequency control services.
	Controllers	The project was carried out at 15 of Iberdrola's wind power facilities, which are equipped with Gamesa wind turbines and have a combined installed capacity of over 480 megawatts (MW). The wind farms are connected to three nodes in the 400 kV transmission grid operated by Red Elettrica de España. They were equipped with the systems developed for the Syserwind project, allowing coordinated work on controlling the power generated by the facilities and altering the voltage in the grid. New controllers were developed and installed in Iberdrola's and Red Eléctrica de España's control centres and the wind farms, which implement new strategies that make 240 wind turbines work in a coordinated way in order to control the voltage in a 400 kV AC corridor more than 350 kilometres long.

Results	Result	Comments
	PV, if uncontrolled, can create voltage problems for the network	Wind farms provided wide-area voltage control in the transmission grid, reducing voltage deviation from 9 kV to 0.7 kV. They operated in a coordinated fashion to provide secondary frequency control with similar technical performance as conventional units.
	Wind generation had to be curtailed	A large amount of energy has to be curtailed to provide the upwards power reserve service which with current market rules it is not currently attractive from an economic perspective.

Talking Power customer engagement process

Project ID	306
Organisation	SA Power Networks
Organisation Type	Network
Partners	
Story	SA Power Networks implemented a comprehensive stakeholder engagement program called Talking Power to engage with our customers and stakeholders in order to understand their current and future needs, concerns and preferences. Based on previous proprietary research four topics areas were investigated: Customer Experience; Community, Safety & Reliability; Visual Amenity; and The Evolving Customer. SA Power networks considers that it has conceived and implemented the most comprehensive stakeholder and customer engagement program seen in our sector to date, using techniques and channels that have not previously been used in Australia.
Start Date	01-11-2012
End Date	31-10-2015
Customer Segment	Industrial, Large commercial, Residential, SME
Customers Involved	Over 4,000
Cost	
Funding Source	Discretionary Spend
Network	SA Power Networks
Connection Point	
Location	Statewide
State	SA
Country	Australia
Future Plans	This approach will guide our ongoing customer engagement into the future.
Contact Name	Mark Vincent
Contact Email	mark.vincent@sapowernetworks.com.au
Contact Phone	0427 580 119
Contact Link	http://www.talkingpower.com.au
Background	The Australian Energy Regulator's Consumer Engagement Guideline for Network Service Providers (AER guideline) was introduced as part of the Better Regulation reform focused on promoting the long term interests of electricity consumers. To guide the development of its 2015-20 regulatory proposal, and consistent with the guideline, SA Power Networks implemented a comprehensive stakeholder engagement program called Talking Power to engage with our customers and stakeholders in order to understand their current and future needs, concerns and preferences. Based on previous proprietary research four topics areas were investigated: Customer Experience; Community, Safety & Reliability; Visual Amenity; and The Evolving Customer.

Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach	The project sought to determine participants understanding of and their opinions with respect to distributed energy resources and cost-reflective tariffs.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources	The project sought to determine participants' understanding of, and their opinions with respect to, proposed changes to the electricity industry, and how these changes may affect them. This included engagement on topics such as smart meters, capacity tariffs and demand side participation.	Med

Approaches	Approach	Comments
	Interviews and Surveys	The Talking Power engagement program spans three distinct stages. The 'research' stage was about listening to customer concerns. The 'strategy' phase has seen these concerns integrated into our planning and verification that our plans are addressing customer concerns. The 'regulatory' stage is about the regulator's evaluation of our plans .During the research phase seven workshops were held across the State with electricity customers and stakeholders. We also conducted an online survey with 2,883 responses from the community. Customer views were gathered and 13 main customer insights summarised these views. During the strategy phase these customer insights and supporting evidence were presented to SA Power Networks' business leaders so they could be incorporated into business planning. Eight workshops were then held around the State to validate the earlier research findings, to outline SA Power Networks' broad plans and to obtain customers' views on how well we had captured customer insights in our business plans. Directions and Priorities, the final stage of our consultation program is designed to facilitate feedback from our customers and stakeholders on our proposals for the 2015-2020 period.

Results	Result	Comments
	Customer engagement achieved	SA Power networks considers that it has conceived and implemented the most comprehensive stakeholder and customer engagement program seen in our sector to date, using techniques and channels that have not previously been used in Australia.

T-City Project

Project ID	226
Organisation	Deutsche Telekom (T-Systems)
Organisation Type	Other
Partners	Friedrichshafen municipality, Technische Werke Friedrichshafen (TWF), ABB and others
Story	Successful smart cities services are often created by a strong partnership between the local governments, one or more telecoms operators and, in many cases, a systems integrator or technology supplier. In some cases, a telco may need to take the lead, building its own smart city ecosystem that can then replicate projects across multiple different cities. In Germany, for example, Deutsche Telekom works with a wide range of partners to pilot complex projects, such as smart metering, Home Network 2.0, and the integration of renewable and distributed energy resources in the T-City of Friedrichshafen in the south of the country. The five year old T-City test bed in Friedrichshafen, Germany, is demonstrating how a smart city can combine innovative information and communication technologies, together with a smart energy grid and services, to help improve the quality of life of citizens. So-called "Smart Energy" is also a particularly important component of the T-City initiative. A smart metering solution developed by Deutsche Telekom, Technische Werke Friedrichshafen (TWF) and other software companies, has been tested with 1,600 households in Friedrichshafen. Deployed in June 2008, the smart electricity meters send consumption data, via a wireless link or a DSL connection, to energy suppliers, which have made the data available to customers through an internet portal. The monitoring service was later expanded to cover domestic gas and water. Consumers now have the information they need to regulate their energy consumption, renewable energy production, resulting in lower utility bills and a lower impact on the environment. Energy providers have also benefited from adjusting energy production to match the demand
Start Date	2009
End Date	
Customer Segment	Large commercial, Residential, SME
Customers Involved	
Cost	
Funding Source	Commercial Partner
Network	
Connection Point	Customer Connections
Location	Friedrichshafen
State	
Country	Germany
Future Plans	The project is on-going
Contact Name	Clinton Davis
Contact Email	
Contact Phone	
Contact Link	
Background	Since the launch of the T-City test bed in 2007, Deutsche Telekom has completed more than 40 pilot projects in Friedrichshafen across different categories: Energy, Mobility and Transport, Learning and Research, Tourism and Culture, Citizens and the State, Health and Support and Business and Work. In many cases, Deutsche Telekom has added value through the provision of IT platforms, managed services and turnkey solutions. Deutsche Telekom is using the programme to explore how a telecoms operator can act as a systems integrator on smart city projects. The new products and services Deutsche Telekom and its partners test in Friedrichshafen are refined and then showcased to other cities and industries. As part of the T-City program to create the city of the future, T-Systems, a subsidiary of Deutsche Telekom and ABB are working closely with regional German utility Technische Werke Friedrichshafen (TWF) to improve the management of power supplies, so consumers can use electricity more efficiently.

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Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	The T-City project is to test an innovative business model for network balancing by managing the integration of distributed generation and demand response. It is worth to explore whether such combination is applicable in Australian context.	Low
	11. Alter local load profile to match a desired level	In T-City project, new power supply systems are embedded with communication technology by default. This is an innovative approach to pilot future oriented power system. However, it is necessary to evaluate if this approach is applicable and can add benefit to Australia's current energy infrastructure.	Low

Approaches	Approach	Comments
	Network Monitoring & Analysis	Key approaches of the project: - Equip power supply systems with communication solutions to better adjust supply and demand to each other - Integrate renewable energy and improve overall efficiency in the T-City of Friedrichshafen with the implementation of smart grid technologies - Provide transparency on electricity consumption and opportunity to control it

Results	Result	Comments
	No results yet	The project is on-going

Technical Rules for connecting PV to the Distribution System

Project ID	331
Organisation	Horizon Power
Organisation Type	Network
Partners	
Story	Details of this project available on request.
Start Date	
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	
Network	Horizon Power
Connection Point	
Location	
State	WA
Country	Australia
Future Plans	
Contact Name	Dave Edwards
Contact Email	david.edwards@horizonpower.com.au
Contact Phone	0417 019 455
Contact Link	
Background	

Areas of Relevance	Area	Comments	Relevance

Approaches	Approach	Comments

Results	Result	Comments

The ANU Solar Radiation and Cloud Measurement Network

Project ID	262
Organisation	The Australian National University
Organisation Type	Research
Partners	
Story	There is uncertainty of suburb scale fluctuations in solar radiation and their impacts on distributed solar energy generation. The primary focus of this project is to improve techniques for forecasting renewable energy output. Specifically, the project aims to observe how well can suburb-scale solar forecasts predict the respective energy fluctuations. To do this, the project establishes a high density network of solar radiation, solar energy generation and sky-imaging equipment and records their observations at high frequency (<20sec) on the rooftops of buildings on the ANU campus. The project is underway and results have not yet been collated or reported.
Start Date	01-01-2012
End Date	01-12-2022
Customer Segment	
Customers Involved	
Cost	AUD 100,000
Funding Source	Discretionary Spend
Network	ActewAGL
Connection Point	
Location	Canberra
State	ACT
Country	Australia
Future Plans	This network will continue to run until a combination of lack of funding and equipment failure prohibit its continued operation.
Contact Name	Nicholas Engerer and Franklin Mills
Contact Email	nicholas.engerer@anu.edu.au
Contact Phone	2 6125 1658 (Nicholas)
Contact Link	http://www.nickengerer.org/projects/
Background	There is uncertainty of suburb scale fluctuations in solar radiation and their impacts on distributed solar energy generation.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	By characterising potential problems in high penetration integration of distributed solar micro-generators, adaptive strategies may be identified and adopted. Theoretical thresholds for the maximum level of penetration possible may also be determined.	Low
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	By characterising potential problems in high penetration integration of distributed solar micro-generators, adaptive strategies may be identified and adopted. Theoretical thresholds for the maximum level of penetration possible may also be determined.	Low
	14. Improve techniques for forecasting renewable energy output.	This is a primary focus of the project. Specifically, once characterised, how well can suburb-scale solar forecasts predict the respective energy fluctuations. The project establishes a high density network of solar radiation, solar energy generation and sky-imaging equipment and records their observations at high frequency (<20sec) on the rooftops of buildings on The ANU	High

Approaches	Approach	Comments
	Renewable Energy Resource Mapping	The project establishes a high density network of solar radiation, solar energy generation and sky-imaging equipment and records their observations at high frequency (<20sec) on the rooftops of buildings on the ANU campus.

Results	Result	Comments
	No results yet	The project is underway and results have not yet been collated or reported.

The Future Grid Research Program

Project ID	307
Organisation	The University of Sydney
Organisation Type	Government, Research
Partners	CSIRO; University of Newcastle; University of Queensland; and University of New South Wales
Story	In 2050, CSIRO predicts that our homes and businesses could be powered by more than 20 different energy sources and technologies. Moving away from a system that has used technologies and energy sources that are predictable and controllable will require a great deal of effort and capacity building. Australia's electricity sector will need to prepare for the monumental make-over required to undergo this transformation. This project aims to develop the nation's capacity to plan and design the most efficient, low emission electricity grid for Australia. It will deliver the first analytical framework of its kind for Australian electricity and natural gas networks.
Start Date	01-01-2013
End Date	Current (Completion target is 2015)
Customer Segment	
Customers Involved	
Cost	AUD 13m
Funding Source	Federal Government
Network	NEM
Connection Point	Customer Connections, Distribution Feeders, Subtransmission Feeders, Zone
Location	
State	
Country	Australia
Future Plans	The project is currently underway
Contact Name	Professor Anthony Vassallo
Contact Email	anthony.vassallo@sydney.edu.au
Contact Phone	
Contact Link	http://arena.gov.au/project/redeployable-hybrid-power/
Background	Existing Australian power grids - in particular the National Electricity Market (NEM) grid - have evolved over the last 60 years as systems where a small number of large, remote generators have provided power at high voltage through a transmission system connected to customers through a lower voltage distribution grid. Power flow is one-way and distribution networks are designed to divide power from large generators into small quantities for customers. However, the future grid will need to evolve and operate under a potentially very different environment. In 2050, CSIRO predicts that our homes and businesses could be powered by more than 20 different energy sources and technologies. Moving away from a system that has used technologies and energy sources that are predictable and controllable will require a great deal of effort and capacity building. Australia's electricity sector will need to prepare for the monumental make-over required to undergo this transformation. The transition from the existing grid to the future grid will involve a period of major and potentially disruptive change. Factors such as renewable generation, demand side technologies, climate change and social / political imperatives will drive changes in power generation, transmission and end use that will severely test the current infrastructure. This project aims to develop the nation's capacity to plan and design the most efficient, low emission electricity grid for Australia. It will deliver the first analytical framework of its kind for Australian electricity and natural gas networks.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	The Future Grid Research Program will deliver the first analytical framework of its kind for Australian electricity and natural gas networks. This framework will allow systematic investigation of the most economically efficient energy network configurations, enabling the electricity sector to make the key decisions required to successfully develop and evolve the nation's future grid over the next two decades.	High
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Models and tools developed by the program will help identify lowest cost pathways to successfully integrating large and small scale renewables into the electricity grid. This will also pave the way for significant emissions reductions in Australia's most carbon intensive economic sector .This project will provide policy analysis and development that will encourage market participants to deliver the desired long-term outcomes.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Identify the optimum mix of renewables and most efficient use of storage to provide lowest cost integration.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources	This project will aim to understand the feasibility and reliability of different generation sources	Low
	9. Strengthen the network to manage higher renewable energy penetration	This project will research the planning of grids with high-share of renewable generators	Low
	10. Smooth out intermittent generation output	The project is modelling and analysing how to use energy storage to smooth intermittent output and also manage load fluctuations	Med
	11. Alter local load profile to match a desired level	Distributed storage and demand response are being researched to adjust local and regional demand profiles for better integration of renewables and other generation	Low
	14. Improve techniques for forecasting renewable energy output	The project is developing methods to forecast PV output up to 1 day ahead	Med

Approaches	Approach	Comments
		This research program will seek to provide the framework to guide the electricity sector in making the key decisions about future grid development over the coming decades. The program will conduct research that draws together engineering, economic and policy aspects of grid development and optimisation and focuses on four major areas.
	Economic Modelling	Economics of alternative network development paths and estimates of total cost and price impacts, led by University of Queensland
	Electrical System Modelling	Grid planning and co-optimisation of electricity and gas networks, led by University of Newcastle
	Policy advocacy	Policy measures and regulatory changes to facilitate a smooth transition to a decarbonised future grid, led by University of New South Wales.
	Electrical System Modelling	Improved understanding of impacts of different loads, generation sources and energy storage on system security, led by the University of Sydney

Results	Result	Comments
	No results yet	The project is still ongoing.

The Impact of distributed solar generation on the wholesale electricity market

Project ID	188
Organisation	Melbourne Energy Institute (University of Melbourne)
Organisation Type	Research
Partners	Project was part funded by the AEMC Consumer Advocacy Panel
Story	This project aimed to build on earlier preliminary work showing the value of the Merit Order Effect for solar PV could be substantial, and could potentially offset the costs of any support scheme. It analysed the effect with a more sophisticated market model, and a more sophisticated (and representative) solar model. The modelling results indicated that in a high distributed solar generation scenario (10GW), spot market turnover could reduce by as much as $1 billion per annum. (This represents approximately 16% of the total market turnover for FY12). The modelling also indicated that distributed solar has a disproportionate impact on black coal generation (output falling by 8% in the high solar capacity scenario, compared with 4% and 6% for gas and brown coal respectively). The spatial distribution of PV had comparatively little impact on the overall spot price reductions
Start Date	01-06-2012
End Date	01-06-2013
Customer Segment	Industrial, Large commercial, Residential, SME
Customers Involved	
Cost	AUD 82,000
Funding Source	Regulator-Approved Spend
Network	
Connection Point	
Location	
State	
Country	Australia
Future Plans	Current and future work will look at another common approach (regression analysis) for analysing the merit order effect. Additionally, rather than modelling solar production, analysis will include estimations of actual solar production. This is done with a view to understand what is currently actually happening (rather than a 'historical forecast') to inform understanding of the long term impact of renewable energy on the electricity market.
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Contact Phone	0408 585 496
Contact Link	http://www.energy.unimelb.edu.au/documents/impact-distributed-solar-generation-wholesale-electricity-markethttp://www.energy.unimelb.edu.au/documents/retrospective-modelling-merit-order-effect-wholesale-electricity-prices-distributed
Background	Policies to accelerate the deployment of renewable energy (e.g. feed-in tariffs and the LRET/SRES scheme) are often criticised for the impact they have on consumer electricity prices. However, the effect that renewable energy has on the wholesale electricity markets is often overlooked when considering the overall impacts. This work aims to further develop our understanding of the impact that renewable energy has on the wholesale market, an impact commonly referred to as the 'Merit Order Effect'. Previous analysis (based on a simplified model of the Australian NEM) evaluated the impact of the solar PV on the wholesale market. This analysis indicated the value of the Merit Order Effect for solar PV could be substantial, and could potentially offset the costs of any support scheme. This finding suggested further analysis would be worthwhile. This project aimed to build on this preliminary work by analysing the effect with a more sophisticated market model, and more sophisticated (and representative) solar model.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	This project directly quantifies an often overlooked phenomenon when considering the costs of renewable energy (i.e. the 'Merit Order Effect'). The depressing effect renewable energy has on the wholesale electricity (often unknown or unreported) is quantified in this project. The project also quantifies the reduction in coal and gas fired generation, and thus emissions (an important environment benefit and objective of renewable energy deployment)	High
	2. Support the transition to an alternative electricity pricing approach	This project evaluates the impact that photovoltaic generation has on the current electricity market. Whilst it does not directly consider or evaluate alternative market designs, it does inform the discussions around wholesale market design and reform (and the suitability of the market design for facilitating high penetrations of renewable energy).	Low
	4. Inform the regulatory environment for renewable energy	The previous work was directly submitted (through the consultation process) to various feed -in tariff reviews, and the previous review of the RET. Both the previous work and the newer work have also been referred to third party submissions (e.g. the recent RET review).	Med

Approaches	**Approach**	**Comments**
	Market Modelling	This project used an electricity market modelling approach. A five market dispatch model of the NEM was developed (utilising linear programming) to retrospectively evaluate the merit order effect for hypothetical installations of PV. Solar PV generation was modelled, assuming the same actual distribution (from Clean Energy Regulator data) as well as other distributions, (in scenarios ranging between 2 and 10 GW of installed distributed solar). This generation was assumed to be a demand side reduction, and was used with historic demand data, to develop a modified demand profile. This modified demand profile (and the market model) was used with historical bid and offer data to re-evaluate the dispatch process (and hence price), allowing for an estimation of the merit order effect. (And an estimation of the impact on other generation types)
Results	**Result**	**Comments**
	PV reduces spot market prices	The modelling results indicated that in a high distributed solar generation scenario (10GW), spot market turnover could reduce by as much as $1 billion per annum. (This represents approximately 16% of the total market turnover for FY12). The spatial distribution of PV had comparatively little impact on the overall spot price reductions.
	PV has a disproportionate impact on black coal generation	The modelling also indicated that distributed solar has a disproportionate impact on black coal generation (output falling by 8% in the high solar capacity scenario, compared with 4% and 6% for gas and brown coal respectively).
	Other	One of the main objectives of this work was to improve previous analysis. In this respect, the project was unsuccessful, as the improved model did not substantially contribute to or improve upon the initial work (and also still contained some of the same short-comings).

The Impact of High Penetration of Solar Photovoltaic Systems on Low Voltage Feeder Power Quality

Project ID	284
Organisation	University of Wollongong
Organisation Type	Other
Partners	Australian Strategic Technology Programme of the Energy Networks Association of Australia
Story	Solar photovoltaic (PV) electricity generating systems are seen as an important component of demand side management and carbon abatement strategies. As such installation of solar PV generating capacity on domestic residences has been strongly encouraged by state and federal governments through capital expenditure grant schemes and generous feed-in tariff arrangements. Consequently, solar PV penetration levels have increased significantly over the past several years. It has been postulated that high penetration of solar PV systems may have an adverse impact on the power quality levels of the low voltage feeders to which the systems are connected. The major power quality concerns due to high penetration levels of solar PV are steady state voltage control and potential voltage harmonic issues due to the harmonics produced by the inverter systems required as the interface between the solar PV cells and the electricity grid. While there have been theoretical studies which attempt to determine the impact of high solar PV penetration levels on low voltage distribution feeder power quality, there is little field data to support these studies. This project aimed to fill this gap by providing field data from three separate locations.
Start Date	6-12-2011
End Date	21-03-2014
Customer Segment	
Customers Involved	
Cost	AUD 49,500
Funding Source	
Network	
Connection Point	
Location	
State	
Country	Australia
Future Plans	No plans at present.
Contact Name	Dr Vic Smith
Contact Email	vic@uow.edu.au
Contact Phone	02 4221 4737
Contact Link	
Background	Solar photovoltaic (PV) electricity generating systems are seen as an important component of demand side management and carbon abatement strategies. As such installation of solar PV generating capacity on domestic residences has been strongly encouraged by state and federal governments through capital expenditure grant schemes and generous feed-in tariff arrangements. Consequently, solar PV penetration levels have increased significantly over the past several years. It has been postulated that high penetration of solar PV systems may have an adverse impact on the power quality levels of the low voltage feeders to which the systems are connected. The major power quality concerns due to high penetration levels of solar PV are steady state voltage control and potential voltage harmonic issues due to the harmonics produced by the inverter systems required as the interface between the solar PV cells and the electricity grid. While there have been theoretical studies which attempt to determine the impact of high solar PV penetration levels on low voltage distribution feeder power quality, there is little field data to support these studies. This project aimed to fill this gap by providing field data from three separate locations.

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Areas of Relevance	Area	Comments	Relevance
	9. Strengthen the network to manage higher renewable energy penetration	The impact on power quality of PV systems at three locations was measured to inform network planners of possible effects. Also a literature review of possible mitigation strategies was performed.	Med

Approaches	Approach	Comments
	Power stabilisation	A total of 3 low voltage feeders with high solar PV penetration levels were identified. Power quality instrumentation was installed at 3 locations on each of these feeders; nominally the start, middle and end.
	Literature Review	In addition to the field work, potential solutions to the effects of high penetration of solar PV systems were investigated by means of a literature survey to determine the best current methods used world-wide.
	Network Monitoring & Analysis	Monitoring was conducted over a period of one year to take climatic variations into account. Steady state voltage, unbalance and harmonics were monitored. Climatic data as well as the grid feed-in power supplied by the solar PV systems on the feeders monitored was also obtained. The impact on power quality of the PV system operation was analysed and summarised.

Results	Result	Comments
	PV, if uncontrolled, can create voltage problems for the network	Voltage rise was recorded at all sites during periods of the day where significant levels of solar generation would be expected; however, Voltage unbalance at the distribution substation decreased or remained constant at all of the distribution substations monitored during periods where voltage rise was observed at one or more of the remote locations. Voltage Total Harmonic Distortion (THD) levels also increased at six of eight monitor locations during periods of voltage rise. The project successfully measured power quality disturbances resulting from PV systems and gave an indication of their magnitude.

The impact of the mass adoption of electric vehicles on the Australian electricity grid.

Project ID	194
Organisation	The University of Melbourne
Organisation Type	Research
Partners	Better Place Australia (no longer exists), Senergy Econnect Australia
Story	The purpose of this study was to determine the potential scale of the impact of electric vehicles (EV) on the network at the low voltage (distribution) level, propose methods to alleviate this impact (controlled charging), and examine the possible use of renewable generation towards electric vehicle charging. To do this, the project examines the number of vehicles charging, their charging needs, and the projected network capacity (e.g. over the next 8 hours). It subsequently schedules charging rates for the vehicles in such a way that takes network constraints – including peak demand, thermal overloading, excessive voltage drop and phase unbalance – into consideration. The solution is recalculated in discrete time intervals to take into account changes such as vehicle arrival/departure. Additionally, charging schedules using locally available information, such as voltage, was analysed. The method used involved simulations based on real-life neighbourhood models and relevant statistical data. From these simulations, three primary conclusions were drawn: - Electric vehicle uptake rates of just 10-15% contributed to network failures in some cases - Low voltage was more problematic than thermal overload - Issues were amplified by highly unbalanced networks It was further determined that the use of controlled charging methods enabled networks to sustain premium EV uptake rates (over 80%) while simultaneously charging all vehicles within a six hour window. Essentially, this indicated that existing networks can handle significant electric vehicle uptake, provided that consumers submit control of their vehicle charging to third parties. It is anticipated that the introduction of renewables will boost opportunities in this field, particularly in relation to issues of low voltage.
Start Date	01-01-2012
End Date	31-12-2014
Customer Segment	Residential
Customers Involved	
Cost	AUD 564,000
Funding Source	Commercial Partner, Federal Government
Network	Ergon Energy, SP Ausnet, United Energy
Connection Point	Customer Connections, Distribution Feeders
Location	Melbourne, Townsville
State	VIC, QLD
Future Plans	The future of this project depends on availability of funding, which is currently being pursued.
Contact Name	Dr. Julian de Hoog
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Contact Phone	
Contact Link	https://apps.eng.unimelb.edu.au/research-projects/index.php?r=site/webView&id=41
Background	Increasing electric vehicle uptake is projected by many industry analysts. The purpose of this study was to determine the potential scale of the impact of electric vehicles on the network at the low voltage (distribution) level, propose methods to alleviate this impact (controlled charging), and examine the possible use of renewable generation towards electric vehicle charging.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	Renewable energy was not the primary focus for this work; however, electric vehicles have a large role to play in the renewable energy picture. The researchers have developed an optimal charging approach in which charging can be shifted in one of several directions; for example, vehicle charging could be scheduled during times of day when PV or wind generation is available.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources	In ongoing work, the direct benefits of controlled charging to both network operators and end-use consumers is being explored.	Low
	8. Establish control over, or otherwise influence, intermittent generation sources	The project has focussed on scheduling algorithms for electric vehicle charging; these could be adapted to maximise use of available renewable generation.	Low
	9. Strengthen the network to manage higher renewable energy penetration	The focus of our work was eliminating negative impacts of electric vehicle charging; however we have developed detailed models of distribution networks and high levels of understanding of where the points of failure are. The work is readily transferable to increased renewable penetration.	Med
	11. Alter local load profile to match a desired level	This has been one of the main motivations for the project's work: scheduling EV charging in such a manner that network constraints (e.g. excessive peak demand) are not violated.	High
	12. Use distributed energy solutions to address network and system constraints	The project has developed what the researchers call a centralised method, in which charging decisions are made by a central controller for each neighbourhood; and also a distributed method, in which charging decisions are guided by only local measurements such as voltage (which is a strong indicator of available network capacity).	Med

Approaches	Approach	Comments
	Electrical System Modelling	The project poses electric vehicle charging in a distribution network as a receding horizon optimisation problem. In other words, at any point in time, the researchers examine the number of vehicles charging, their charging needs, and the projected network capacity over the horizon (e.g. the next 8 hours). The project then schedule charging rates for the vehicles in such a way that none of the network constraints are violated. Such constraints include peak demand, thermal overload of transformer or lines, excessive voltage drop, or phase unbalance. The solution is recalculated in discrete time intervals to take into account changes such as vehicle arrival/departure. In a separate but closely related approach, the researchers determine charging schedules using only locally available information, such as voltage. Such an approach is more suitable for scenarios where smart metering and central control are not available.

Results	Result	Comments
	Uptake of electric vehicle can lead to network failures in some cases	The project's method was tested on several models of real neighbourhoods, in simulations that used real network demand data and real vehicle travel data. The conclusion was that electric vehicle uptake rates of only 10-15% already lead to network failures in some cases. For most failures it was low voltage (rather than thermal overload) that caused the first problems. This is exacerbated by networks that are highly unbalanced.
	Existing networks are capable of handling large electric vehicle uptake	Using controlled charging methods, however, it was possible for the highly unbalanced networks to sustain very high EV uptake rates (>80%), and still have all vehicles charged within 6 hours. In other words, the existing networks are capable of handling large electric vehicle uptake, if consumers can be convinced to allow their vehicle charging to be controlled by third parties. The researchers expect that the introduction of renewables will improve the picture further still, particularly regarding problems of low voltage.

The Integrated Grid Project

Project ID	229
Organisation	The Electric Power Research Institute
Organisation Type	Research
Partners	
Story	The successful integration of distributed energy resources (DER) depends on the existing electric power grid, which especially its distribution systems, was not designed to accommodate a high penetration of DER while sustaining high levels of electric quality and reliability. To realize fully the value of distributed resources and to serve all consumers at established standards of quality and reliability, the need has arisen to integrate DER in the planning and operation of the electricity grid and to expand its scope to include DER operation—what EPRI is calling the Integrated Grid. This report is the first phase of a three phase project which is based on desk research to scope the lay of the land. Phase II will be a six-month project to develop a framework for assessing the costs and benefits of the combinations of technology that lead to a more integrated grid. This includes recommended guidelines, analytical tools, and procedures for demonstrating technologies and assessing their unique costs and benefits. Phase III will conduct global demonstrations and modelling using the analytics and procedures developed in Phase II to provide comprehensive data, techniques and information that stakeholders will need for the system-wide implementation of integrated grid technologies in the most cost-effective manner.
Start Date	2013
End Date	2015
Customer Segment	Large commercial, Residential, SME
Customers Involved	
Cost	
Funding Source	Discretionary Spend
Network	
Connection Point	Distribution Feeders, Subtransmission Feeders, Zone Substations
Location	
State	
Country	United States

Future Plans	EPRI has developed the following Action Plan: The current and projected expansion of DER may significantly change the technical, operational, environmental, and financial character of the electricity sector. An integrated grid that optimizes the power system while providing safe, reliable, affordable, and environmentally responsible electricity will require global collaboration in the following four key areas: 1. Interconnection Rules and Communications Technologies and Standards • Interconnection rules that preserve voltage support and grid management • Situational awareness in operations and long-term planning, including rules of the road for installing and operating distributed generation and storage devices • Robust information and communication technologies, including high-speed data processing, to allow for seamless interconnection while assuring high levels of cyber security • A standard language and a common information model to enable interoperability among DER of different types, from different manufacturers, and with different energy management systems 2. Assessment and Deployment of Advanced Distribution and Reliability Technologies • Smart inverters that enable DER to provide voltage and frequency support and to communicate with energy management systems • Distribution management systems and ubiquitous sensors through which operators can reliably integrate distributed generation, storage, and end-use devices while also interconnecting those systems with transmission resources in real time • Distributed energy storage and demand response, integrated with the energy management system 3. Strategies for Integrating DER with Grid Planning and Operation • Distribution planning and operational processes that incorporate DER • Frameworks for data exchange and coordination among DER owners, distribution system operators, and organizations responsible for transmission planning and operations • Flexibility to redefine roles and responsibilities of DSOs and independent system operator 4. Enabling Policy and Regulation • Capacity-related costs must become a distinct element of the cost of grid-supplied electricity to ensure long-term system reliability • Power market rules that ensure long-term adequacy of both energy and capacity • Policy and regulatory framework to ensure that costs incurred to transform to an integrated grid are allocated and recovered responsibly, efficiently, and equitably • New market frameworks using economics and engineering to equip investors and other stakeholders in assessing potential contributions of distributed resources to system capacity and energy costs"
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Background	The successful integration of distributed energy resources (DER) depends on the existing electric power grid, which especially its distribution systems, was not designed to accommodate a high penetration of DER while sustaining high levels of electric quality and reliability. The technical characteristics of certain types of DER, such as variability and intermittency, are quite different from central power stations. To realize fully the value of distributed resources and to serve all consumers at established standards of quality and reliability, the need has arisen to integrate DER in the planning and operation of the electricity grid and to expand its scope to include DER operation—what EPRI is calling the Integrated Grid. This paper is the first phase in a larger Electric Power Research Institute (EPRI) project aimed at charting the transformation to the Integrated Grid. Also under consideration will be new business practices based on technologies, systems, and the potential for customers to become more active participants in the power system. Such information can support prudent, cost-effective investment in grid modernization and the integration of DER to enable energy efficiency, more responsive demand, and the management of variable generation such as wind and solar. Along with reinforcing and modernizing the grid, it will be essential to update interconnection rules and wholesale market and retail rate structures so that they adequately value both capacity and energy Secure communications systems will be needed to connect DER and system operators. As distributed resources penetrate the power system more fully, a failure to plan for these needs could lead to higher costs and lower reliability.” Note that the payment for prosumers’ electricity and “net metering” is a major issue in the US This report is the first phase of a three phase project:- • Phase II will be a six-month project to develop a framework for assessing the costs and benefits of the combinations of technology that lead to a more integrated grid. This includes recommended guidelines, analytical tools, and procedures for demonstrating technologies and assessing their unique costs and benefits. • Phase III will conduct global demonstrations and modelling using the analytics and procedures developed in Phase II to provide comprehensive data, techniques and information that stakeholders will need for the system-wide implementation of integrated grid technologies in the most cost-effective manner

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Under consideration will be new business practices based on technologies, systems, and the potential for customers to become more active participants in the power system.	Low
	4. Inform the regulatory environment for renewable energy	The study will cover a range of regulatory rules.	Low
	6. Make the process of integrating renewable energy into the grid more cost-efficient	To realize fully the value of distributed resources and to serve all consumers at established standards of quality and reliability, the need has arisen to integrate DER in the planning and operation of the electricity grid and to expand its scope to include DER operation—what EPRI is calling the Integrated Grid.”	Low
	Other	Develop comprehensive data, techniques and information that stakeholders will need for the system-wide implementation of integrated grid technologies in the most cost-effective manner.	

Approaches	Approach	Comments
	Case Study	Thus far the project has drawn on research that is available including drawing on what is widely regarded in the US as the lessons that can be drawn from "Experience in Germany which provides a useful case study regarding the potential consequences of adding extensive amounts of DER without appropriate collaboration, planning, and strategic development." The lessons from Germany are that "The lack of coordination in planning and deploying DER increases the cost of infrastructure upgrades for all customers and does not provide the full value of DER to power system operation. Rapid deployments have led to several technical challenges: 1. Local over-voltage or loading issues on distribution feeders. Most PV installations in Germany (~80%) are connected to low-voltage circuits, where it is not uncommon for the PV capacity to exceed the peak load by three to four times on feeders not designed to accommodate PV. This can create voltage control problems and potential overloading of circuit components. 2. Risk of mass disconnection of anticipated PV generation in the event of a frequency variation stemming from improper interconnection rules. This could result in system instability and load-shedding events. The same risk also exists from both a physical or cyber security attack. 3. Resource variability and uncertainty have disrupted normal system planning, causing a notable increase in generation re-dispatch events in 2011 and 2012. 4. Lack of the stabilizing inertia from large rotating machines that are typical of central power stations has raised general concern for maintaining the regulated frequency and voltage expected from consumers, as inverter-based generation does not provide the same inertial qualities. The rate impacts and technical repercussions observed in Germany provide a useful case study of the high risks and unintended consequences resulting from driving too quickly to greater DER expansion without the required collaboration, planning, and strategies set forth in the Action Plan."

Results	Result	Comments
	Distributed energy solutions not currently integrated into network operations	So far, rapidly expanding deployments of DER are connected to the grid but not integrated into grid operations, which is a pattern that is unlikely to be sustainable.
	Distributed energy solutions derive value from being grid-connected	Electricity consumers and producers, even those that rely heavily on DER, derive significant value from their grid connection. Indeed, in nearly all settings the full value of DER requires grid connection to provide reliability, virtual storage, and access to upstream markets. Grid services have five primary benefits:- "1. Reliability – the grid serves as a reliable source of high-quality power in the event of disruptions to DER. 2. Start-up Power – the grid provides instantaneous power for appliances and devices such as compressors, air conditioners, transformers, and welders that require a strong flow of current ("in-rush" current) when starting up. 3. Voltage Quality – the grid's high fault current level also results in higher quality voltage by limiting harmonic distortion 11 and regulating frequency. 4. Efficiency – grid connectivity enables rotating-engine-based generators to operate at optimum efficiency. 5. Energy Transaction – perhaps the most important value that grid connectivity provides consumers, especially those with distributed generation, is the ability to install any size DER that can be connected to the grid." We estimate that the cost of providing grid services for customers with distributed energy systems is about \$51/month on average in the typical current configuration of the grid in the United States; in residential PV systems, for example, providing that same service completely independent of the grid would be four to eight times more expensive.

Market reform is needed	Increased adoption of distributed resources requires interconnection rules, communications technologies and standards, advanced distribution and reliability technologies, integration with grid planning, and enabling policy and regulation.

The National Feeder Taxonomy Study

Project ID	308
Organisation	CSIRO and Ausgrid
Organisation Type	Network, Research
Partners	
Story	Working with network service providers from across Australia as part of the Smart Grid, Smart City programme, CSIRO and AusGrid produced, for the first time, a succinct and publically accessible set of network models that effectively capture the diversity of Australia's electricity distribution networks. The set reveals the fundamental characteristics of electrical feeders deployed in Australia, from modern urban underground systems through to the remote single-wire earth-return networks of rural Australia. The work underlines the unique context of Australian electricity systems, explores regional differences in network construction and provides a mechanism for assessing the transferability of existing trials.
Start Date	27-06-2012
End Date	27-06-2013
Customer Segment	
Customers Involved	
Cost	
Funding Source	Federal Government
Network	Acquired and used distribution network data from Ausgrid, United Energy,
Connection Point	Distribution Feeders
Location	Various locations
State	QLD, VIC, NSW, ACT, WA
Country	Australia
Future Plans	The National Feeder Taxonomy rests as a key platform for upcoming CSIRO research. It provides an avenue to explore the impact of novel demand response, operational control and distributed generation and storage approaches on the behaviour of Australian electricity networks. Future work may expand the taxonomy to include models of low voltage networks.
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Contact Link	The final report will be available on the Ausgrid Information Clearing House (likely 3rd Quarter, 2014) and upon request from CSIRO.
Background	Though individual distribution network service providers are intimately aware of the construction and operation of their own electricity networks, competing proprietary software systems and models, concerns around privacy and security, and the complexity of the data itself has largely prevented collation, analysis and presentation of a nationally representative set of electricity systems. Without such data, understanding the national impact of policy initiatives, integration of new technologies and increasing renewable penetration can only be based on assumptions and small-scale trials. In response, working cooperatively with 11 distribution network service providers from across Australia as part of the Smart Grid, Smart City programme, CSIRO and AusGrid produced, for the first time, a succinct and publically accessible set of network models that effectively capture the diversity of Australia's electricity distribution networks. The set reveals the fundamental characteristics of electrical feeders deployed in Australia, from modern urban underground systems through to the remote single-wire earth-return networks of rural Australia. The work underlines the unique context of Australian electricity systems, explores regional differences in network construction and provides a mechanism for assessing the transferability of existing trials.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	Since the Taxonomy provides estimates of population numbers for each representative (that is, how common is the network type), the value and relevance of existing smart-grid and renewable energy trials targeting distribution networks may also be estimated.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources	The models allow new technologies and/or methodologies to be simulated and their impact measured on exactly the types of network that will be encountered across Australia.	Med
	9. Strengthen the network to manage higher renewable energy penetration	Since the models support full load-flow analysis, issues such as voltage rise under increasing renewables, the behaviour of transformers, the effectiveness of static compensators and the optimal placement and operation of distributed generation storage can be explored.	Med

Approaches	Approach	Comments
	Interviews and Surveys	Consultation with 11 of the 16 DNSPs in Australia, acquiring a large volume of network data and supporting information for Australia's electricity network.
	Electrical System Modelling	Application of data mining techniques to identify the distinct clusters which categorise Australia's distribution networks. Clustering focussed on cable length, cable lay, customer counts, feeder rating, voltage class and topology. An iterative approach of assessing and refining clusters with DNSPs. Construction of detailed network models that will be made publically available for both research and commercial use.

Results	Result	Comments
	Mapped potential for distributed energy resources	The representative taxonomy feeders are a succinct and meaningful set that captures the core characteristics of the network data provided by DNSPs. That they have been reviewed and approved by distribution planners underscores that they have real-world value and coherence, suitable for ongoing use and application beyond this work. Key outcomes include: o A set of 19 representative feeders that describe typical elements in the Australian distribution network, from urban industrial centres through to remote rural environments with a preponderance of single wire earth return systems. The representative feeders (and the clusters they are drawn from) are described across a series of tables, charts and visualisations that provide context for their selection and insight into their role and purpose. o A review of feeder characteristics in the context of reliability classifications, voltage class and region for over 350 Australian feeders. Findings include: o the identification of approximate relationships between variable types that hold across regional divisions (such as the power-law relationship between kVA/load-point and average feeder cable impedance); o a description of the commonalities in feeder construction and configuration across state lines, particularly with respect to load densities, cable lengths and line impedances; and o a brief review of the relationships between reliability classification, reliability performance (in the form of SAIDI and SAIFI metrics) and cable lengths for the sampled Australian feeders.

o A consistent and publically available set of robust SINCAL models for all representative feeders that will facilitate detailed analysis of load flows. Importantly, the models will enable the analysis of different smart grid proposals and policy initiatives on a set of representative Australian distribution feeders.

o A set of indicative load profiles that are fully integrated into the SINCAL models and draw on real-world SCADA data to describe the behaviour of representative feeders and their sub-stations over time.

o A rich set of publically available supporting material based on information provided by DNSPs. The material further describes the construction and operation of the representative feeders and includes fault data, feeder-head SCADA data for multiple days

TK NOAC scheme fault level mitigation

Project ID	282
Organisation	CitiPower Pty
Organisation Type	Network
Partners	
Story	This project came about because the fault levels on the 11kV bus at TK on Powercor's network were approaching the limit of plant ratings. The approach to solve the problem is to segment the distribution network by opening either a bus tie circuit breaker or transformer circuit breaker. This reduces the fault contribution upstream and creates fault level headroom for future distributed generators downstream of the zone substation. The project successfully created approximately 5kA fault level headroom.
Start Date	5-09-2013
End Date	1-09-2014
Customer Segment	
Customers Involved	
Cost	AUD 510,449
Funding Source	
Network	Powercor
Connection Point	Zone Substations
Location	Toorak
State	VIC
Country	Australia
Future Plans	Yes. The project is applied to other zone substations.
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Contact Link	
Background	This project came about because the fault levels on the 11kV bus at TK were approaching the limit of plant ratings.

Areas of Relevance	Area	Comments	Relevance
	9. Strengthen the network to manage higher renewable energy penetration	By segmenting the network, the fault level capacity was increased thereby allowing connection of future distributed generation. The resultant fault level headroom created is approximately 5kA.	Med
Approaches	**Approach**	**Comments**	
	Changing System / Protection Settings	The approach to solve the problem is to segment the distribution network by opening either a bus tie circuit breaker or transformer circuit breaker. This reduces the fault contribution upstream and creates fault level headroom for future distributed generators downstream of the zone substation.	
Results	**Result**	**Comments**	
	Segmenting the network led to an increase in fault level	Segmenting the distribution network reduces the fault contribution upstream and creates fault level headroom for future distributed generators downstream of the zone substation. The resultant fault level headroom created is approximately 5kA.	

Townsville PV/ EV/ DS impacts

Project ID	291
Organisation	Ergon Energy
Organisation Type	Network
Partners	CSIRO
Story	The potential uptake of Photovoltaics (PV), Electric Vehicles (EV) and distributed storage (DS) is currently unknown. Increasing uptake of such technologies can have impacts on the network. This project aims to identify the potential adoption rates of solar PV, EV and DS within Townsville. To do this, the project utilised CSIRO's integrated modelling methodology for high resolution spatial and temporal projection of EV and solar PV uptake, and the subsequent electrical grid impacts from these technologies. This modelling approach is unique as it is integrated, and inherently spatial, which allowed Ergon Energy to realistically understand the full range of the potential impacts and opportunities that can arise from different incentives and technologies from different stakeholder perspectives (government, network and customer). The project was successful in identifying adoption rates of all three technologies.
Start Date	1-12-2011
End Date	
Customer Segment	
Customers Involved	
Cost	AUD 378,000
Funding Source	Discretionary Spend
Network	Ergon Energy
Connection Point	
Location	Townsville
State	QLD
Country	Australia
Future Plans	
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Contact Link	
Background	The potential uptake of PV/ EV and Distributed Storage is unknown. CSIRO has developed an integrated modelling methodology for high resolution spatial and temporal projection of EV and solar PV uptake, and the subsequent electrical grid impacts from these technologies. Unlike any other EV and PV modelling in the world, our approach is integrated, and inherently spatial, which allows us to realistically understand the full range of potential impacts and opportunities that can arise from different incentives and technologies from different stakeholder perspectives (government, network and customer).

Areas of Relevance	Area	Comments	Relevance
	4. Inform the regulatory environment for renewable energy.	The project aimed to identify potential adoption rates (time, quantity, type) of solar PV, energy storage and electric vehicles with in Townsville. The project was successful in identifying the adoption rates.	Low
Approaches	**Approach**	**Comments**	
	Electrical System Modelling	The project uses the CSIRO's integrated modelling methodology for high resolution spatial and temporal projection of EV and solar PV uptake, and the subsequent electrical grid impacts from these technologies.	
	Market Modelling	Unlike any other EV and PV modelling in the world, the project's approach is integrated, and inherently spatial, which allows Ergon Energy to realistically understand the full range of potential impacts and opportunities that can arise from different incentives and technologies from different stakeholder perspectives (government, network and customer).	
Results	**Result**	**Comments**	
	Identified adoption rates	The project was successful in identifying adoption rates (time, quantity, type) of: Solar PV (for less than 2kw, between 2kw and 3.5kw, and more than 3.5kw)- Energy Storage (select one battery size/price)- Electric Vehicles The project contact is happy to discuss further if contacted.	

Townsville Solar City

Project ID	145
Organisation	Ergon Energy
Organisation Type	Network
Partners	Queensland Government, Townsville City Council, Delfin Lend Lease, Honeycombes Property Group, Chester Holdings (Federation Place) and Cafalo Pty Ltd
Story	The Townsville Solar City was set up to demonstrate the economic and environmental impacts of cost-reflective pricing, the concentrated uptake of solar, demand management and smart metering technologies. Additionally, the project aimed to identify and implement options for addressing barriers to distributed solar generation, energy efficiency and electricity demand management for grid-connected urban areas. The project utilises an Energy Behaviour Change Model which follows three stages; it begins with research, proceeds to developing a community culture, and finally conducting personal interview with the customer which incorporates a range of proven and tailored interventions aimed at changing behaviour. Using this model, the project engaged residents and businesses to work together to reduce peak demand and electricity consumption. Energy consumption during the year 2011-12 was 1.6% less than in the previous year. Analysis of the effect of the PV systems on the electricity network has shown expected, but within manageable limits, for voltage rises and little effect from harmonics. Experimentation with power factor correction by the latest inverters shows promise for positive effects on the network. With the communities of Ayer and Magnetic Island achieving a progressive reduction in load since mid-2010, the augmentation of cables feeding Magnetic Island was deferred and thus saved an investment worth $17 million.
Start Date	13-09-2008
End Date	
Customer Segment	Large commercial, Residential, SME
Customers Involved	
Cost	AUD 31 M
Funding Source	Commercial Partner, Federal Government, State Government
Network	Ergon Energy
Connection Point	Customer Connections, Distribution Feeders
Location	Townsville
State	QLD
Country	Australia
Future Plans	
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Background	

Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach	Demonstrate the economic and environmental impacts of cost-reflective pricing, the concentrated uptake of solar, demand management and smart metering technologies.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Identify and implement options for addressing barriers to distributed solar generation, energy efficiency and electricity demand management for grid connected urban areas.	Low
	5. Engage customers to build their and the industry's understanding of distributed energy resources	The project aimed to engage residents and businesses to work together to reduce peak demand and electricity consumption by utilising a Energy Behaviour Change Model. The Energy Behaviour Change Model is based on the proven principles of community engagement, community based social marketing and thematic communication. Energy consumption during the year 2011-12 was 1.6% less than in the previous year. This is a 46% reduction when comparing business as usual with the impact of the Solar City project, and 29% below the target set for the project.	High

Approaches	Approach	Comments
	Interviews and Surveys	The Energy Assessment is the culmination of the Energy Behaviour Change Model developed by the project which starts with research, proceeds to developing a community culture and then culminates with a personal interview with the customer which incorporates a range of proven and tailored interventions aimed at changing behaviour. This all combines to elicit written commitment from the customer to undertake changes to achieve greater energy efficiency. The Energy Behaviour Change Model is based on the proven principles of community engagement, community based social marketing and thematic communication. Using the model, residents and businesses on Magnetic Island were asked to join the project and take part in an energy assessment, with the aim of working together to reduce peak demand and electricity consumption.
	Network Monitoring & Analysis	The PV trial uses a business model where all electricity is fed back into the grid and the ownership and maintenance of the PVs remains with the utility company, in this case Ergon.

Results	Result	Comments
	Distributed energy solutions reduce energy consumed from the network	Energy consumption during the year 2011-12 was 1.6% less than in the previous year. This is a 46% reduction when comparing business as usual with the impact of the Solar City project, and 29% below the target set for the project.
	Load reduction defers network augmentation	The decline in maximum demand is more impressive when compared with the control town of Ayr where it has been steadily rising at 2.4 % per year up to mid 2010 compared with the Island where it has been falling by 4.5 %. Since mid 2010, both communities have been reducing load, making the difference now 7.4%. This in turn has deferred the augmentation of cables feeding Magnetic Island, an investment worth $17 million. The Solar City project aimed to defer the cable by 6 years to 2014, and at this stage the commissioning of a third cable is now being deferred from 2014 to 2016.
	PV, if uncontrolled, can create voltage problems for the network	Analysis of the effect of the PV systems on the electricity network has shown expected, but within manageable limits, for voltage rises and little effect from harmonics. Experimentation with power factor correction by the latest inverters shows promise for positive effects on the network.

Unlocking the grid: the future of the electricity distribution network

Project ID	56
Organisation	Barbara Hardy Institute - University of South Australia
Organisation Type	Research
Partners	Electricity Supply Industry Planning Council, National Center for Atmospheric Research, CEEM, University of New South Wales, CSIRO, University of Waterloo, Meteotest, University of Camerino,Physics, University of Reunion Island
Story	Increases in electricity demand lack uniformity in time and space. Power networks across Australia need considerable reinvestment over the next decade or so. Managing supply and demand on the future network poses great challenges; there is a need for forward planning and preparation to manage these challenges. The project aimed to gain benefits through a scientific design of the planned grid architecture, enabling timely and efficient incorporation of new wind or solar farms, and a carbon emission efficient and cost effective electricity grid management strategy.
Start Date	
End Date	
Customer Segment	
Customers Involved	
Cost	
Funding Source	Federal Government, State Government Australian Research Council (ARC) Linkage Project scheme (2008-2011); and the
Network	
Connection Point	
Location	
State	SA
Country	Australia
Future Plans	
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Background	Increases in electricity demand lack uniformity in time and space. Power networks across Australia need considerable reinvestment over the next decade or so. Managing supply and demand on the future network poses great challenges; there is a need for forward planning and preparation to manage these challenges.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	The project aimed to gain benefits through a scientific design of the planned grid architecture, enabling timely and efficient incorporation of new wind or solar farms, and a carbon emission efficient and cost effective electricity grid management strategy.	Low
	1. Measure or quantify the benefits and costs of renewable energy.	Produced a GIS model of electricity demand and both conventional and renewable supplies for electricity for all of Australia	Med
	9. Strengthen the network to manage higher renewable energy penetration	Produced algorithmic tools to solve the optimisation problems necessary for the transmission expansion problem with increased renewable supply	Med
	14. Improve techniques for forecasting renewable energy output.	Developed a short term solar radiation forecasting tool and developed statistical tools for typifying spatial and temporal variability in wind farm output	Med

Approaches	Approach	Comments
	Load Monitoring & Analysis	GIS-based analysis and time series modelling of the spatial and temporal evolution of demand will be undertaken

Results	Result	Comments
	Produced a GIS model of electricity demand	The project helped (in conjunction with other funding) produced a GIS model of electricity demand and both conventional and renewable supplies for electricity for all of Australia.
	Other	The project also produced algorithmic tools to solve the optimisation problems necessary for the transmission expansion problem with increased renewable supply. Note that this was in the deterministic case and we continue to develop the solution to the case with stochastic supply and demand.
	Developed a short term solar radiation forecasting tool	The project developed a short term solar radiation forecasting tool that out performs any in the scientific literature. Final revisions are being made for inclusion in Solar Energy journal.
	Developed statistical tools for typifying spatial and temporal variability in wind farm output	The project developed statistical tools for typifying spatial and temporal variability in wind farm output. These will continue to be developed.

UQ 1.22 MW Solar PV Array

Project ID	298
Organisation	University of Queensland
Organisation Type	Research
Partners	
Story	The project was to provide a large-scale rooftop solar PV system with battery storage primarily for research purposes. The system was constructed over four roof-tops and has allowed for research to be undertaken on battery storage integration, orientation of panels, anti-reflective coatings, impacts of soiling and impacts of shading. The deployment of the solar array was seen as a necessary step in providing infrastructure for teaching and research purposes in the renewable energy generation, integration with traditional electricity networks and energy economics. One of the key objectives was the capture of renewable energy data and a dedicated UQ Solar website (www.uq.edu.au/solarenergy) was established. This website can be freely accessed and provides the ability to review the various PV arrays data since installation. The project is a 'work-in-progress' with additions to the solar array occurring annually. Some of these are integrating additional research projects (such as building integrated PV and anti-reflective coatings into existing research programmes.
Start Date	01-11-2010
End Date	01-06-2011
Customer Segment	
Customers Involved	
Cost	AUD 4.75m
Funding Source	Discretionary Spend, State Government
Network	Energex
Connection Point	
Location	
State	
Country	Australia
Future Plans	This project is still a work-in-progress and additional arrays will be constructed in Campus and additional research projects undertaken as opportunities arise.
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Background	The project was to provide a large-scale rooftop solar PV system with battery storage primarily for research purposes. The system was constructed over four roof-tops and has allowed for research to be undertaken on battery storage integration, orientation of panels, anti-reflective coatings, impacts of soiling and impacts of shading.

Areas of Relevance	Area	Comments	Relevance
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	The benefits of distributed generation have been internally recognised, with all subsequent major building projects undertaken by the University including some level of distributed generation incorporated into the building design.	Med
Approaches	**Approach**	**Comments**	
	Distributed Energy Solutions	The deployment of the solar array was seen as a necessary step in providing infrastructure for teaching and research purposes in the renewable energy generation, integration with traditional electricity networks and energy economics.	
	Generation Output Monitoring & Analysis	One of the key objectives was the capture of renewable energy data and a dedicated UQ Solar website (www.uq.edu.au/solarenergy) was established. This website can be freely accessed and provides the ability to review the various PV arrays data since installation.	
Results	**Result**	**Comments**	
	No results yet	The project is a 'work-in-progress' with additions to the solar array occurring annually. Some of these are integrating additional research projects (such as building integrated PV and anti-reflective coatings) into existing research programmes.	

Urban Solar Atlas City of Port Phillip

Project ID	138
Organisation	Entura Hydro Tasmania
Organisation Type	Association
Partners	
Story	The Urban Solar Atlas is a demonstration project, developed for mapping building rooftop solar resource potential for electricity and hot water generation. By applying a rooftop mapping approach, a 1m2 Digital Surface Model (DSM) was created using LiDAR (Light Detection and Ranging) data captured over the city of Port Phillip. By using DSM as the input, the ESRI ArcGIS Solar Radiation toolbox software was used to calculate solar radiation across the city. This was done by taking into account the path of the sun overhead during a typical year, shading of nearby objects (such as trees, buildings and terrains) and the slope and orientation of the surface around each point being calculated. Based on the use of aerial photography, geographic information systems along with seasonal variations and other factors, it was found that the feasible area for installation of solar PV or solar hot water on residential rooftops in the city of Port Phillip is estimated to be between 1.2 million m2 and 1.9 million m2. This area could provide space for between 180 and 285 MW of solar PV panels. Additionally, the feasible area for installation of solar PV on large buildings (commercial/industrial) with flat roofs in the city of Port Philip is estimated to be between 0.6 million m2 and 1.0 million m2. This area could provide space for between 40 and 70 MW of solar PV panels.
Start Date	
End Date	24-10-2011
Customer Segment	Industrial, Large commercial, Residential
Customers Involved	
Cost	
Funding Source	Local Government City of Port Phillip
Network	None
Connection Point	Customer Connections
Location	Port Phillip, Melbourne
State	VIC
Country	Australia
Future Plans	
Contact Name	Jay Knight
Contact Email	
Contact Phone	
Contact Link	http://www.enviroehub.com.au/what-council-is-doing/relevant-council-reports
Background	The Urban Solar Atlas is a demonstration project, developed for mapping building rooftop solar resource potential for electricity and hot water generation.

Areas of Relevance	Area	Comments	Relevance
	14. Improve techniques for forecasting renewable energy output	Mapping building rooftop solar resource potential for electricity and hot water generation.	Med
Approaches	**Approach**	**Comments**	
	Renewable Energy Resource Mapping	By applying a rooftop mapping approach, a 1m2 Digital Surface Model (DSM) was created using LiDAR (Light Detection and Ranging) data captured over the city of Port Phillip. By using DSM as the input, the ESRI ArcGIS Solar Radiation toolbox software was used to calculate solar radiation across the city. This was done by taking into account the path of the sun overhead during a typical year, shading of nearby objects (such as trees, buildings and terrains) and the slope and orientation of the surface around each point being calculated.	
Results	**Result**	**Comments**	
	Mapped potential for distributed energy resources	Based on the use of aerial photography, geographic information systems along with seasonal variations and other factors, it was found that the city of Port Phillip has around 1.8 million m2 of suitable rooftop area.	

Virtual Power Plant

Project ID	296
Organisation	United Energy
Organisation Type	Network
Partners	Energy Makeovers
Story	With the rapidly falling price of solar PV and battery storage, UE is exploring the use of solar PV and controlled battery storage technology to develop an incremental approach to addressing immediate capacity shortfalls and defer traditional network augmentation solutions which by comparison, provided a much larger step change in available capacity. The aim of the project is to validate Virtual Power Plants (VPP) as a suitable approach for managing augmentation in low growth, low voltage distribution networks with no adverse impacts to network reliability and safety. To do this the project installed VPP at 13 premises to collect data and allow the project's objectives to be validated .The project is still underway and final results will be available after the project is complete.
Start Date	01-09-2013
End Date	01-07-2015
Customer Segment	Residential, SME
Customers Involved	13
Cost	
Funding Source	Regulator-Approved Spend
Network	United Energy
Connection Point	Customer Connections
Location	TBA
State	VIC
Country	Australia
Future Plans	The project is in progress.
Contact Name	Karl Edwards
Contact Email	karl.edwards@ue.com.au
Contact Phone	03 8544 9954
Contact Link	
Background	With the rapidly falling price of solar PV and battery storage, UE is exploring the use of solar PV and controlled battery storage technology to develop an incremental approach to addressing immediate capacity shortfalls and defer traditional network augmentation solutions which by comparison, provided a much larger step change in available capacity. The aim of the project is to validate or otherwise, the use of a VPP to manage embedded generation and storage in a residential setting for the provision of efficient and prudent non-network augmentation.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	The project aims to validate VPP as a suitable approach for managing augmentation in low growth, low voltage distribution networks with no adverse impacts to network reliability and safety The project also aims to develop an understanding of the economics of the solution and validate the solution is a viable load management tool by exploring and then testing the business model(s), taking the generation, retail and distribution aspects into consideration.	Med
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	The project explores and tests the contractual and commercial agreements with 3rd parties (retailers and technology providers) and Residential Hosts (customers).	Med
	11. Alter local load profile to match a desired level	Through the use of storage technologies, the project alters the local load profile to match a desired level.	Low
	12. Use distributed energy solutions to address network and system constraints	The project investigates the benefits of pairing solar distributed generation with energy storage solutions to address network constraints and provide value to multiple stakeholders.	Med
Approaches	**Approach**	**Comments**	
	Generation Output Monitoring & Analysis	The project is undertaking installations at 13 premises to collect data and allow objectives to be validated.	
Results	**Result**	**Comments**	
	No results yet	The project is not complete.	

Virtual Power Station

Project ID	269
Organisation	CSIRO
Organisation Type	Government
Partners	Lake Macquarie City Council
Story	Australia's electricity demand is continually growing, placing further pressure on the existing electricity network to provide more and more power. While one solution may be to build more power stations, an alternate approach of developing a 'Virtual' Power Station (VPS) is being undertaken by CSIRO. The VPS combines the energy generated by solar and wind sources across various sites into a single power source for electricity supply. The VPS will work by linking numerous dispersed renewable energy generators and storage systems through a web-based communication network. Each discrete generator and storage system is fitted with a small computing device which is able to collect and send data to a central web-based control point which intelligently monitors the combined power output of the linked network. Electricity generated by renewable systems - which varies with weather - can be combined by the VPS to provide a single electricity supply. This supply offers significant benefit to the wider electricity network and could be sold at the owner's discretion - just as with conventional power from coal and gas - forming what is called a dispatchable supply. The data obtained has been used to help other researchers and DNSPs understand the impacts of solar intermittency on distribution networks.
Start Date	01-01-2009
End Date	01-01-2015
Customer Segment	Residential
Customers Involved	20
Cost	
Funding Source	Discretionary Spend, Local Government
Network	Ausgrid
Connection Point	Customer Connections, Distribution Feeders
Location	Lake Macquarie
State	NSW
Country	Australia
Future Plans	Yes, this is an ongoing project.
Contact Name	Dr John K Ward
Contact Email	John.K.Ward@csiro.au
Contact Phone	0249606072
Contact Link	http://www.csiro.au/Outcomes/Energy/Renewables-and-Smart-Systems/Virtual-Power-Station.aspx
Background	Australia's electricity demand is continually growing, placing further pressure on the existing electricity network to provide more and more power. While one solution may be to build more power stations, an alternate approach is being developed by CSIRO engineers: a 'Virtual' Power Station (VPS), which combines the energy generated by solar and wind sources across various sites into a single power source for electricity supply.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	Relevant dataset were collected to identify correlation between customer energy use and PV generation.	Low
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	Data was collected to identify correlation between customer energy use and PV generation. Hence network impact and case for energy storage.	Med
	8. Establish control over, or otherwise influence, intermittent generation sources	PV generation and energy storage coordinated with energy demand (load).	High
	9. Strengthen the network to manage higher renewable energy penetration	The project aims to monitor voltages at customer sites to allow assessment of how loads/PV influence the network and hence how energy storage and load control can be used to manage this.	Med
	10. Smooth out intermittent generation output	Using energy storage to smooth out intermittent generation output, the project investigates how geographic diversity influences intermittency.	Med
	11. Alter local load profile to match a desired level	The project uses battery energy storage to reduce impacts of PV intermittency and provide firm net output.	Med
	12. Use distributed energy solutions to address network and system constraints	The project will monitor voltages within the distribution network as a proxy for understanding the network conditions.	Low
	13. Store and organise information on customer renewable energy deployments	The project is developing a web portal to allow high resolution PV output to be viewed.	Med
	14. Improve techniques for forecasting renewable energy output	The project will help improve techniques for forecasting renewable energy output by using some learning algorithms specifically around energy storage management.	Med

Approaches	Approach	Comments
	Generation Output Monitoring & Analysis	The VPS will work by linking numerous dispersed renewable energy generators and storage systems through a web-based communication network. Each discrete generator and storage system is fitted with a small computing device which is able to collect and send data to a central web-based control point which intelligently monitors the combined power output of the linked network. Electricity generated by renewable systems - which varies with weather - can be combined by the VPS to provide a single electricity supply. This supply offers significant benefit to the wider electricity network and could be sold at the owner's discretion - just as with conventional power from coal and gas - forming what is called a dispatchable supply. The data obtained has been used to help other researchers and DNSPs understand the impacts of solar intermittency on distribution networks.

Results	Result	Comments
	Produced information resources	Data collection provided 10 second resolution PV, load and voltage data across a distribution area and has been used to help other researchers and DNSPs understand the impacts of solar intermittency on distribution networks.

Volt VAR Strategy

Project ID	242
Organisation	CitiPower and Powercor
Organisation Type	Network
Partners	
Story	With the increase in PV there have been recorded issues at the zone substation and feeders where traditional voltage regulation techniques are unable to manage satisfactorily the changing energy flows associated with increased customer PV. This project will consider a range of feeder types with varying levels of load and PV penetration, and model the voltage profile of these to determine the extent to which voltage regulation facilities need to be improved and at what tipping points of PV penetration is a change in voltage management likely to be required. This Strategy should also place a cost against the requirement to upgrade voltage VAR control facilities. The project is presently only at the modelling stage with no results yet available.
Start Date	01-06-2014
End Date	01-09-2014
Customer Segment	Residential
Customers Involved	
Cost	AUD 70,000
Funding Source	Discretionary Spend
Network	Citipower
Connection Point	Distribution Feeders, Zone Substations
Location	
State	VIC
Country	Australia
Future Plans	There is anticipation that this project will inform us and allow us to adjust our Solar Connection Policy to match the present capabilities of the network. It is also anticipated it will allow us to formulate a range of Volt Var control facility projects that can assist the network in coping with increased PV penetration.
Contact Name	Stephen Hunt
Contact Email	shunt@powercor.com.au
Contact Phone	03 9683 4301
Contact Link	
Background	The project originated out of the requirement to better manage the impact of PV on the distribution network. With the increase in PV there have been recorded issues at the zone substation and feeders where traditional voltage regulation techniques are unable to manage satisfactorily the changing energy flows associated with increased customer PV.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy.	This Strategy should place a cost against the requirement to upgrade voltage VAR control facilities.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	By better understanding improved voltage and Var control facilities and the associated costs, the flexibility of this technology can potentially provide the lowest cost option for network upgrades associated with alleviating the network constraints associated with connecting PV to the distribution network.	Low
	7. Improve internal practices and processes relating to the acceptance of distributed energy resources on the network	Through the studies conducted in this strategy it is anticipated that there will be a better appreciation of levels of PV penetration that can be accommodated before limits to connections are required or remedial works within the network required.	Low
	9. Strengthen the network to manage higher renewable energy penetration	This Strategy should identify the change required in Volt Var management technology to be deployed at various PV penetration levels to maintain voltage levels within code	Med
Approaches	**Approach**	**Comments**	
	Electrical System Modelling	The strategy will consider a range of feeder types, Rural Long, Rural Short and Urban with varying levels of load and PV penetration and model the voltage profile of these using PSE-SinCal. The models will determine the extent to which voltage regulation along feeders is impacted by increased PV penetration and in doing so provide a range of Volt Var control options that could be deployed to better manage the feeder voltage profile.	
Results	**Result**	**Comments**	
	No results yet	The project is presently only at the modelling stage with no results yet available.	

Weipa Solar Farm

Project ID	217
Organisation	Weipa Solar Farm Pty Ltd
Organisation Type	Proponent
Partners	First Solar (Australia) Pty Ltd, Ingenero Pty Ltd
Story	Rio Tinto Australia (RTA) has a large bauxite mine and shipping facility at Weipa. As part of the current mining operation, RTA operates a 26 MW diesel fired power station in Weipa. First Solar and Ingenero are constructing a 1.7MWp solar PV power station that will feed renewable electricity to the grid, reducing the load on the diesel power station and saving diesel. The project is a proof of concept project to demonstrate the ability of solar PV to operate in remote location in a resource industry environment. An Independent Power Producer was formed to construct the solar farm and sign a PPA with RTA. The solar farm will be constructed in 2014-15.
Start Date	16-05-2014
End Date	28-02-2015
Customer Segment	Industrial
Customers Involved	1
Cost	
Funding Source	Discretionary Spend, Federal Government
Network	Local Weipa Network
Connection Point	Customer Connections
Location	Weipa
State	QLD
Country	Australia
Future Plans	Weipa Solar Farm will own and operate the project.
Contact Name	Rob Bartrop
Contact Email	rbartrop@firstsolar.com
Contact Phone	02 9002 7736
Contact Link	
Background	Rio Tinto Australia (RTA) has a large bauxite mine and shipping facility at Weipa. As part of the current mining operation, RTA operates a 26 MW diesel fired power station in Weipa. The amount of diesel used in the power station has a direct relationship to the load on the grid which is made up of mining operations and the Weipa township. The 1.7MWp solar PV power station will feed renewable electricity to the grid reducing the load on the diesel power station and saving diesel.

Areas of Relevance	Area	Comments	Relevance
	5. Engage customers to build their and the industry's understanding of distributed energy resources.	The project is a proof of concept project to demonstrate the ability of solar PV to operate in remote location in a resource industry environment. Customer is a large resource company.	Low
	1. Measure or quantify the benefits and costs of renewable energy.	The project will quantify the benefit of solar PV displacing diesel used for electricity generation at this location.	Med

Approaches	Approach	Comments
	Power Purchase Agreement	The approach used was to form an Independent Power Producer (IPP) to construct the solar farm and sign a Power Purchase Agreement (PPA) with RTA. This approach transferred the risk of solar production to the owner of the asset (Weipa Solar Farm Pty Ltd).

Results	Result	Comments
	No results yet	Project is not yet constructed

What Happens When We Un-Plug: Exploring the Consumer and Market Implications of Viable Off-Grid Energy Supply

Project ID	37
Organisation	Energy for the people and Alternative Technology Association (ATA)
Organisation Type	Association
Partners	
Story	The National Electricity Market (NEM) is transitioning from a centrally planned and controlled market to one where local generation, storage and control of power is becoming common. Because of this, Australian energy consumers will incur significant costs resulting from stranded network and generation assets. This research project aimed to understand the impact on energy markets if battery technologies followed the trajectory of photovoltaic (PV) technology. This project is designed to understand the timeframes over which stand-alone power solutions may become viable across a range of housing market contexts (that is, housing types and climate zones). The research explored the viability of stand-alone power solutions (SAPS) across a range of Victorian climate zones and household scenarios. Key findings from this project are summarised below: 1) It is anticipated that, where natural gas - and potentially wood fuel - is available, stand-alone micro-grids will be viable for greenfield housing developments before 2020. 2) When assessed over a 25-year period and delivered by an energy service provider, stand-alone micro-grids are already viable in regional areas with natural gas. 3) In regional communities where residents can organise themselves and realise cost reductions on stand-alone power infrastructure, those homes with high summer and winter loads can anticipate stand-alone power solutions before 2020. 4) Without significant change to stand-alone power infrastructure costs or a reduction in the size of homes to offset those costs, solutions for individual homes in greenfield developments are unlikely to be viable before 2020.
Start Date	
End Date	10-02-2014
Customer Segment	Residential
Customers Involved	
Cost	
Funding Source	Discretionary Spend Consumer Advocacy Panel
Network	None
Connection Point	None
Location	Inner-Melbourne, Bendigo and Werribee
State	VIC
Country	Australia
Future Plans	
Contact Name	Tosh Szatow (Energy for the people), Damien Moyse (ATA), Craig Memery (ATA)
Contact Email	tosh@energyforthepeople.net
Contact Phone	+61 414155547 (Tosh Szatow)
Contact Link	http://www.ata.org.au/ata-research/towns-and-estates-could-unplug-from-the-
Background	The National Electricity Market (NEM) is transitioning from a centrally planned and controlled market to one where local generation, storage and control of power is becoming common. Because of this, Australian energy consumers will incur significant costs resulting from stranded network and generation assets.

Areas of Relevance	Area	Comments	Relevance
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources	This research project aimed to understand the impact on energy markets if battery technologies followed the trajectory of photovoltaic (PV) technology. This project is designed to understand the timeframes over which stand-alone power solutions may become viable across a range of housing market contexts (that is, housing types and climate zones). The results of this project are intended to be useful for policy makers, industry participants, energy market institutions and industry observers.	Med

Approaches	Approach	Comments
	Load Monitoring & Analysis	The research explored the viability of stand-alone power solutions (SAPS) across a range of Victorian climate zones and household scenarios. Based on this, 12 scenarios were identified across three locations (Melbourne, Werribee and Bendigo), and a baseline energy load profile was developed for each home and scenario.

Results	Result	Comments
	Microgrids will be viable in the near future	Stand-alone micro-grids for greenfield housing developments, delivered by a specialist energy service provider, are highly likely to be viable before 2020 where natural gas is available, and may be viable where wood fuel displaces natural gas.
	Microgrids will be viable in the near future	In regional areas with natural gas, stand-alone micro-grids delivered by an energy service provider are viable today when assessed over a 25 year period, and are highly likely to be viable by 2020, particularly where the short-term weighted cost of capital can be reduced.
	Stand alone power solutions have limited applicability in the near future	Stand-alone power solutions for individual homes in regional areas, with high winter and summer thermal loads, are likely to be viable before 2020 where communities can self-organise and realise cost-reductions on stand-alone power infrastructure. However, they are constrained by the size of the PV systems required (in the order of 8kW was needed for a typical house, which will be difficult for many household roofs to accommodate).
	Stand alone power solutions have limited applicability in the near future	Stand-alone power solutions for suburban areas are significantly constrained by the availability of adequate space for solar PV, and the difficulty of using wood fuel in suburban areas
	Stand alone power solutions have limited applicability in the near future	Stand-alone power solutions for individual homes in greenfield developments are unlikely to be viable before 2020 without a significant step-change in stand-alone power infrastructure costs, or customers choosing to reduce the size of their home to save on construction costs and offset stand-alone power infrastructure costs.

Yokohama Smart City HEMS Project

Project ID	176
Organisation	Yokohama city
Organisation Type	Government
Partners	Panasonic Corporation, Toshiba Corporation, Tokyo Electric Power Company, Incorporated (TEPCO), Tokyo Gas Co., Ltd., Accenture Japan Ltd. and others
Story	The Yokohama Smart City is a five-year-long field test that began when Yokohama City was designated as a "Next-Generation Energy and Social systems Demonstration Areas" by the Ministry of Economy, Trade and Industry of Japan in April, 2010. Through the use of renewable energy, such as solar power, Yokohama City is taking steps to create a new social system that has the goal of reducing carbon dioxide emissions by 30 percent. The Yokohama HEMS Project is to verify the following hypothesis: “Both residents’ quality of life (QOL) and a reduction in household CO2 emissions can be achieved if the following measures are taken: demonstrating (at a certain size) the effects of load creation and load-shifting through the streamlining and visualization of household power consumption using Home Energy Management System (HEMS) and through the introduction of economic incentives which contribute to the introduction of large numbers of PV systems; and utilizing high efficiency energy systems that are effective in CO2 emissions reduction.
Start Date	01-04-2010
End Date	
Customer Segment	Residential
Customers Involved	4000
Cost	AUD 50.9 M
Funding Source	Commercial Partner, Local Government, Regulator-Approved Spend
Network	
Connection Point	Customer Connections, Zone Substations
Location	Yokohama
State	
Country	Japan
Future Plans	
Contact Name	Mr. Suzuki
Contact Email	suzuki@nepc.or.jp
Contact Phone	
Contact Link	
Background	Yokohama, a city of 3.7 million people, is highly regarded as a city that values both the environment and the economy. In Yokohama, public and private enterprises work together to leverage Yokohama's strengths towards the resolution of various urban problems in developing countries, the realization of a low-carbon society, and the realization of a society of sustainable mobility.

Areas of Relevance	Area	Comments	Relevance
	2. Support the transition to an alternative electricity pricing approach.	The project introduces economic incentives which contribute to the introduction of large numbers of PV systems. The project addresses the given objective. However, the detailed policies and alternative pricing schemes are primarily developed for Japanese market.	Low
	3. Create new business models to cater to the shift to a network with high levels of distributed energy resources.	The introduction of housing which is effective in CO2 emissions reduction will be accelerated through the provision of various combinations of high-efficiency energy systems and HEMS, and by combining the introduction of HEMS with housing-related services such as renovations. The project aims to develop new business models through the integration of HEMS.	Med
	13. Store and organise information on customer renewable energy deployments	Energy data for each district will be collected. A model for predicting the supply-demand balance of an area will be developed. The energy data will be used for balancing and forecasting purposes.	Med

Approaches	Approach	Comments
	Demand Side Incentives	Gradual introduction of incentives for shifting demand. Assessing the degree of change in consumption behaviour as well as assessing how family composition influences the degree of change in behaviour. Verification of the effects of each incentive. The provision of a commercial service package which combines HEMS and incentives will be considered. Efforts will be made to build mechanisms for continuing the activities.

Results	Result	Comments
	Smart Meters and In-Home Displays	The introduction of the system in demonstration households and the launch of the collection of data on energy consumption from the system equipment.

YSCP CEMS Project

Project ID	177
Organisation	Toshiba Japan
Organisation Type	Proponent
Partners	Tokyo Electric Power Company (TEPCO), Accenture Japan Ltd. and others
Story	The YSCP demonstration is one of the largest smart city demonstration projects in Japan, piloted in three Yokohama districts – the Minato Mirai district, the Kohoku New Town district, and the Green Valley district. This project was selected as a Next Generation Energy Infrastructure and Social System Demonstration Area by the Ministry of Economy, Trade and Industry of Japan in April 2010, and is expected to be completed by 2014. With a project area covering around 60 km^2 and a population of more than 420,000 people in 170,000 households, the project includes various aspects such as renewable energy, energy management of households, buildings and local communities, and electric vehicles. The main focus of the YSCP is to demonstrate energy management and demand response (DR) across the city with the goal of reducing carbon emissions by 25%.CEMS system for community energy management project will enable the adjustment of the output fluctuations of PV systems which have been installed in an area through intensive investment, by connecting the PV systems, stationary storage batteries and BEMS which have been installed in the area through intensive investment. The project will demonstrate whether or not combination of storage battery and demand control will lower social cost for the introduction of PV systems as compared with compensating output fluctuations of PV systems using stationary storage batteries alone.
Start Date	2010
End Date	
Customer Segment	Industrial, Large commercial, Residential, SME
Customers Involved	4,000 houses, 4 office buildings, 3 commercial buildings, 4 apartments, 1 large-
Cost	AUD 27.8 M
Funding Source	Commercial Partner, Local Government, Regulator-Approved Spend
Network	Other
Connection Point	Customer Connections, Zone Substations
Location	Minato Mirai district, Kohoku New Town district, and the YGA district of Yokohama
State	
Country	Japan
Future Plans	
Contact Name	Mr. Suzuki
Contact Email	suzuki@nepc.or.jp
Contact Phone	
Contact Link	
Background	The Yokohama Smart City Project (YSCP) is a proof of concept being implemented over a broad area. Its purpose is to help protect the global environment by exploring the possibility of building social systems with the aim of cutting CO2 emissions by 25 percent. The Community Energy Management System (CEMS) provides system stabilization through the integration of the HEMS and BEMS with 2,000 electric vehicles (EVs), charging stations, SCADA storage batteries, and photovoltaic (PV) solar energy generation.

Areas of Relevance	Area	Comments	Relevance
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Development of CEMS, SCADA system for power storage and stationary storage battery for distribution substations; Introduction of CEMS and storage batteries in the three areas of Yokohama city. The project addresses the objective of integrating renewables into the grip more effectively by using community-based energy management approach, including energy storage management.	Med
Approaches	**Approach**	**Comments**	
	Communications Network	The key activities include: 1) Development of CEMS, SCADA for power storage and stationary storage battery. 2) Development of CEMS function for heat energy. 3) Formulation of a plan for large-scale demonstration using CEMS. 4) Introduction of CEMS in the three pilot areas. 5) Installation of stationary storage batteries in the Kohoku NT and YGV areas. 6) Demonstration of coordination between areas using CEMS. 7) Demonstration of the virtual EMS which connects CEMS of the three areas.	
Results	**Result**	**Comments**	
	No results yet	Project is ongoing	

Zhangbei National Energy Storage and Transmission Demonstration Project (China)

Project ID	276
Organisation	State Grid of China (SGCC)
Organisation Type	Government
Partners	North China Grid Company, Ltd.
Story	China has a growing desire to decrease pollution caused by black energy and increase energy security. Renewable energy is seen as a valuable resource to achieve these outcomes. This project is designed to test and improve China's capability to integrate renewables into the grid, on a large scale. While there are other hybrid renewable energy system power plants of similar scale in service today, there are no power plants as aggressively reinforced with battery energy storage. This State Grid of China (SGCC) project serves as a demonstration of a stable solution for transferring large amounts of predictable, dependable, and dispatchable renewable electricity to the national transmission grid on an unprecedented scale. The 216 MW Zhangbei National Energy Storage and Transmission Demonstration Project was put into operation in 2011 and includes wind turbine generation (100 MW), solar PV generation (40 MW), battery power storage (20 MW to 36 MW), and intelligent transmission technologies.
Start Date	2011
End Date	
Customer Segment	Residential
Customers Involved	
Cost	Approximately AUD 1.88 B (first phase investment: AUD 550 M)
Funding Source	Federal Government, State Government
Network Connection Point	
Location	Zhangbei
State	Hebei
Country	China
Future Plans	
Contact Name	State Grid Corporation of China (SGCC)
Contact Email	sgcc-info@sgcc.com.cn
Contact Phone	
Contact Link	
Background	China's has a growing desire to decrease pollution caused by black energy and increase energy security. Renewable energy is seen as a valuable resource to achieve these outcomes. This project is designed to test and improve China's capability to integrate renewables into the grid, on a large scale.

Areas of Relevance	Area	Comments	Relevance
	1. Measure or quantify the benefits and costs of renewable energy	Analyses the cost of integrating renewable energy into the network. In particular the infrastructure required for large scale renewable energy generation and battery storage.	Med
	6. Make the process of integrating renewable energy into the grid more cost-efficient	Tested the SGCC capability of connecting large scale renewable energy into the network, the experience gained is hoped to help inform and lower the costs of future connections of this kind.	Med
	10. Smooth out intermittent generation output	Large scale renewable energy generation utilising battery storage to smooth out the intermittent output prior to entering the network	Low

Approaches	Approach	Comments
	Storage, Grid-Connected	While there are other hybrid renewable energy system power plants of similar scale in service today, there are no power plants as aggressively reinforced with battery energy storage. This State Grid of China (SGCC) project serves as a demonstration of a stable solution for transferring large amounts of predictable, dependable, and dispatchable renewable electricity to the national transmission grid on an unprecedented scale.

Results	Result	Comments
	Storage can combine with PV to reduce peak demand	While integration of solar PV and wind generation alone significantly helps in the generation of energy, it is the use of large scale power storage and intelligent, smart grid transmission that truly enables the Zhangbei power plant to fully meet power demand. Battery manufacturer BYD has indicated that the use of large scale battery storage can improve renewable energy efficiencies by 5% to 10%. BYD's lithium-ion iron-phosphate battery shares many advantages and disadvantages with other lithium-ion chemistries, however, there are significant differences: Lithium-ion iron-phosphate chemistry offers a longer cycle life than other lithium-ion approaches; the use of phosphates avoids the cost and environmental concerns of the use of cobalt, particularly concerns about cobalt entering the environment through improper disposal: and these iron-phosphate batteries have higher current or peak-power ratings than typical lithium-ion technologies
	Deployment of Storage	The 216 MW Zhangbei National Energy Storage and Transmission Demonstration Project was put into operation in 2011 and includes wind turbine generation (100 MW), solar PV generation (40 MW), battery power storage (20 MW to 36 MW), and intelligent transmission technologies.

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FURTHER INFORMATION

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