ELECTRICITY NETWORK TRANSFORMATION ROADMAP

2017-27

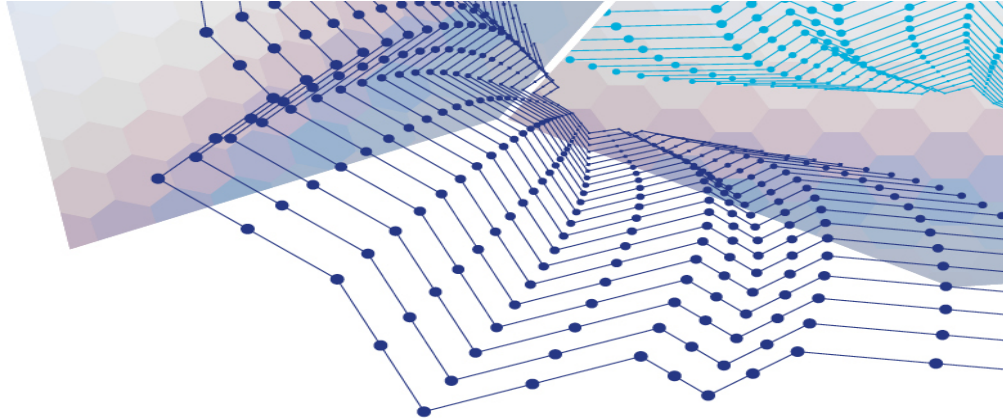
Final Report Launch & Next Steps

28th April 2017

Energy Networks Australia

CSIRO

Today’s Agenda



- Roadmap findings
- Feedback & Changes to Final Report
- New Content: Modelling Insights
- Next Steps & Priority Projects
- Questions and Discussion

Please submit questions throughout the webinar and we’ll address these as we go

2017-27 Electricity Network Transformation roadmap

- ✓ **CSIRO- ENA public facing collaboration**
  - ✓ **Evidence-based** (Qual + Quant)
    - ✓ Informs **specific, purposeful actions** (‘Milestones’ + ‘Actions’)
      - ✓ Central focus on **balanced outcomes** for **customers and society**

2027 Roadmap Vision

Australia's electricity systems in 2027 are resilient to divergent futures and are positioned to achieve balanced outcomes for customers:

Status today …

1.5 million microgenerators, 15% average Solar PV penetration

Highest per capita emissions, generation sector reliant on coal

Significant increase in av. retail bills since 2008

System security and stability challenges with with loss of synchronous generation and millions of DER

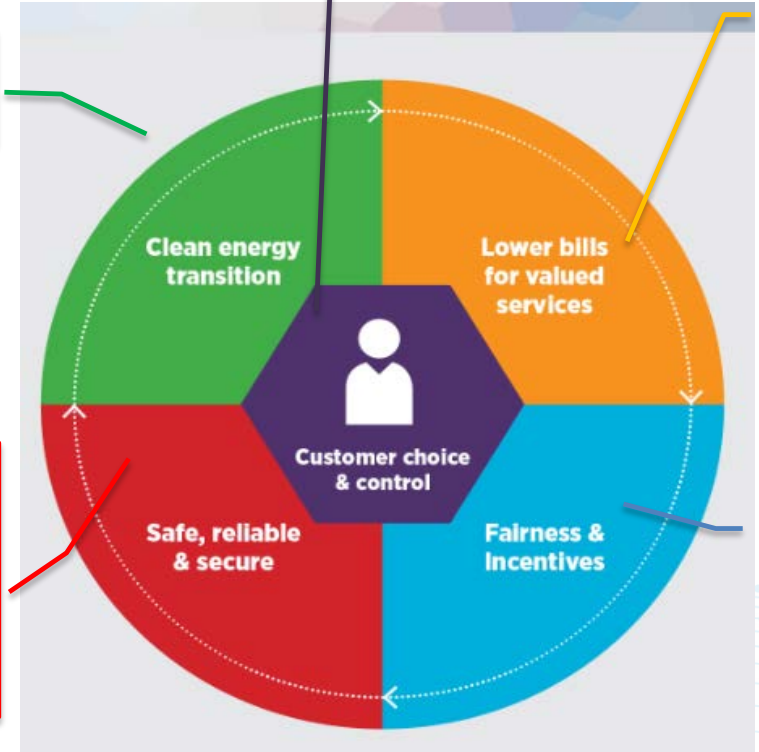
Cross-subsidies between customers drive by technology (A/C, solar) and diverse use.

Blunt incentives to DER, regardless of location, time.

A better future…

- Almost 2/3 of customers have DER
- 1/3 customers on ‘stand alone power system’ tariff
- Customer protection and concession schemes fit for purpose.

- COP 21 aspiration of Zero Net Emissions by 2050 is met



- Reduce total system spend by $101 BN by 2050
- Save Households $414 pa
- Network charges 30% lower than 2016

- Efficient solutions for new NEM services avoid security & stability risks.
- Real time balancing, reliability & quality of supply with millions of DER participants

- Avoid over $18 BN in cross subsidies
- Means $600 pa. for mid size family without DER
- Networks pay over $2.5 BN pa for DER services

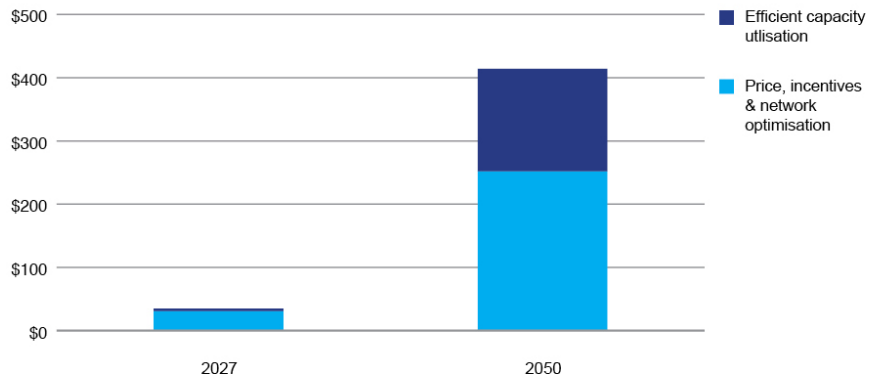
Overview of the Electricity Network Transformation Roadmap

	FOUNDATION						IMPLEMENTATION					
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2027+
CUSTOMER ORIENTED ELECTRICITY	**Improve Trust with Customers** » Enhanced customer engagement and collaboration » Customised choices, better information on services and new connection and advisory services » Demonstrate investment reflects customer value while improving service performance and response times » Review of Consumer Protection and concessions						**Networks provide a service platform** » Open network platforms embrace diverse customer needs and aspirations » Collaborate with customers and market actors to create new value with streamlined connections » Leverage network information and digital services for personalised innovation in a dynamic market					
POWER SYSTEM SECURITY	**New systems to support diverse generation** » Update Transmission Interconnection test » Review frameworks for protection systems, efficient capacity and balancing services » New market frameworks for ancillary services » Develop new power system forecasting and planning approaches to anticipate system constraints » Enhanced intelligence and decision making tools » Close focus on physical & cyber security						**Harmonised System Operations at all levels** » Transmission networks support system stability with new services. » Distribution networks provide visibility of DER and potentially Frequency Control Ancillary Services (FCAS) and delegated balancing services. » Real-time communication and controls					
CARBON ABATEMENT	**A stable Carbon Policy for higher targets** » Develop nationally integrated carbon policy framework » Implement emissions Baseline & Credit Scheme » Set Light Vehicle emissions standard policy to provide incentives for electric vehicle uptake, supporting climate goals » Review Australia's emissions reduction target » Agile network connections and integration of large and small scale renewable technologies						**Reviewing scope for greater efficiency** » Review technology specific incentive schemes to focus on least cost abatement » Review scope for more efficient economy wide carbon pricing where consensus » Review Australia's emissions reduction target (2027)					
INCENTIVES & NETWORK REGULATION	**Incentivising efficiency and innovation** » Ensure extensive smart meter penetration » Assign customers to new range of fairer demand-based network tariffs, with a choice to Opt Out » Enable standalone systems and micro-grids as a substitute for traditional delivery models » New innovation incentives in Regulation and Competition frameworks						**Unlocking value of distributed energy resource orchestration** » Networks pay for distributed energy resource orchestration to provide system support in the 'right place at right time' » New network tariffs that provide beneficial incentives for standalone systems and micro-grids to stay connected to the grid » New and more adaptive regulatory approaches that are customer focused					
INTELLIGENT NETWORKS & MARKETS	**Essential information for an integrated grid** » Establish open standards and protocols to enable secure system operation, management and exchange of information and interoperability with distributed energy resources » Networks enhance current system monitoring and models to inform advanced system planning » Build distributed energy resource maps and feeder hosting analysis to support locational valuation of distributed energy based services						**Networks optimised with distributed energy resources** » Active network management for technical stability, enabling distributed energy resource markets and efficient optimisation. » Networks provide a suite of grid intelligence and control architectures to animate distributed energy resource markets, as well as providing system security. » Establish a new network optimisation market to procure DER services for network support. » A flexible and agile workforce to support the new optimised energy system.					

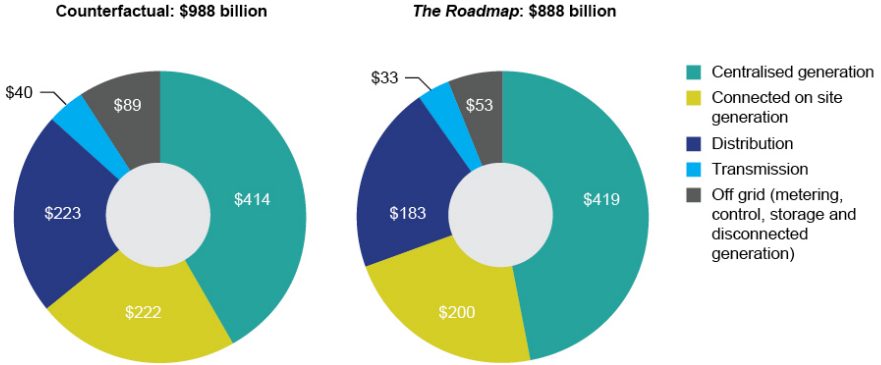
Overall Customer outcomes by	
2027	2050
CUSTOMER CHOICE AND CONTROL	
» Over 40% customers use onsite resources: 29 GW solar and 34 GWh of batteries. » Concessions to support those who need it most.	» Almost 2/3 customers use onsite resources, including 1/3 customers on a new stand alone system tariff.
LOWER BILLS FOR VALUED SERVICES	
» Avoid over $1.4 BN in network investment. » Average network bills 10% lower than 2016.	» Total system spend is $101BN lower to 2050. » Save households $414 pa by 2050. » Network charges 30% lower than 2016.
FAIRNESS & INCENTIVES	
» Networks pay over $1.1 BN pa for DER services. » Over $1.4 BN in cross subsidies avoided, saving $350 pa for med size family without DER.	» Networks pay over $2.5 BN pa for DER services. » Over $18 BN in cross subsidies avoided, saving $600 pa for med size family without DER.
SAFETY, SECURITY, RELIABILITY	
» Planned and efficient market response avoids security & stability risks. » Robust physical & cyber security management.	» Real time balancing, reliability and quality of supply at small and large scale, with millions of market participants.
CLEAN ENERGY TRANSITION	
» Electricity sector carbon abatement to reach 40% by 2030 – greater than current national target of 26-28%.	» Electricity sector achieves Zero Net Emissions by 2050.

Comparing the roadmap Outcomes

Projected savings in average residential bills under the roadmap scenario



Cumulative electricity system total expenditure to 2050 – Roadmap & counterfactual



Comparing the Roadmap Outcomes

Figure 6: Residential bill outcomes for selected Australian household types in 2050 under the counterfactual and *Roadmap* scenarios

	Counterfactual			*The Roadmap*		
	Active $	**Passive $**	**The Gap $**	**Active $**	**Passive $**	**The Gap $**
Working Couple	$1,346	$1,811	**$465**	$1,123	$1,422	**$299**
Medium Family	$1,816	$2,601	**$785**	$1,428	$1,988	**$560**
Large Family	$2,794	$3,950	**$1,156**	$2,346	$2,734	**$288**
Single, Retired	$1,058	$1,730	**$672**	$883	$1,355	**$472**

ENTR Supporting Report Library

Program Quantification

- *Economic benefits of the Electricity Network Transformation Roadmap: Technical report.* (March - 2017)

Customer-oriented Networks

- Electricity Network Transformation Roadmap: Interim Program Report (2015)
- *Electricity Network Transformation Roadmap: Customer Engagement Handbook* (2016)
- Network business model evolution:
  - Network business model evolution: an investigation of the impact of current trends on DNSP business model evolution. Accenture (2015)
  - Insights from Global Jurisdictions, New Market Actors & Evolving Business Models, Accenture (2016)

Customer Safety Net

- External: Consumer Action Law Centre, *Power Transformed* (2016)

Carbon & Renewable Policy Options

- *Enabling Australia's Cleaner Energy Transition*, Energy Networks Association (2016)
- *Australia's Climate Policy Options – Modelling of Alternate Policy Scenarios.* Jacobs (2016)

Efficient Capacity Utilisation

- *Efficient capacity utilisation: transport and building services electrification.* (2016)
- *Gas-electricity substitution projections to 2050.* ClimateWorks Australia (2016)

Pricing & Incentives

- Energeia, *Price and Incentives Report*. (2016)
- Energeia *Stand Alone Power Systems and Microgrids Report* (2016)

Regulatory & Policy Frameworks

- Cambridge Economic Policy Associates F*uture Regulatory Options for Electricity Networks,* 3 August 2016

Power System Security

- *Embedded Generation Report*. Marchment Hill Consulting (2015)
- *Grid Design, Operation, Platform & Telecoms Report.* EA Technology (2016)

Intelligent Networks

- *Network Transformation Roadmap: Innovation Gap Analysis and Plan.* EA Technology (2016)

DER Markets & Orchestration

- *Grid Design, Operation, Platform & Telecoms Report.* EA Technology (2016)
- *Distribution Systems in a High DER Future: Planning, Market Design, Operation and Oversight.* Lawrence Berkeley (2015)
- *Future Market Platforms & Network Optimisation Synthesis report (2017)*

Future Workforce Requirements

- *Changing Industry, A Changing Workforce: Electricity National Transformation Roadmap Workforce Skilling Impacts* (Energy Skills Queensland), October 2016.

Technical Standards and Regulations

- *Standards and the Future of Distributed Electricity (Standards Australia)*, November 2016.

Collaboration/Co-design in developing the Final *Roadmap*

The final report is the product of more than two years of collaborative work carried out by Energy Networks Australia and CSIRO.

More than 200 different industry representatives contributed at over 14 workshops and webinars held as part of the public consultation process.

Information on the Roadmap has been viewed more than 30,000 times during the development process.

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Roadmap Feedback

Energy Networks Australia

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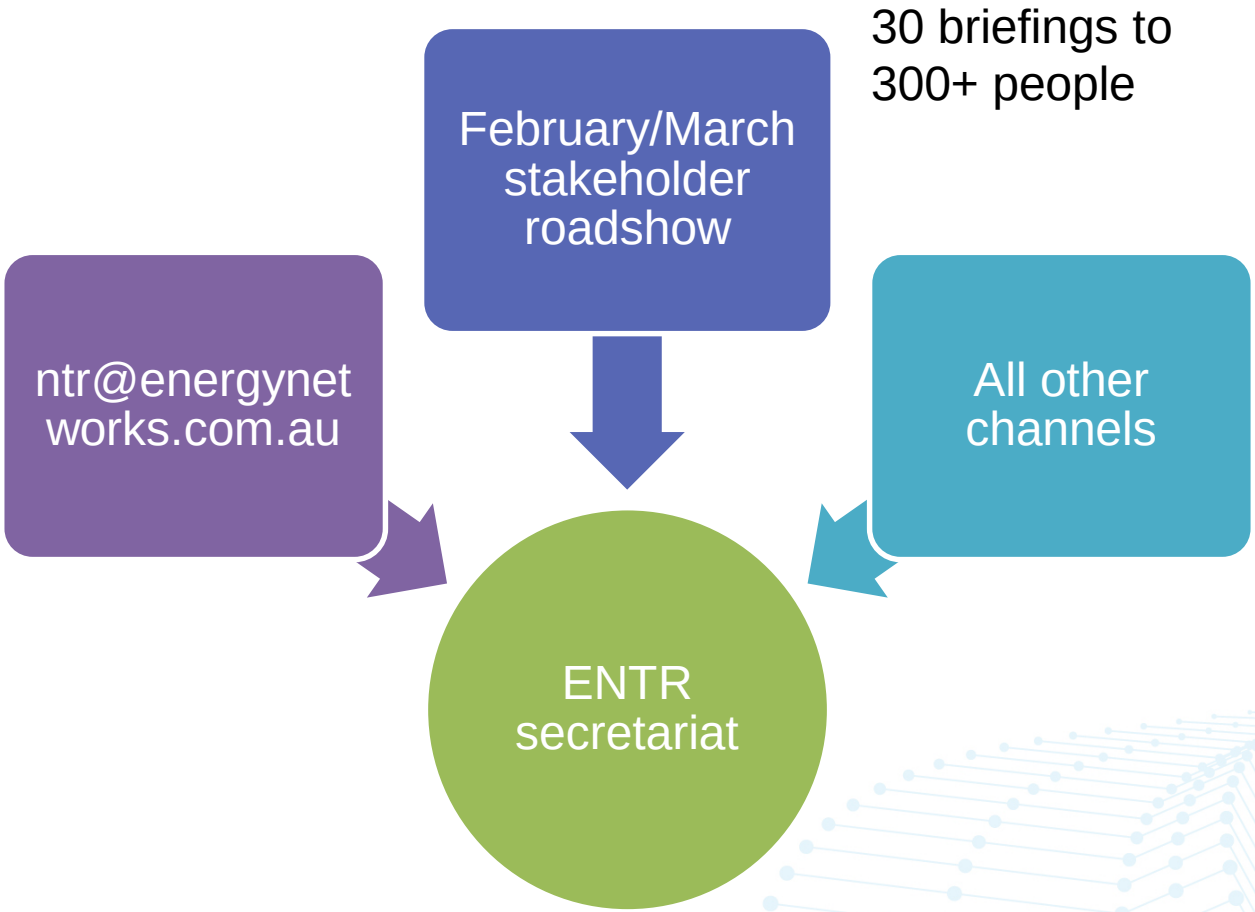
Feedback summary

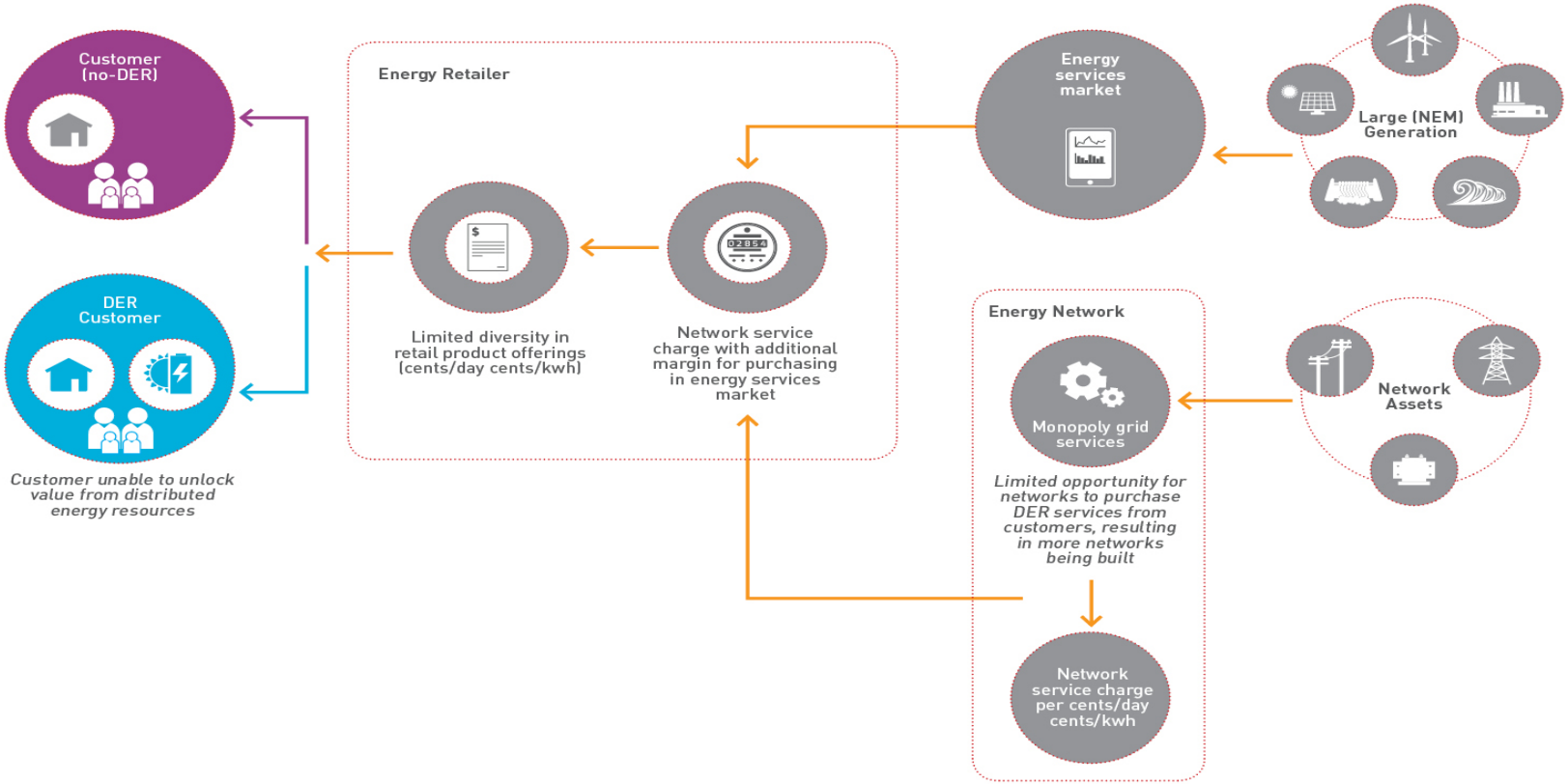


The most substantial changes that were made in response to feedback

- Expanding on the role of retailers in price reform
- Timing on price and tariff reform
- Pass through of Network price signal
- Clarifying the scope for avoided network expenditure
- Carbon policy and Emissions Intensity Trading Scheme
- Regional modelling
- Strengthened the discussion regarding Transmission network and interconnection role in System Security
- Wording in the System security section modified regarding system strength and stability
- Timing of Grid Modernisation activities
- Ongoing role for networks in behind the meter relationships with customers
- Ensured the language of report reflects the need to address network capability to address increasing penetrations of DER
- Identification of opportunities for the procurement of DER services as an alternative to grid augmentation
- Reviewed general timing of milestones
- Governance of Roadmap Implementation

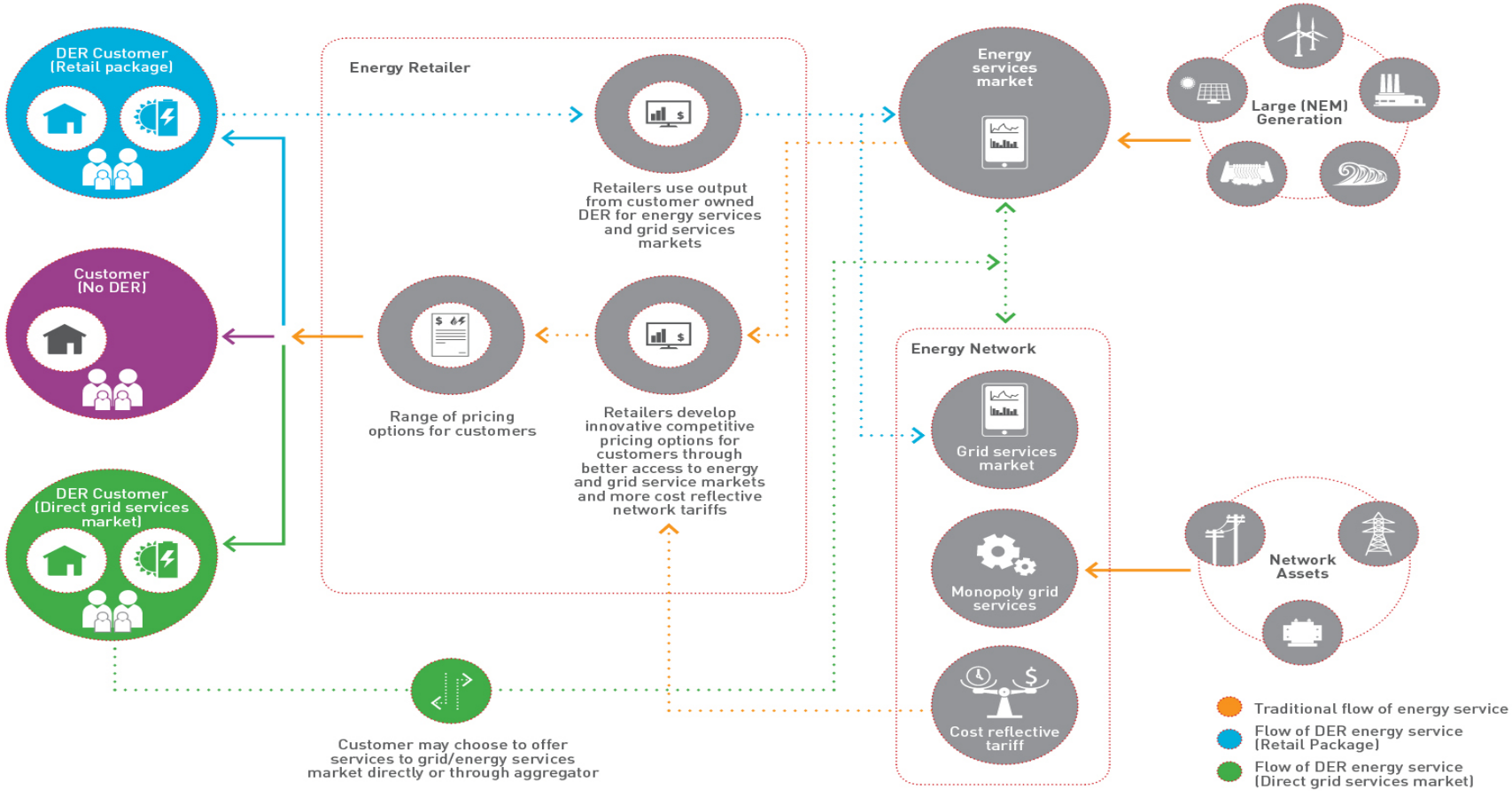
Current state of pricing frameworks

Limited choice and flexibility for customers and network businesses



Unlocking value through better prices and better access to new markets

Instead of building networks "buy" output from DER (through retailers, aggregators or directly from customers) for locational, dynamic benefits

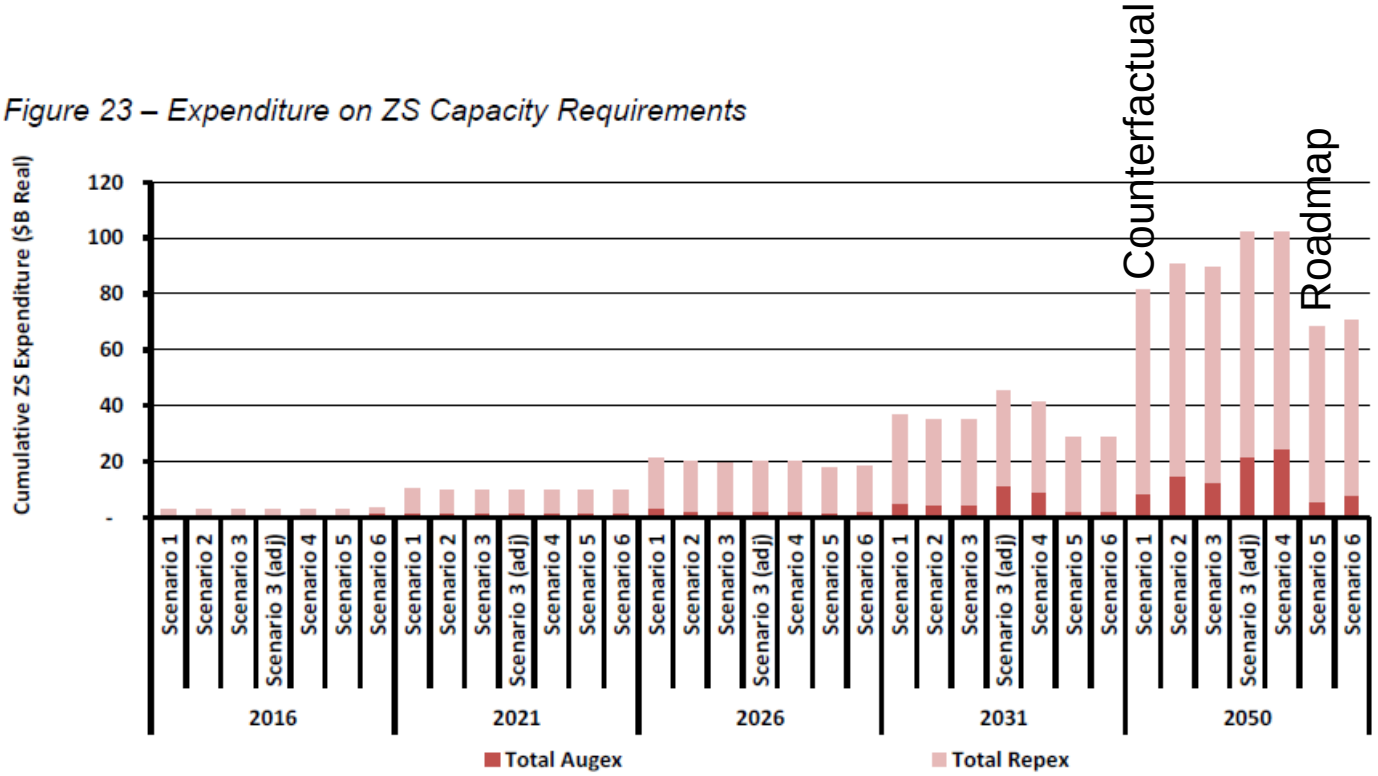


Feedback: more on price reform

- The pace of price reform
- How soon networks will be ready to provide spatial constraint signalling
- Demand tariffs versus other network tariff structures – changed to ‘cost reflective’ terminology instead of ‘demand based’ to recognise that while this is the most popular structure, it is not the only approach which networks are considering to suit their local circumstances.

Feedback: Clarifying the scope for avoided network expenditure

Figure 23 – Expenditure on ZS Capacity Requirements



Feedback: Carbon policy

While carbon policy remains an area of political churn:

- The roadmap goal remains to achieve decarbonisation, reliably and at lowest cost to customers.
- All available modelling continues to support an emission intensity scheme (baseline and credit scheme) as the most effective way to do that

Roadmap urges consensus must emerge on carbon policy which is outcome-based:

- Stable
- Technology neutral, and
- Keep costs to customers low

Feedback Summary

A detailed feedback summary and copy of the final Roadmap report is available at:

http://www.energynetworks.com.au/roadmap-final-report

ELECTRICITY NETWORK TRANSFORMATION ROADMAP

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New Content: Modelling Insights

Energy Networks Australia

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New Content: Regional Modelling

- A new Appendix has been added to the Roadmap report providing more detail on State by State modelling.

- This new section makes no changes to the national results represented in the Roadmap Reports.

- We conducted the modelling and analysis at regional scale, typically state and zone substation level, and outcomes at that level are, not surprisingly, more diverse.

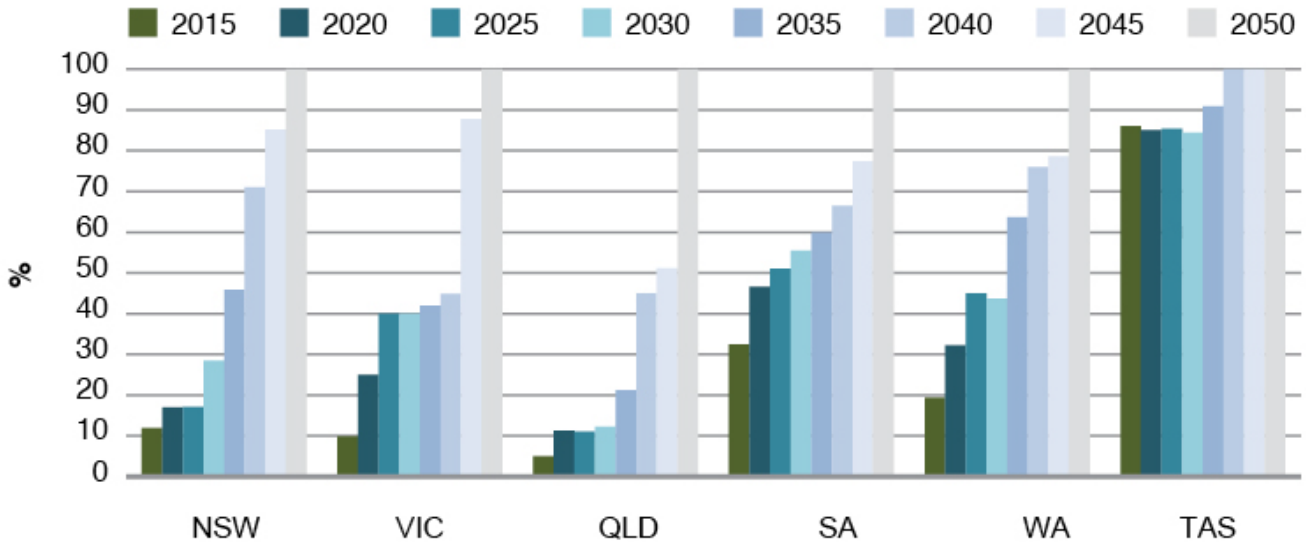
- The major implication of the diversity of regional results is that some of *the Roadmap* milestones and actions, particularly the issue of timing, will need to be considered in the context of the region in which they are implemented.

Regional Modelling: Large Scale Renewable Generation

Finding 1: Some states will require earlier action to manage power system security.

South Australia and Victoria will likely need to bring forward actions relating to managing power system security.

Finding 2: Some states could see very significant generator construction programs required in compressed timeframes.

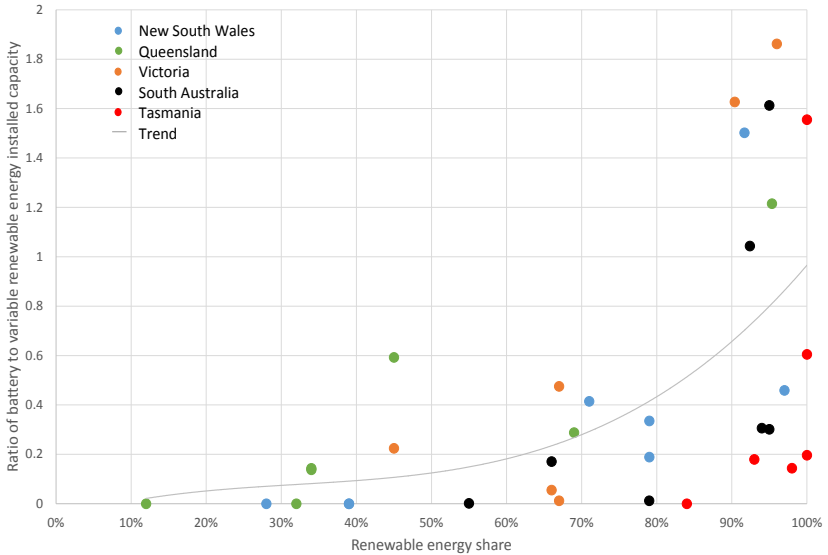


Projected renewable generation as a share of state generation under the Roadmap scenario

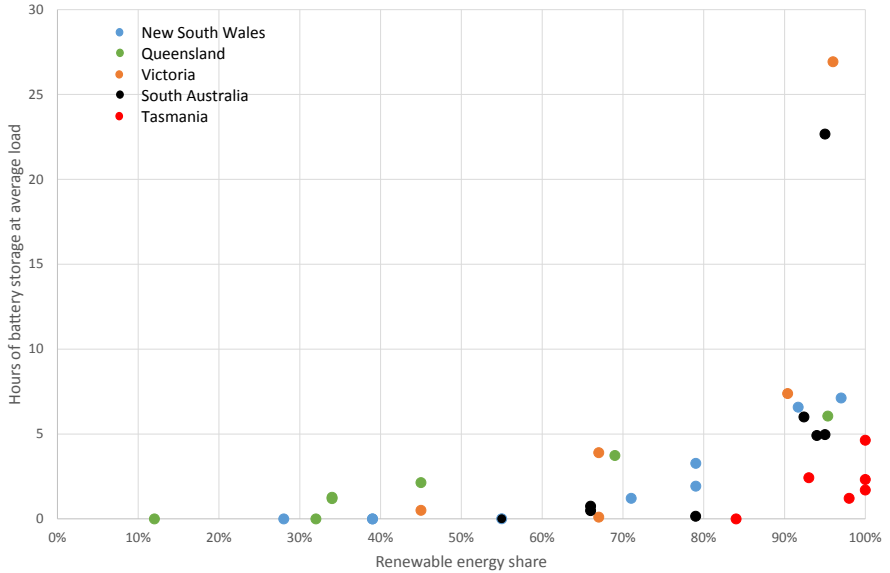
Regional Modelling: Total battery requirements (incl Grid Scale)

Finding 3: Battery storage may begin to contribute to an optimised energy mix when renewable shares are in the range of 30 to 50 percent

Finding 4: Gas or biogas peaking plant are more cost effective than adding additional storage capacity in circumstances where a substantial renewable generation shortfall extends for more than a third of a day.



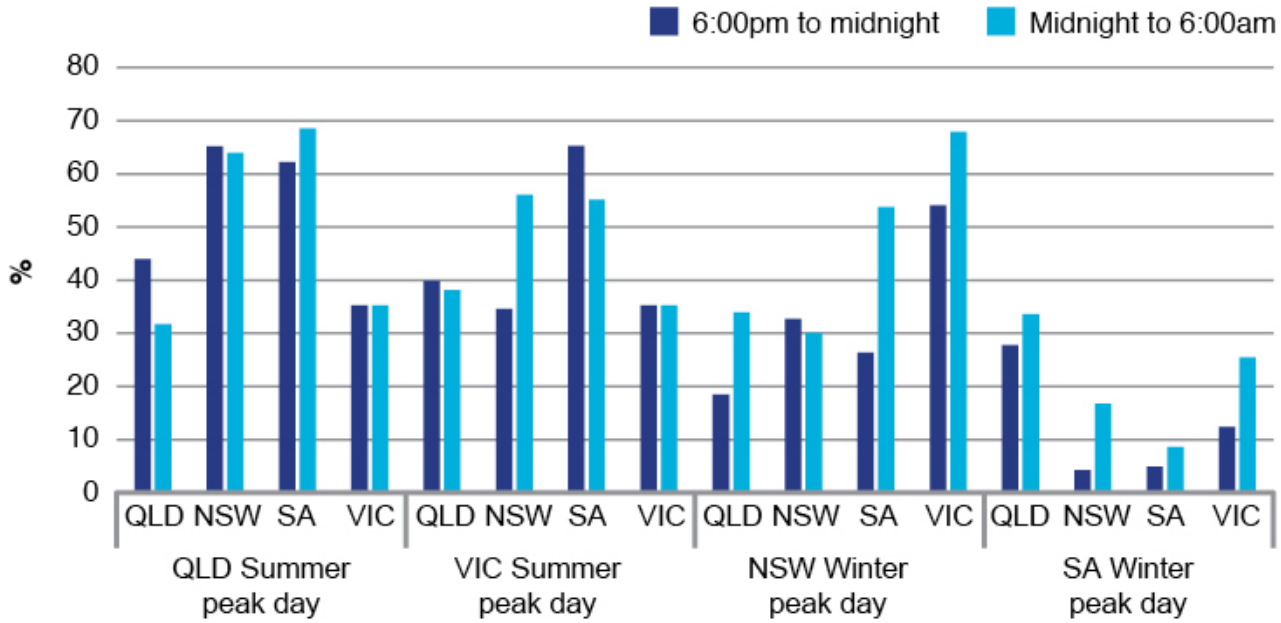
Projected ratio of battery capacity to variable renewable generation capacity to achieve energy balancing for a given renewable energy share, by state



Projected hours of battery storage required to achieve energy balancing for a given renewable energy share, by state

Regional Modelling: The Role of State Interconnectors

Finding 5: The diversity of variable renewable generation, particularly wind generation, across regions during summer and winter peaking conditions, suggests a stronger role for state transmission interconnections.

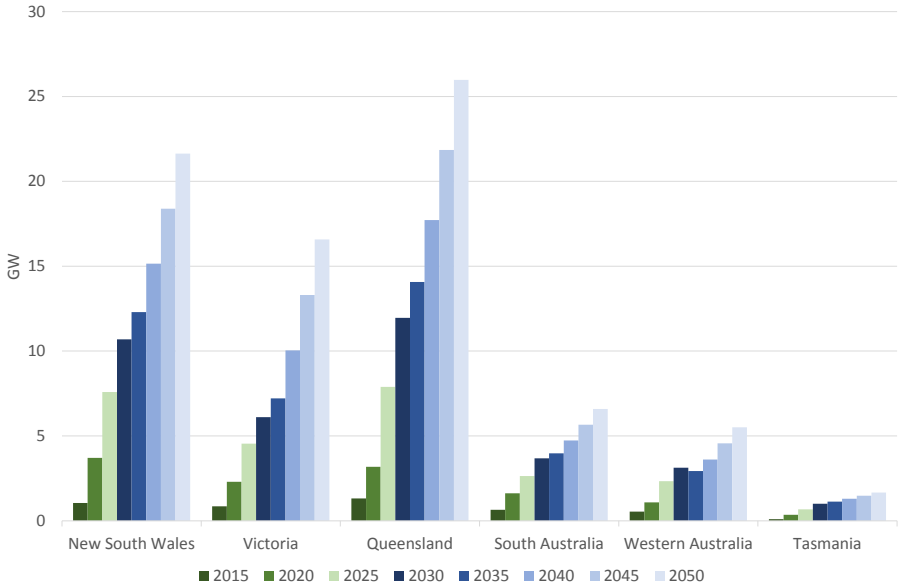


Historical (2009-10) coincident wind generation capacity factors on winter and summer maximum demand days in selected states

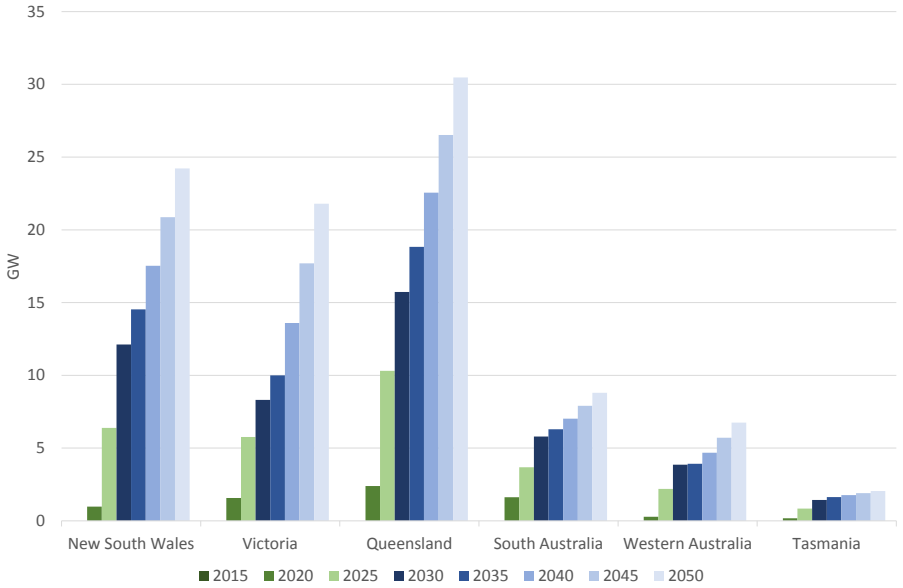
Regional Modelling: Distributed energy resources adoption

Finding 6: Projected higher rooftop solar capacity reflects both expected increasing customer adoption and larger average systems sizes

Finding 7: Bundling of battery and rooftop solar systems together is expected to be the primary driver of battery storage adoption



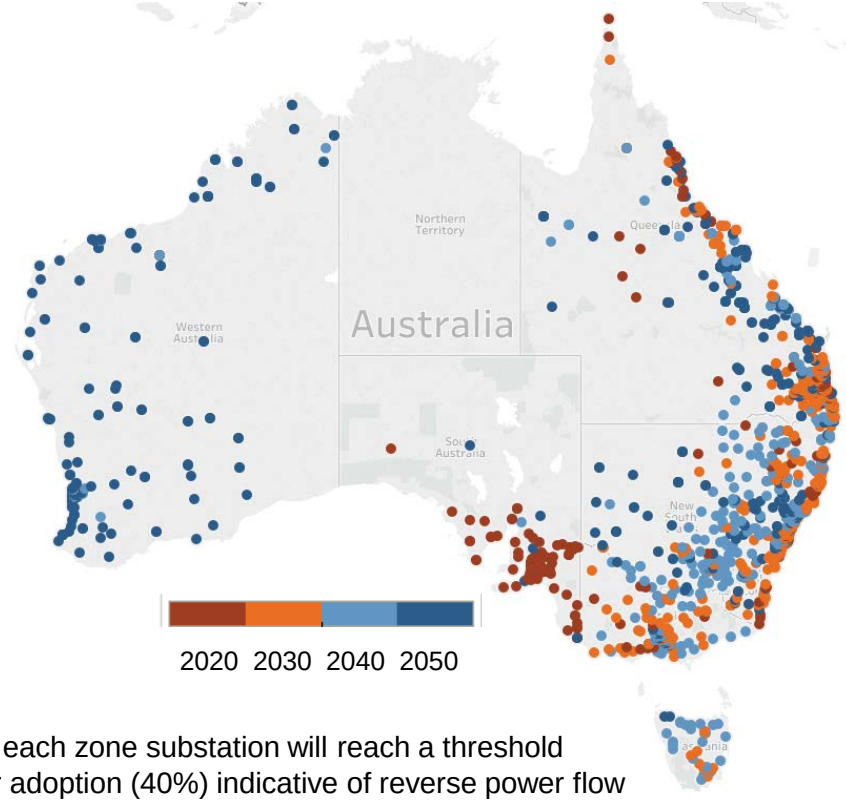
Projected installations of rooftop solar by state



Projected installations of onsite battery storage by state

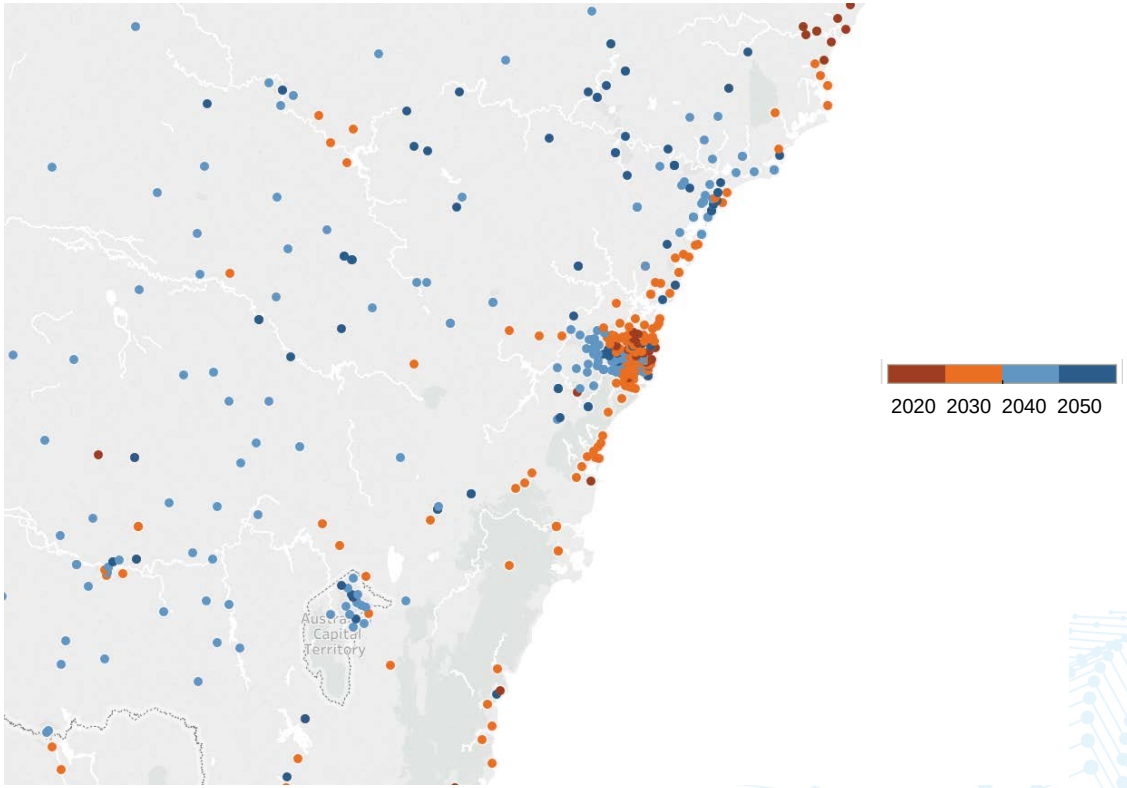
Regional Modelling: Distributed energy resources adoption

Finding 8: While South Australia is most at risk of reverse power flow associated with high rooftop solar adoption, other states, or particular substations within a state, are expected to follow over time, making it a growing national issue.

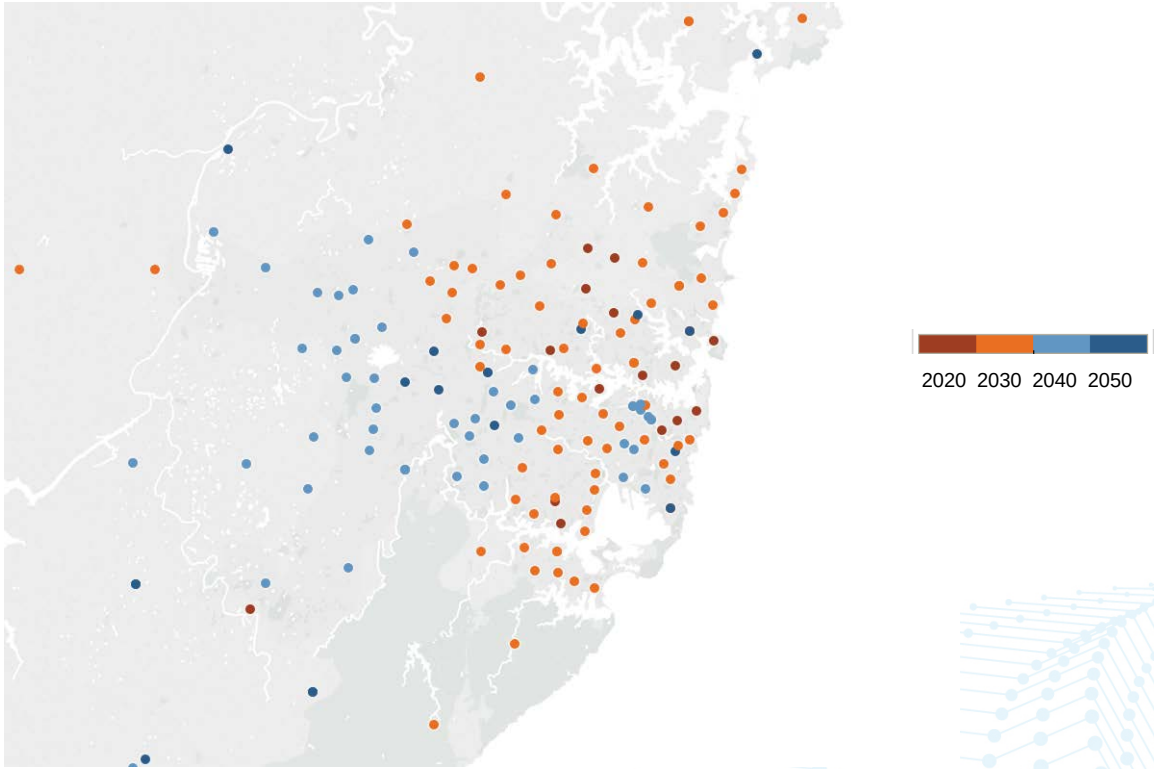


Projected decade in which each zone substation will reach a threshold penetration of rooftop solar adoption (40%) indicative of reverse power flow

ACT and Sydney view



Sydney view



ELECTRICITY NETWORK TRANSFORMATION ROADMAP

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Next Steps & Implementation

Energy Networks Australia

CSIRO

A partnership between the ENA and CSIRO

Roadmap Implementation Planning

Detailed Planning underway to guide implementation of the Roadmap's 45 Milestones and 145 Actions.

Projects are being scoped across three broad categories:

1. **Coordinated Implementation** – activities which require coordination both nationally across network businesses, as well as between network businesses and other key stakeholders such as retailers, researchers and regulators.

2. **Network Business Implementation** – activities which will be led by individual network businesses, as they represent changes to their own operational or business practices as driven by their own business needs or regional challenges.

3. **Influenced Implementation –** activities where network businesses cannot drive outcomes, but will play a key role in providing important input to key stakeholders.

Influenced Implementation

Critical Roadmap activities where networks are committed to working closely with key stakeholders to support and provide input. Examples include:

- Developing an agreed enduring, stable and nationally integrated carbon policy framework

- Metering Penetration monitoring & Intervention

Member Business Implementation

Activities that can be led by individual network businesses as they represent changes to their own operational or business practices. Examples include:

- Enhanced Customer Engagement & Segmentation
- Regulatory Proposals supporting recommended roadmap approaches
- Systems processes enhancements
- Innovation and Risk Management

Coordinated Implementation

Activities which require coordination and broad stakeholder input and collaboration. This work will include a range of proposed Roadmap project categories including:

- **ENTR flagship projects**
- **Knowledge sharing around ENTR demonstration projects and trials**
- **Development of a long-term industry R&D Innovation framework**
- **ENTR implementation progress monitoring and reporting**
- **Industry engagement**

Coordinated Implementation – Flagship Projects

Projects identified as being critical to support optimal Roadmap Pathways in the shorter term:

	Flagship Program Title	NTR Domain/s
1	Advanced Customer Engagement	Customer Orientated Networks
2	Distributed Energy Resources Connection Guideline	Customer Orientated Networks
3	Tariff Implementation Plan	Incentives and network regulation
4	Metering penetration monitoring & intervention	Incentives and network regulation
5	Second wave incentives – Trials and implementation	Incentives and network regulation and Intelligent networks and markets
6	New regulatory models - Trials and implementation	Incentives and network regulation and Intelligent networks and markets
7	Unlocking transmission capacity for system security	Power System Security
8	Distributed Energy Resources visibility for AEMO	Power System Security
9	Advanced Grid Architecture	Intelligent Networks and Markets
10	Network hosting capacity and Distributed Energy Resources valuation	Power System Security and Intelligent Networks and Markets
11	Prioritised Standards Development	Power System Security and Intelligent Networks and Markets

Flagship Projects Examples

- **DER connection guideline** - Development of a DER Connection Guideline for the industry in consultation with key stakeholders to facilitate easier integration of customer DER with the grid.
  - *It should be noted that this project has already been approved for funding.*
- **New Regulatory models -** TOTEX trials to test a rebalancing of CAPEX and OPEX to incentivise networks for being efficient and encouraging more payments to customers in return for DER services as a non-network alternative. (i.e. a 'sand box approach')
- **DER Visibility with AEMO -** Define and establish the minimum requirements to enable the coordination of the power system at the interface between the Independent Market Operator and the Distribution networks
  - *It should be noted that an agreement between Energy Networks Australia and AEMO has been established to progress this project*

Coordinated Implementation – cont

Activities which require coordination and broad stakeholder input and collaboration. This work will include a range of proposed Roadmap project categories including:

- **Demonstration Projects:** where implementation of pilots or trials are important in advancing key Roadmap activities or projects
- **Long Term R&D and Innovation Framework:** including identification of long-term research gap priorities and development of an innovation framework to address gaps and opportunities in innovation by:
  - Exploring needs, capabilities and gaps to scope potential research projects
  - Develop a collaborative innovation agenda to guide industry
  - Develop a platform for shared research and outputs

Stakeholder Engagement and Roadmap Monitoring

The Roadmap aims to continue the significant engagement and collaboration achieved through the Roadmap development process by:

- Continuation of wide Roadmap Stakeholder engagement across a wide range of Roadmap projects
- Concept being considered for establishment of an External Stakeholder Reference Group to guide Roadmap Implementation activities and projects
- Program Monitoring and Reporting on a regular basis to keep industry abreast of Roadmap progress and key milestones

Alignment with other programs

Recognising that ENTR has been prepared at the same time as the NEM Security (‘Finkel’) Review, we acknowledge that we will need to:

- Cross reference the ENTR findings with the findings of that process
- Seek to align the roadmap implementation around common points of action.

Note: Individual businesses across different jurisdictions are looking at their own state or business specific implementation plans as a way of making the information from the *Roadmap* more explicit for their own planning.

Proposed Timing for Next Steps

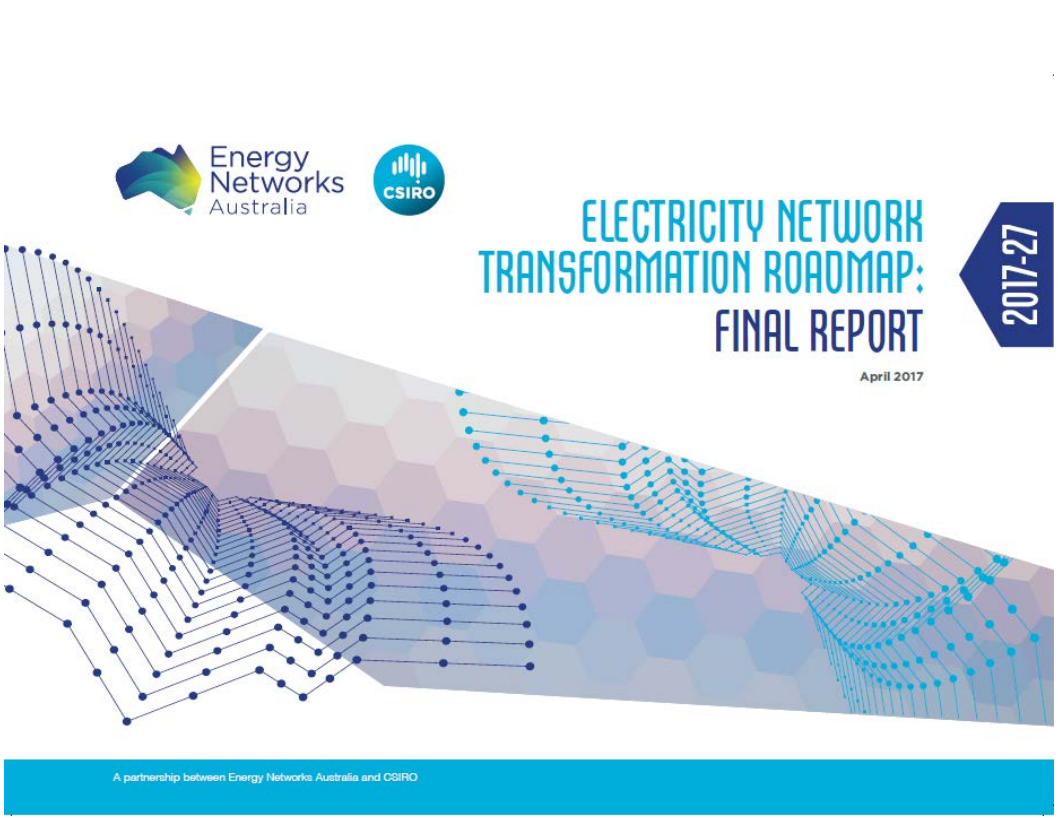
Energy Networks Australia is currently developing an implementation plan to achieve the Roadmap's 45 milestones. This will include:

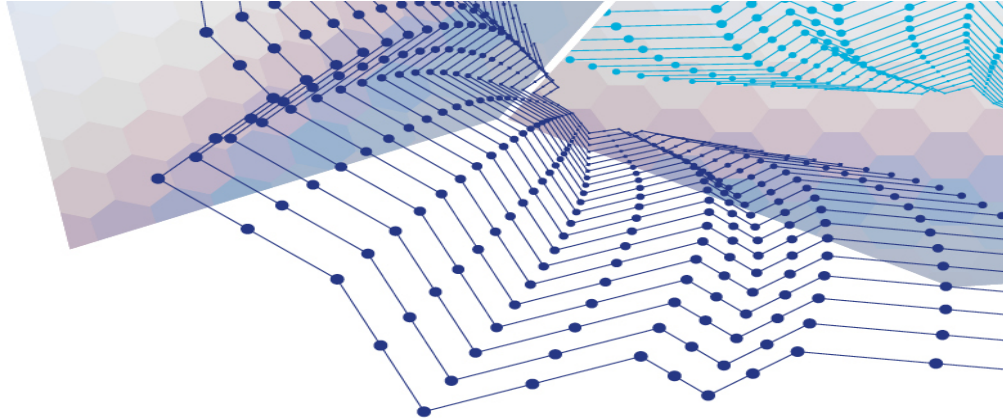
- **Engagement with both internal and external stakeholders on implementation priorities; and**
- **Developing distinct project plans for the flagship programs and high priority projects.**

Energy Networks Australia will provide further details on the Roadmap's implementation over the coming months

For More Information:

http://www.energynetworks.com.au/roadmap-final-report





Questions & Discussion

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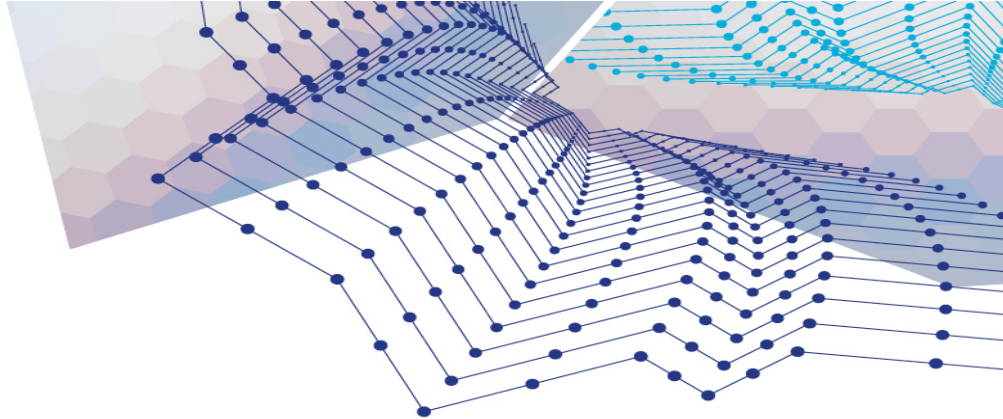

Thanks!