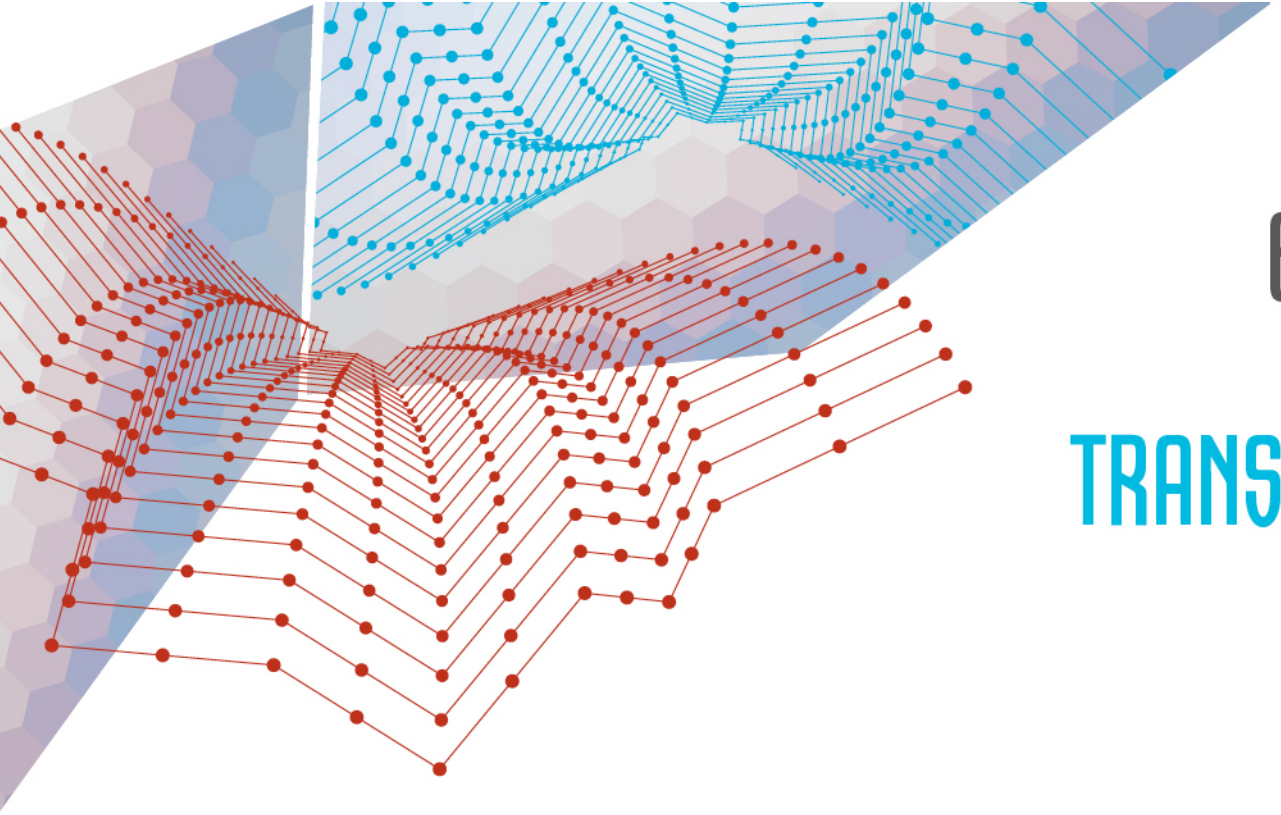

ELECTRICITY NETWORK TRANSFORMATION ROADMAP

2015-25

Welcome and Introduction to Interim Program Report

ena energy networks association

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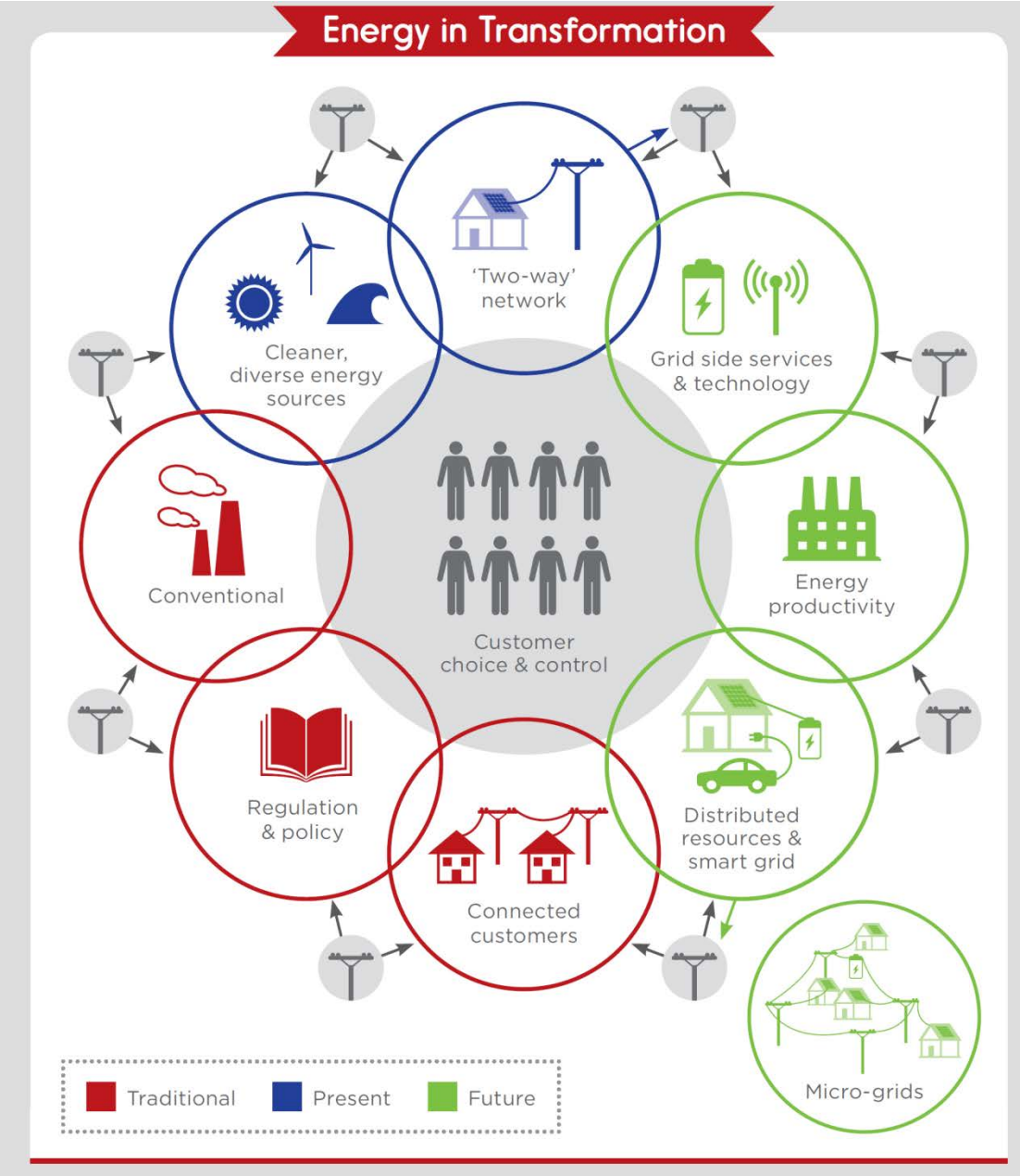
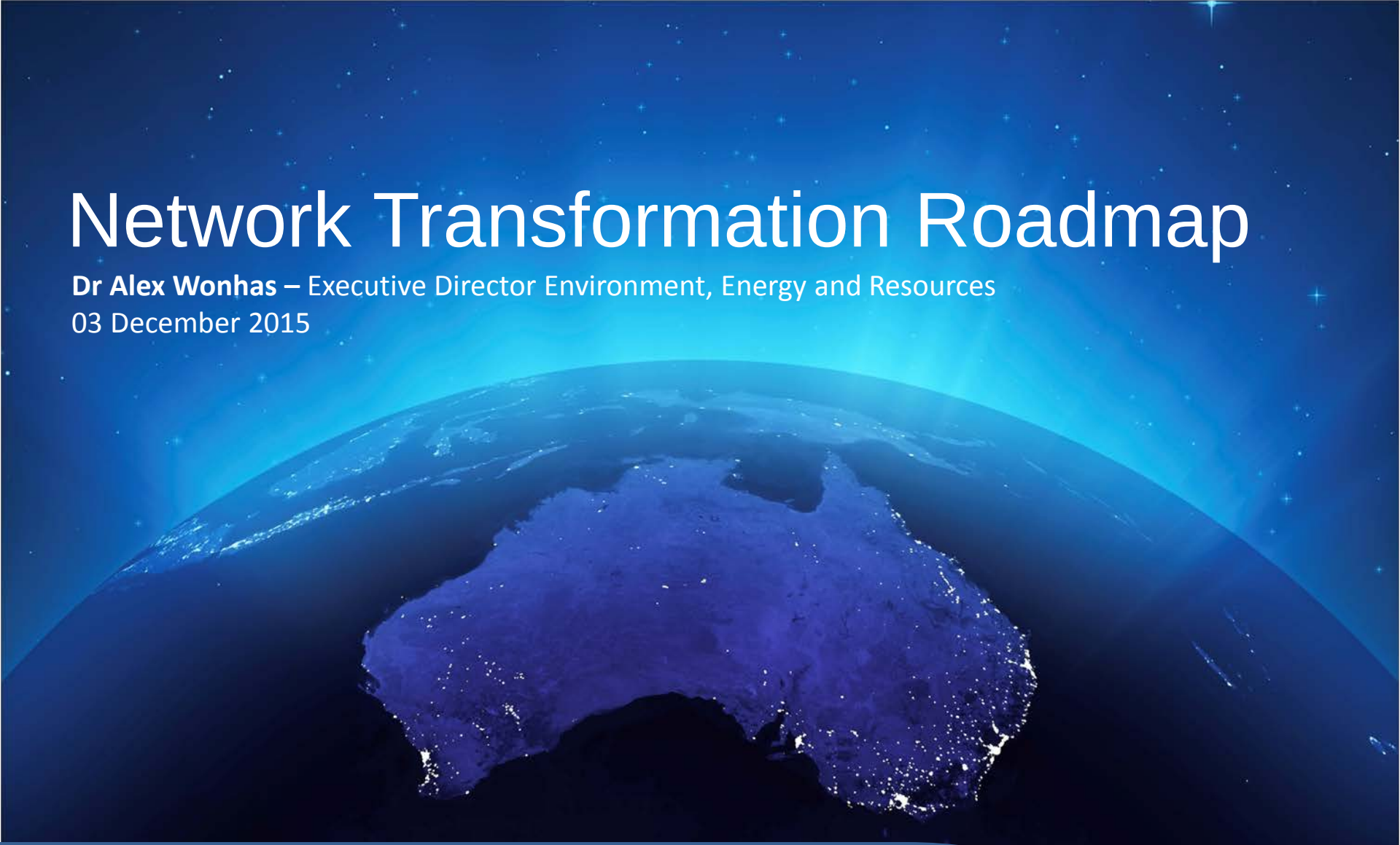
Australia's Great Energy Disruption



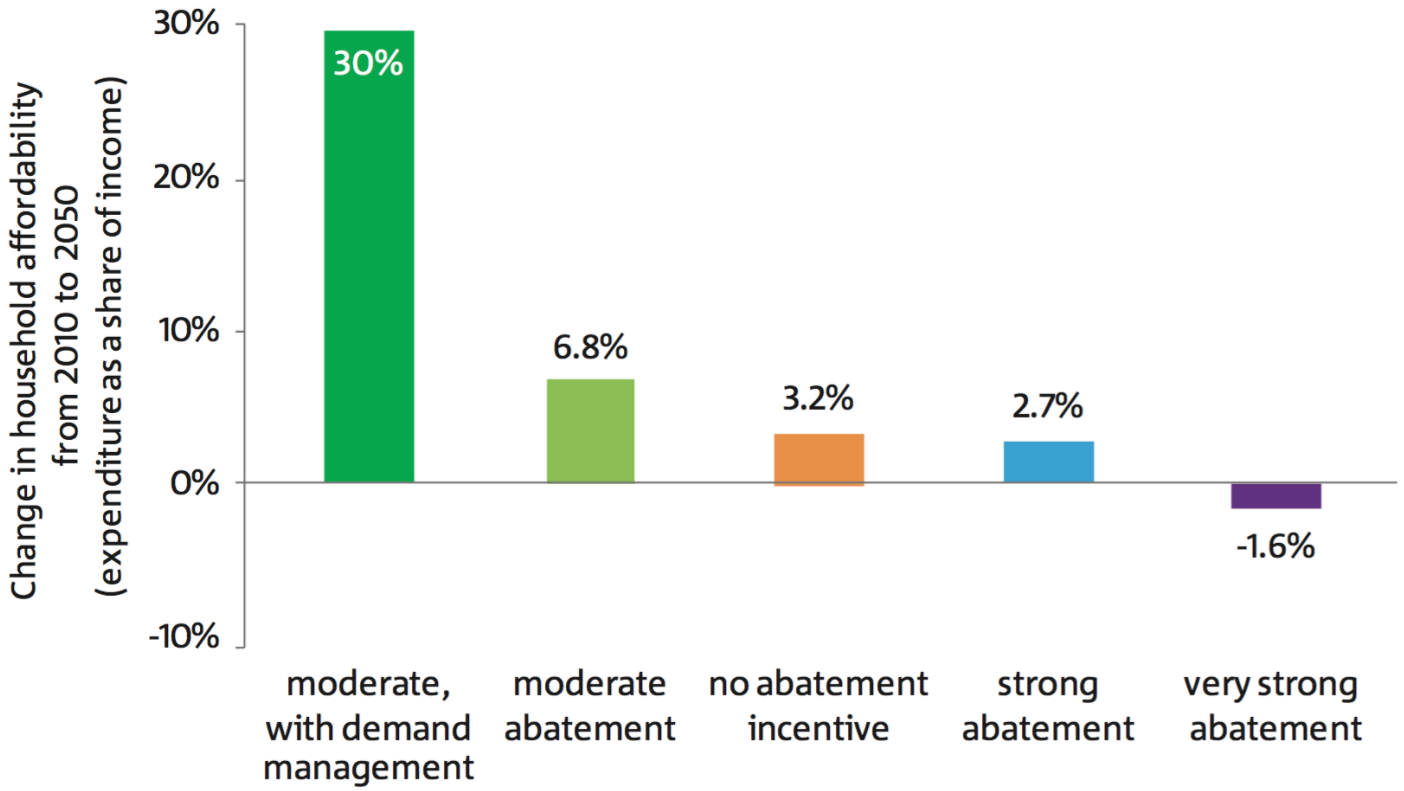
Network Transformation Roadmap

Dr Alex Wonhas – Executive Director Environment, Energy and Resources

03 December 2015



Managing Australia's electricity system well could improve affordability by up to 30%



SOURCE: CSIRO Australian National Outlook 2015

Insights from the Future Grid Forum of 2012/13

1. Network-centric → Customer-centric
2. Centralised → Hybrid/Decentralised
3. Fossil fuel generation → Continuous decarbonisation and greater intermittency
4. Regulated natural monopoly → Increasing exposure to competition
5. 20 – 50% of electricity generated locally by 2050
6. Under every scenario the electricity grid continues to play a critical (but evolved) role in 2050
7. 2015-25 decade characterised by profound transition

Converging costs of centralised generation technologies

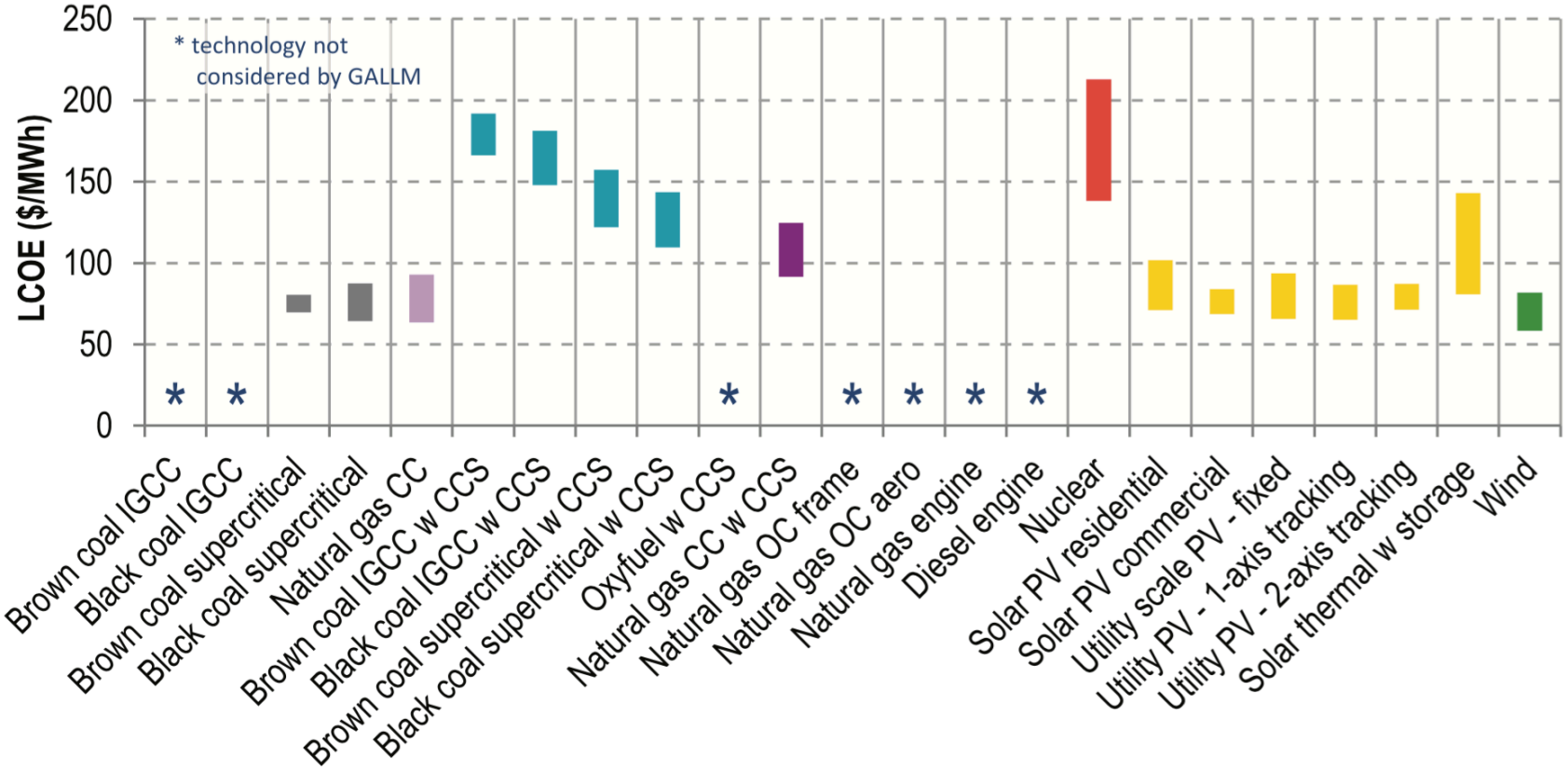
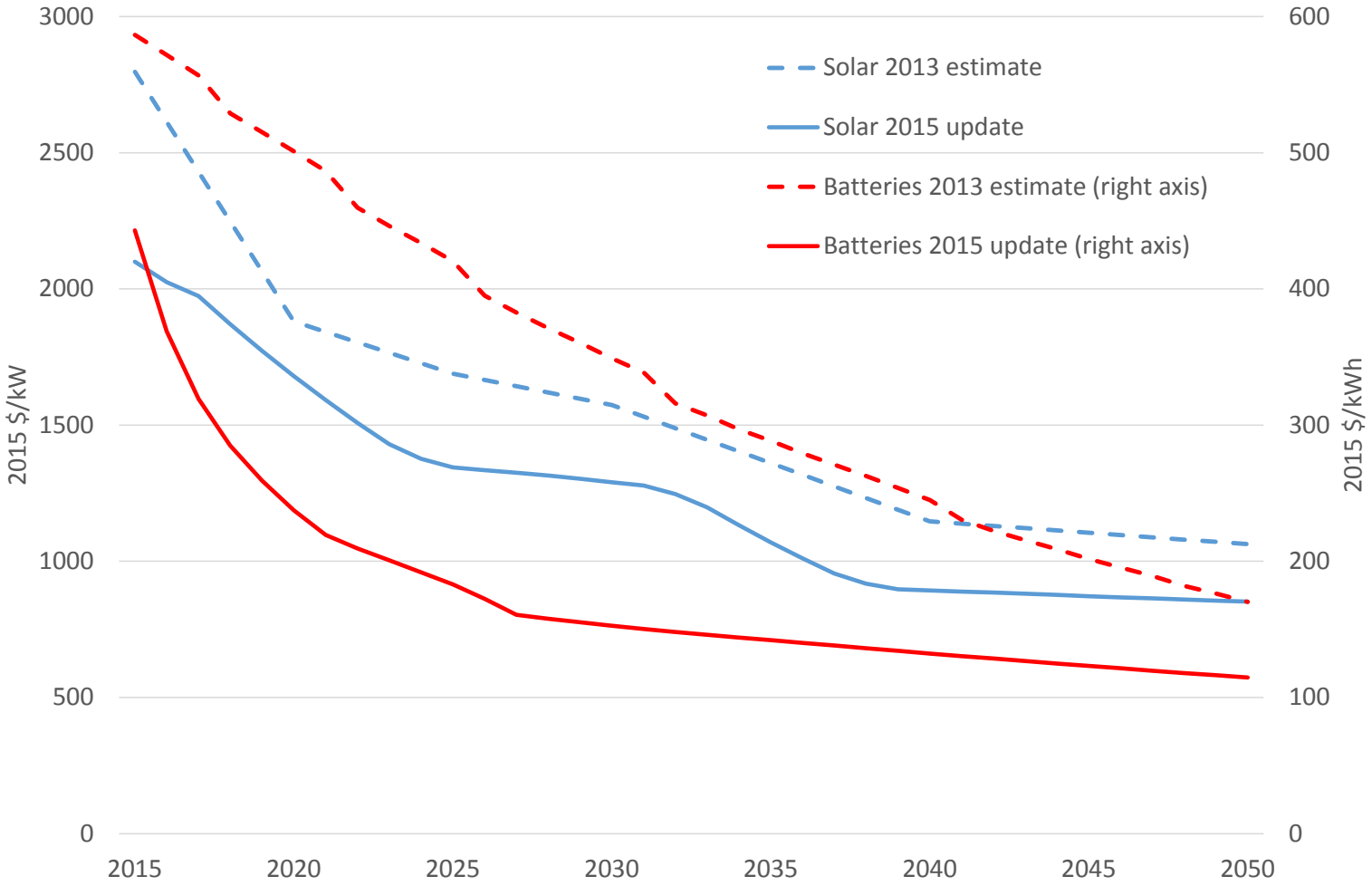


Figure E3: 2030 Levelised cost of electricity ($/MWh)

SOURCE: Australian Power Generation Technology Cost Study 2015

Expected costs of solar panels and storage continues to drop

The key transformation drivers – competitive on-site generation and storage – have each strengthened their competitive position since 2013 by about 20%



Off-grid parity still expected around 2030

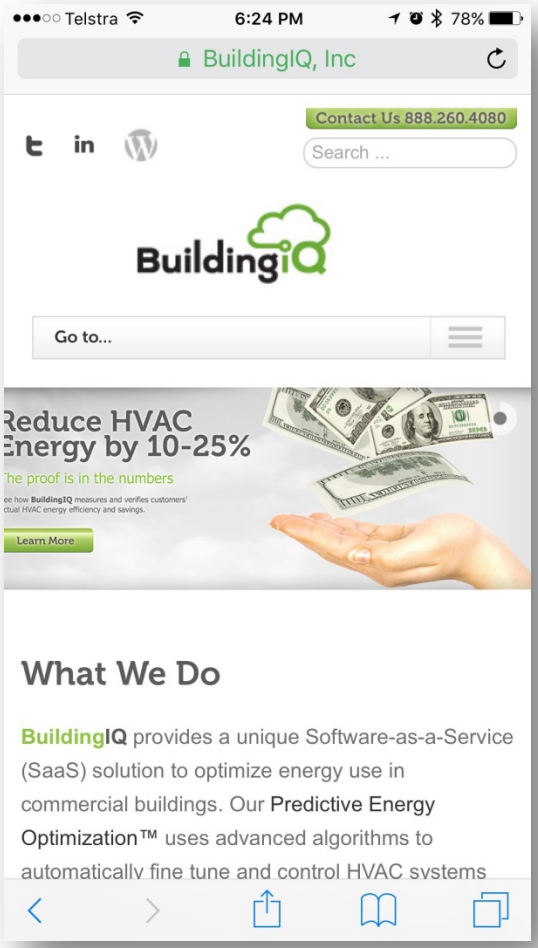
Updated our economic modelling of a household off-grid system for an existing connected customer. While system costs had improved so has the outlook for grid electricity prices such that the economic point of disconnection remains exactly where it was: late 2030s

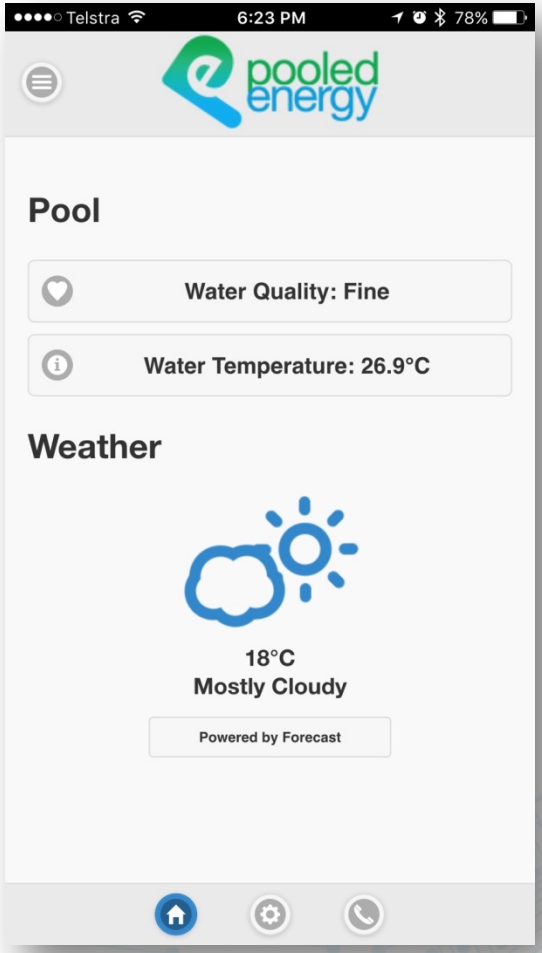
Solar panel and battery storage costs are lower

The price of retail electricity from the grid is lower

Batteries and solar are by far not the only disruptive technologies

Two examples: BuildingIQ and Pooled Energy

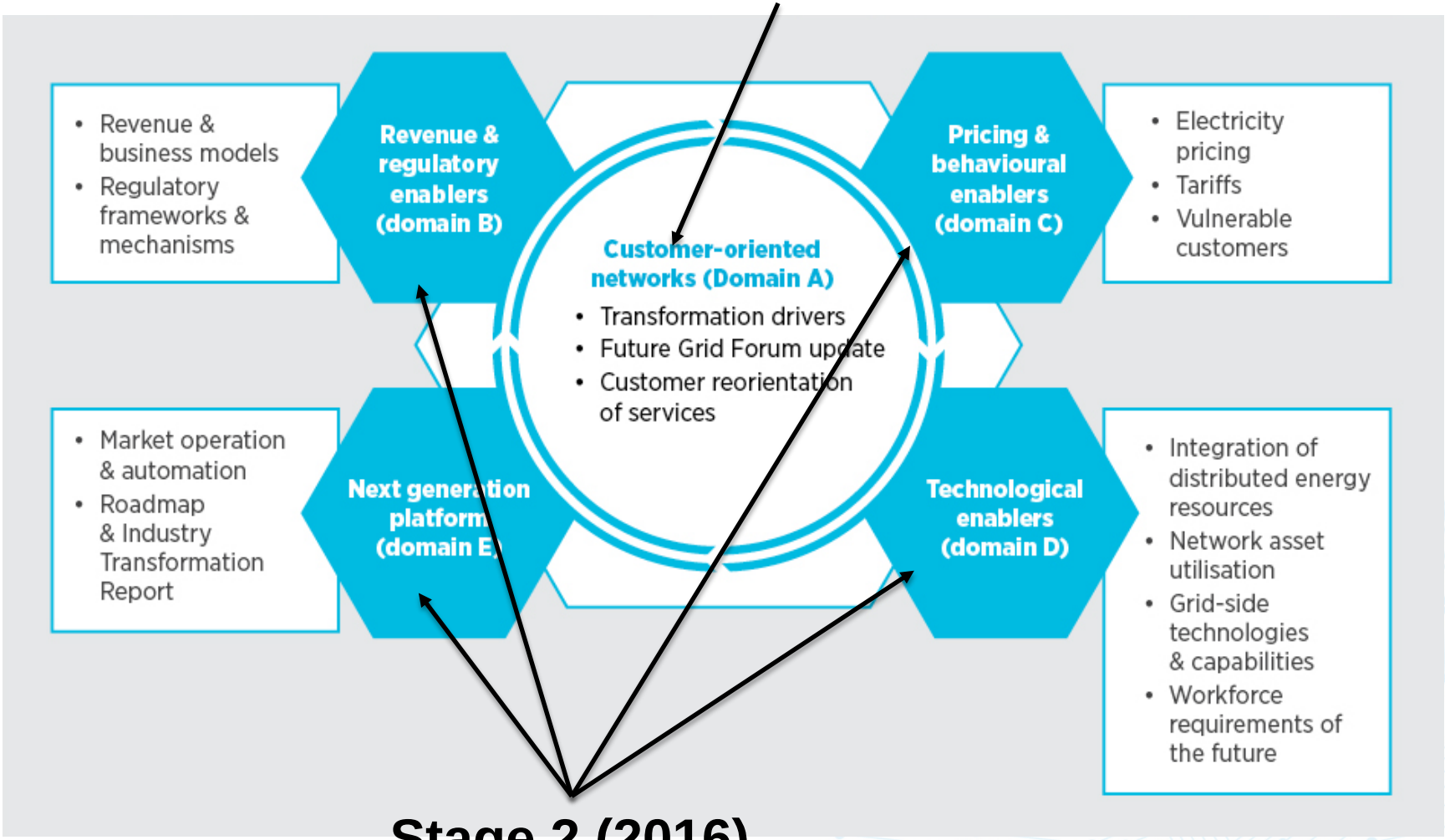




Network Transformation Roadmap 2015/16

A CSIRO – Energy Networks Association Collaboration

Stage 1 (2015)



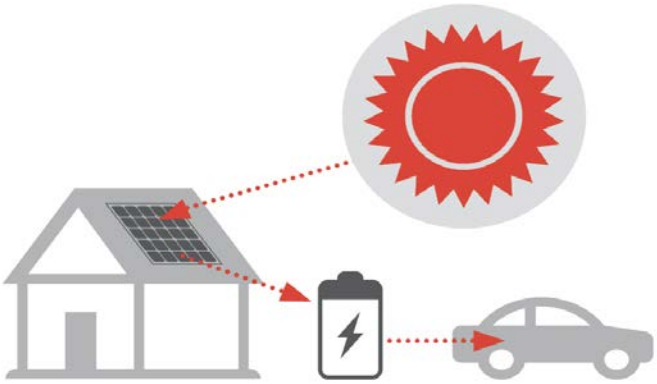
Stage 2 (2016)

Four possible scenarios of the future

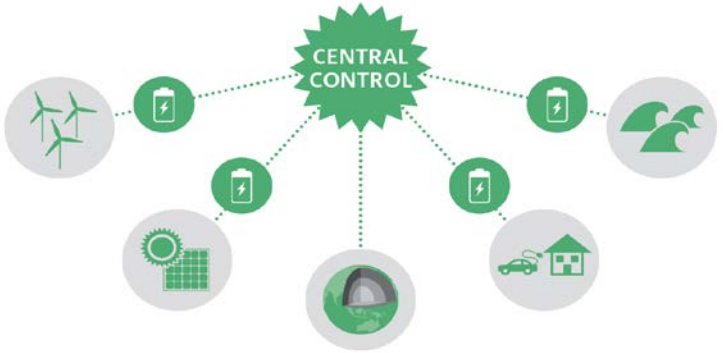
Set and forget

Customer-centric model
where customers consume, trade, generate and store electricity.

Rise of the ‘Prosumer’

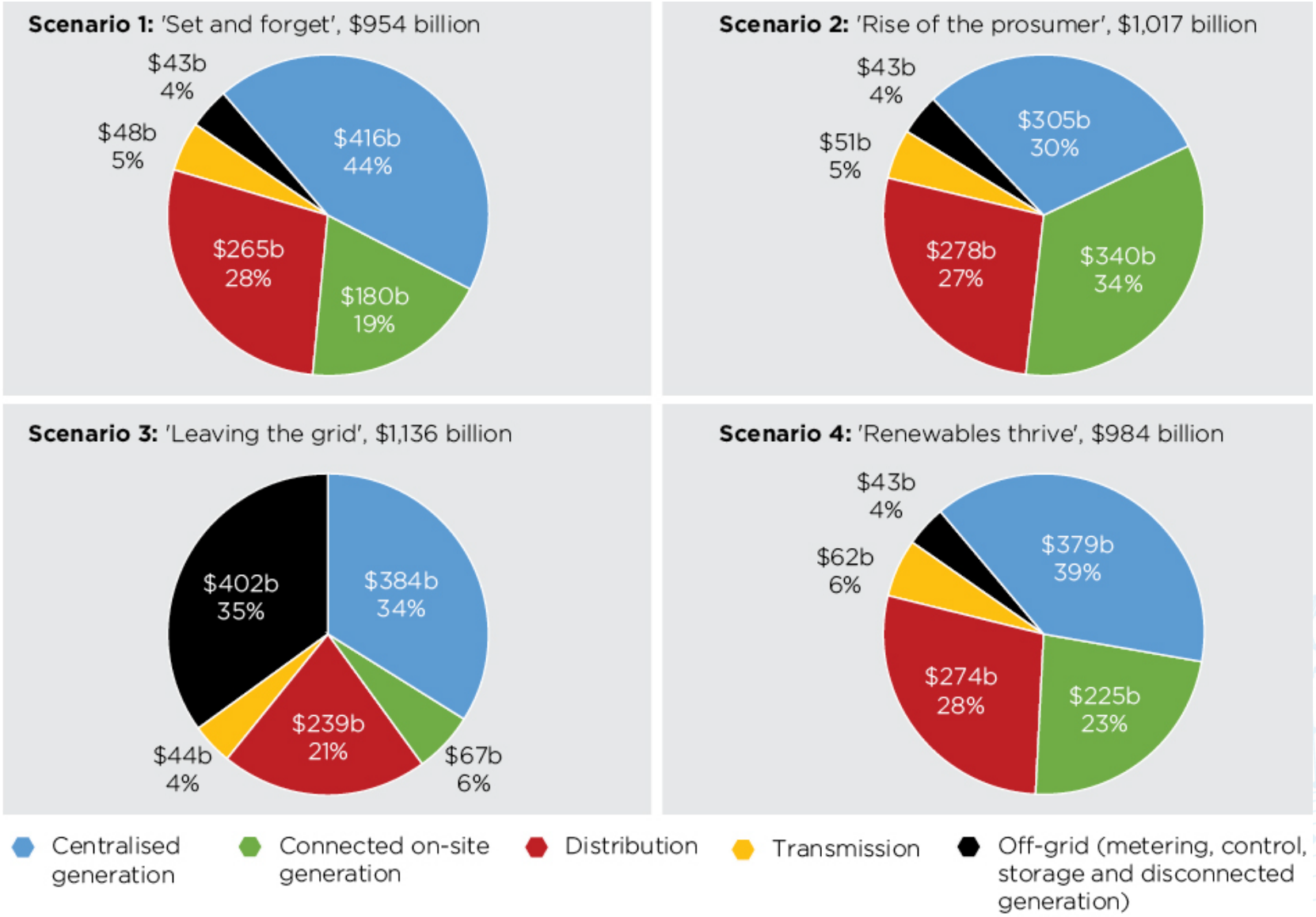


Leaving the grid



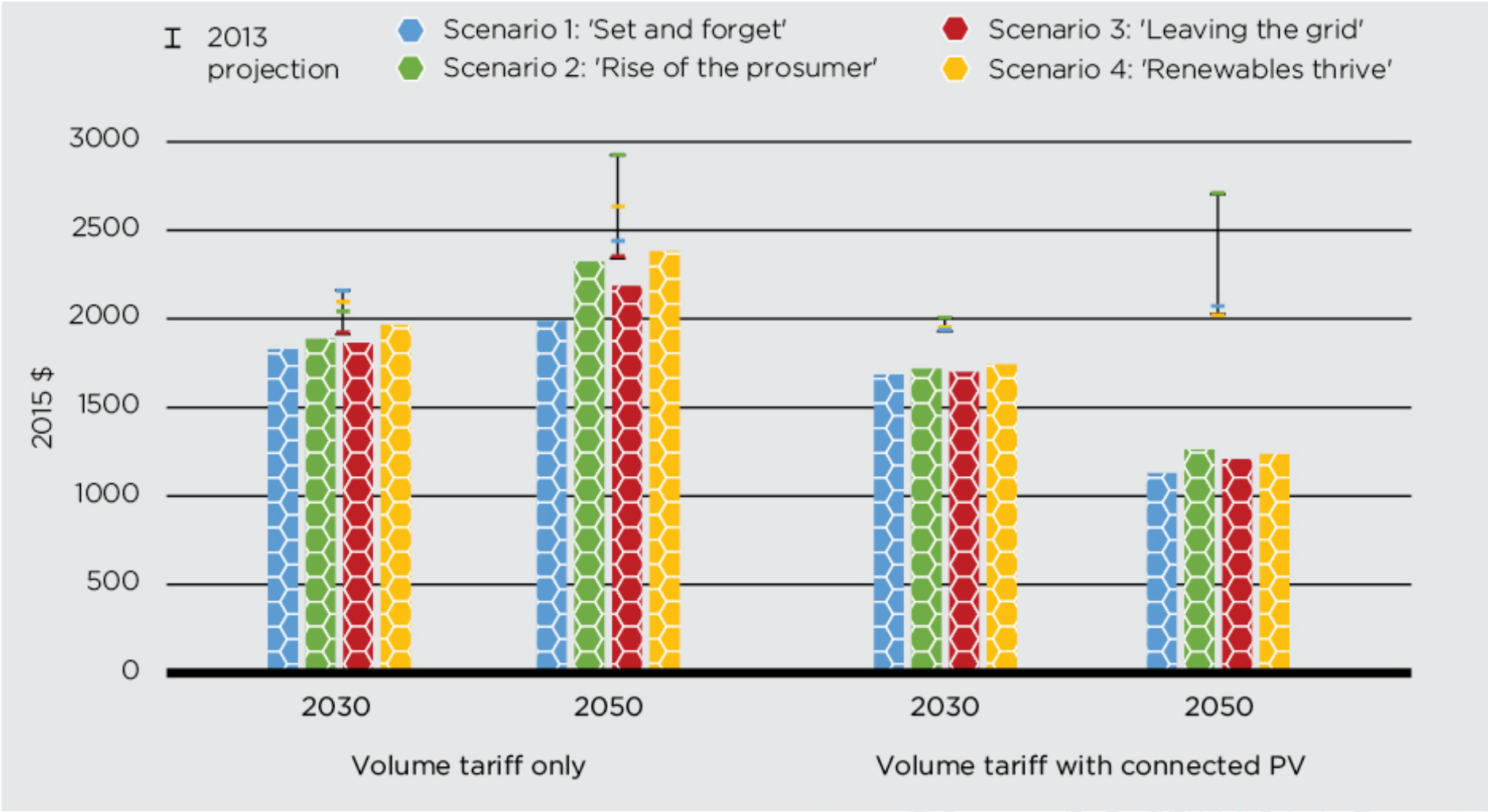
Renewables thrive

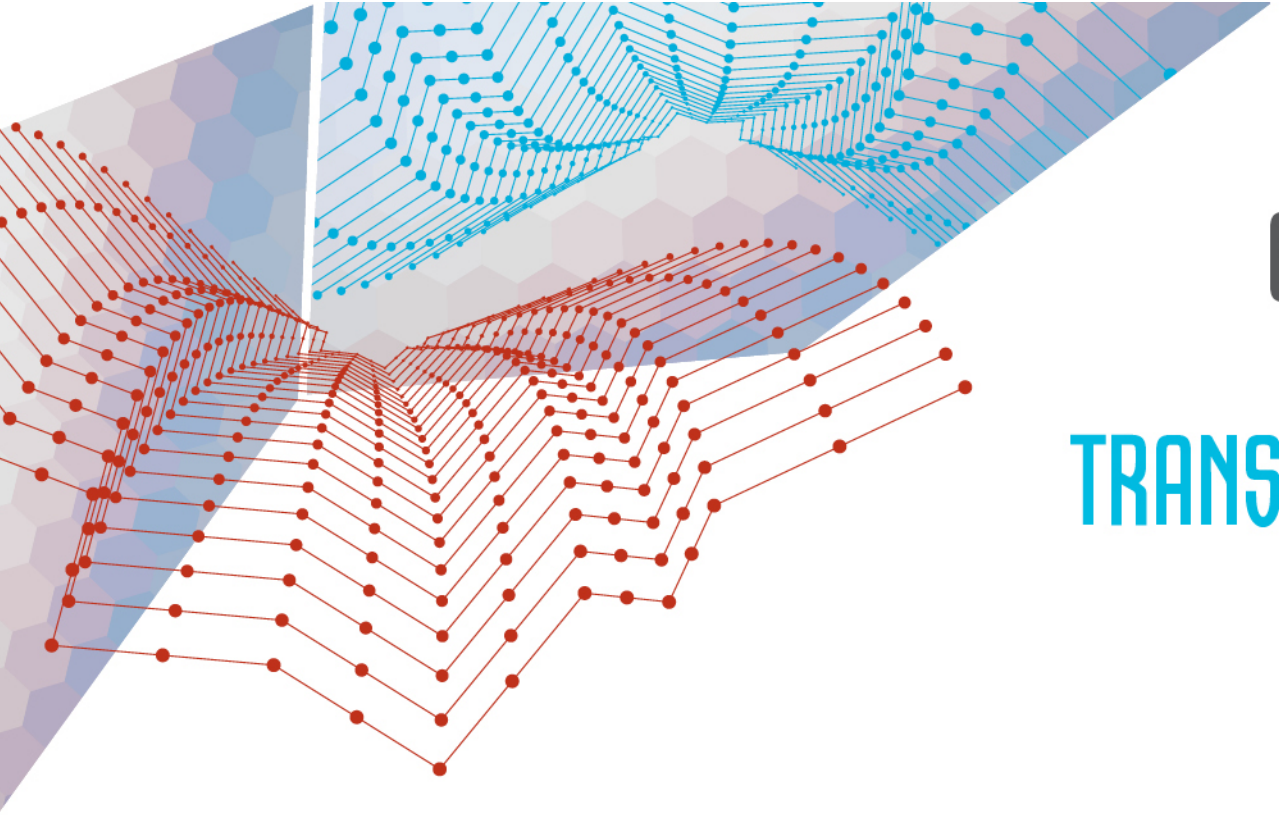
Overall system expenditure ~$1 trillion across all scenarios, but significantly different outcomes



Residential electricity bills are lower than expected in 2013

However the potential for inequality between solar owners and non-owners is greater





ELECTRICITY NETWORK TRANSFORMATION ROADMAP

2015-25

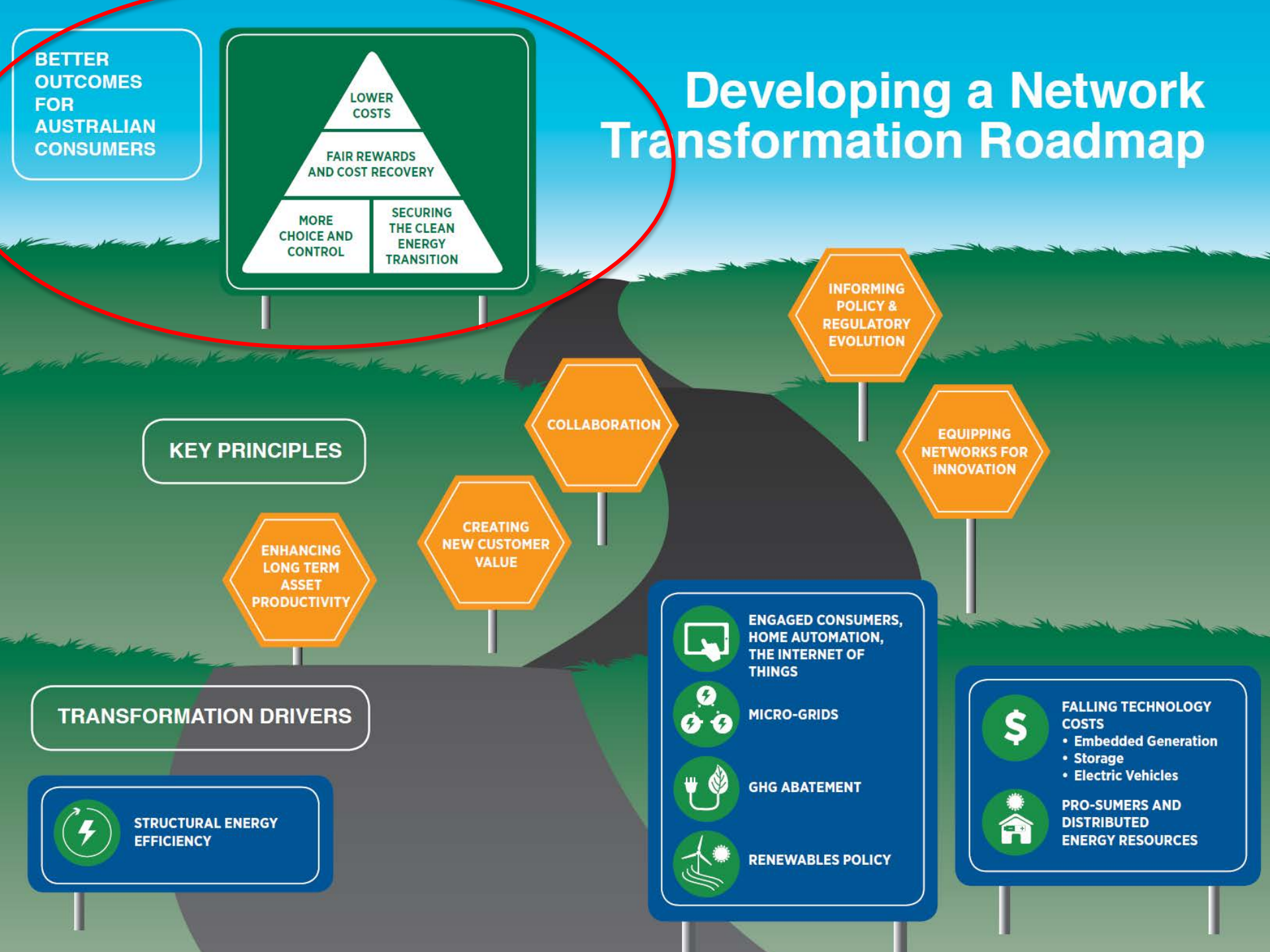
NTR Interim Program Report

John Bradley

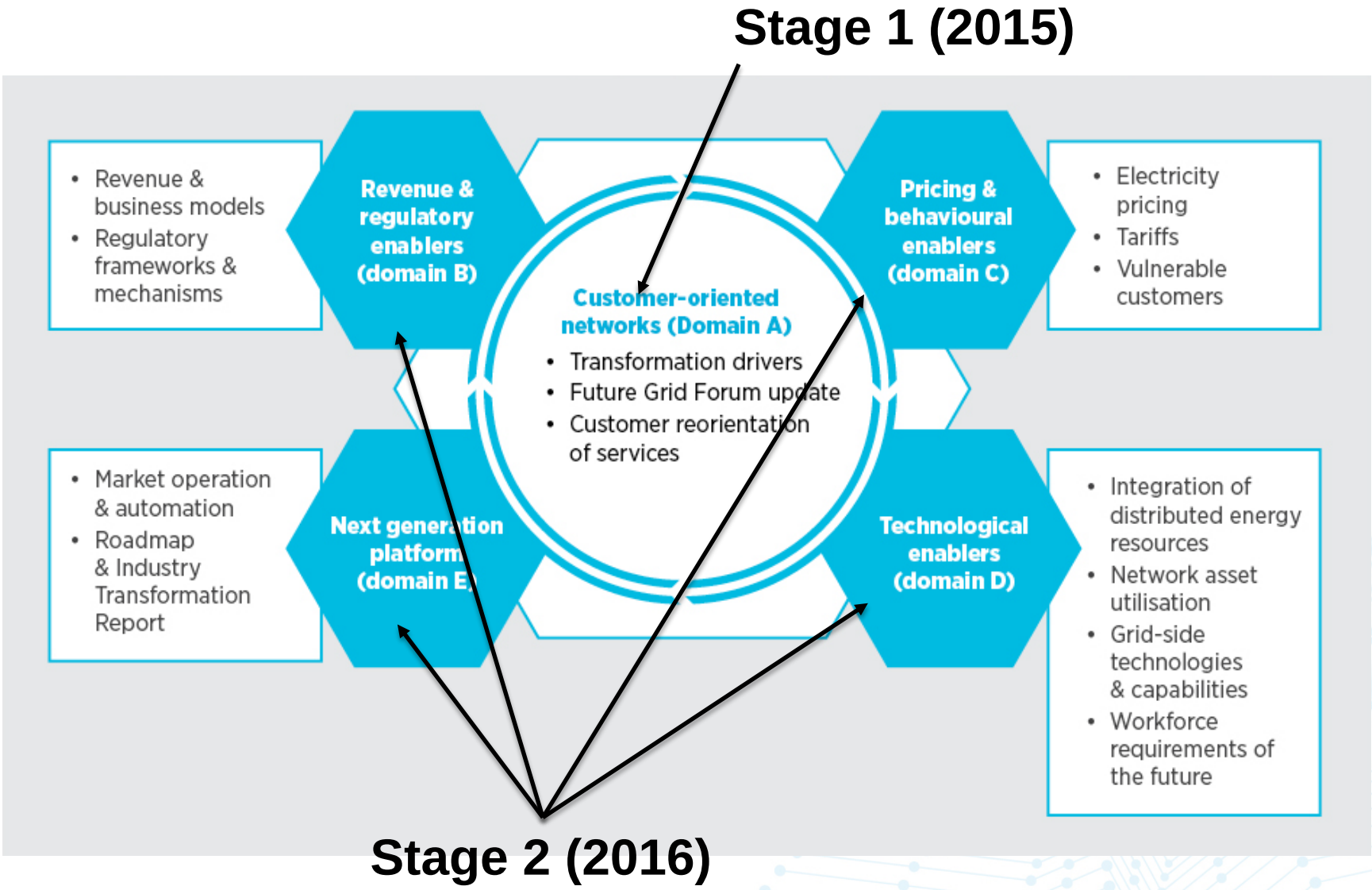
ena energy networks association

CSIRO

Developing a Network Transformation Roadmap

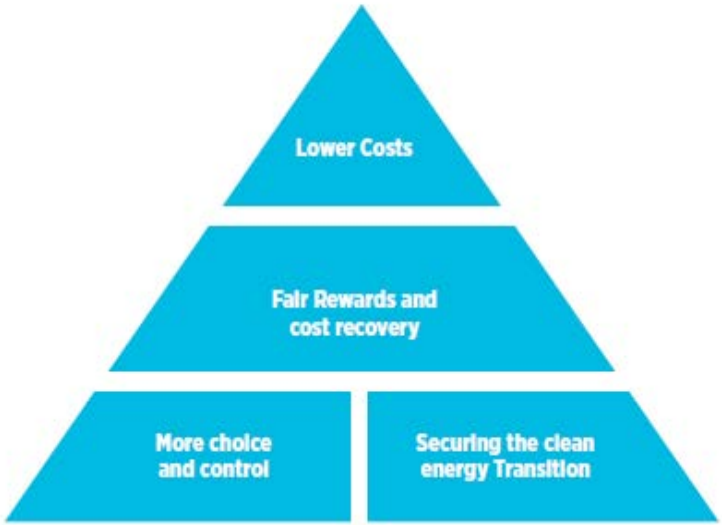


Areas of Focus – Network Transformation Roadmap



Balanced Scorecard of Consumer Outcomes

- There are many ways that Australia's energy future may unfold. Some futures will produce demonstrably better customer and societal outcomes compared to others.
- Many aspects of long-term transition cannot be planned and will depend on the varied forces of innovation, disruption and vibrant competition.
- The Roadmap seeks to foster an operating environment where Australia's energy system gives greatest priority to serving diverse and evolving customer needs.
- CSIRO's quantitative modelling will compare the 'balanced scorecard' outcomes for distinct customer segments resulting from alternative transition options.



Customer-orientation of Networks

- Future electricity customers may:
  - be increasingly heterogeneous in their expectations
  - be diverse across a broad ***vulnerable—engaged—empowered*** spectrum of market segments.
  - continue to value solutions that provide **secure and reliable** electricity for an increasingly digitized and automated lifestyle and the expanding role of electric vehicles; and
  - In some cases be **willing to trade-off** aspects of services that were traditionally standardised in return for a financial benefit.

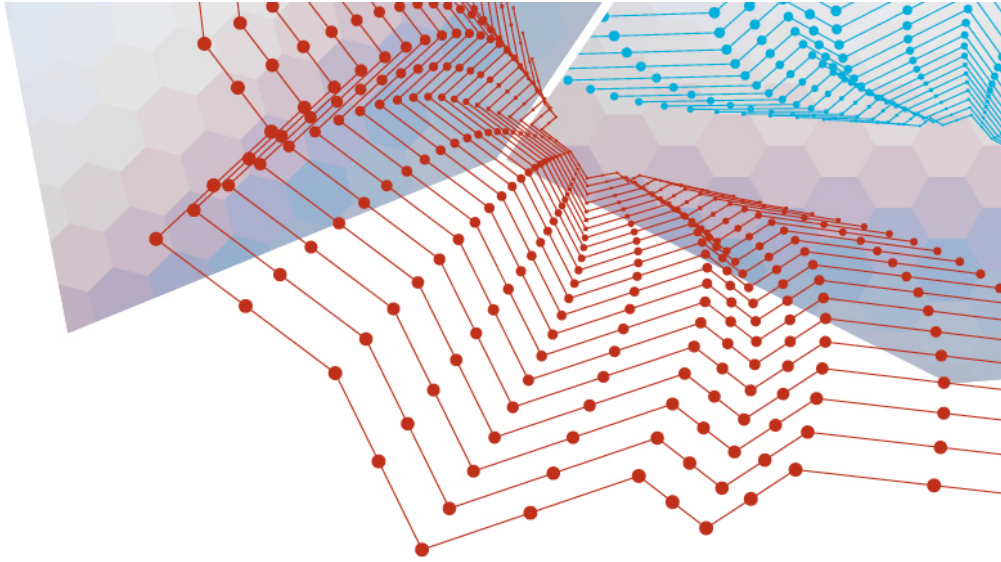
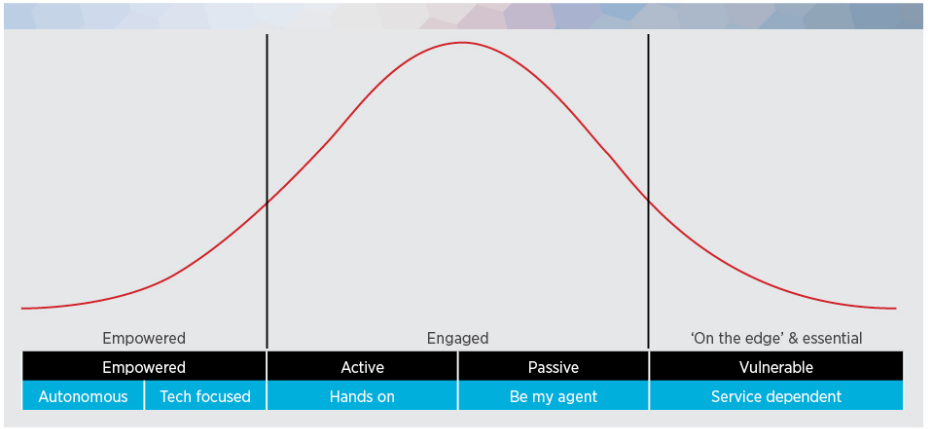


Figure 2: Example market segmentation curve for residential customers in 2025



Prospective 2025 Market Segments - Residential

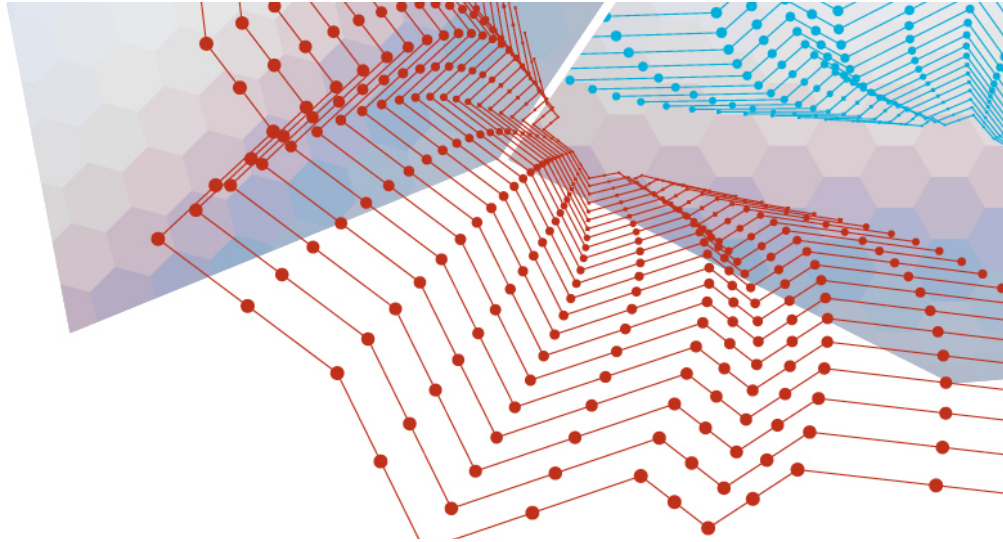


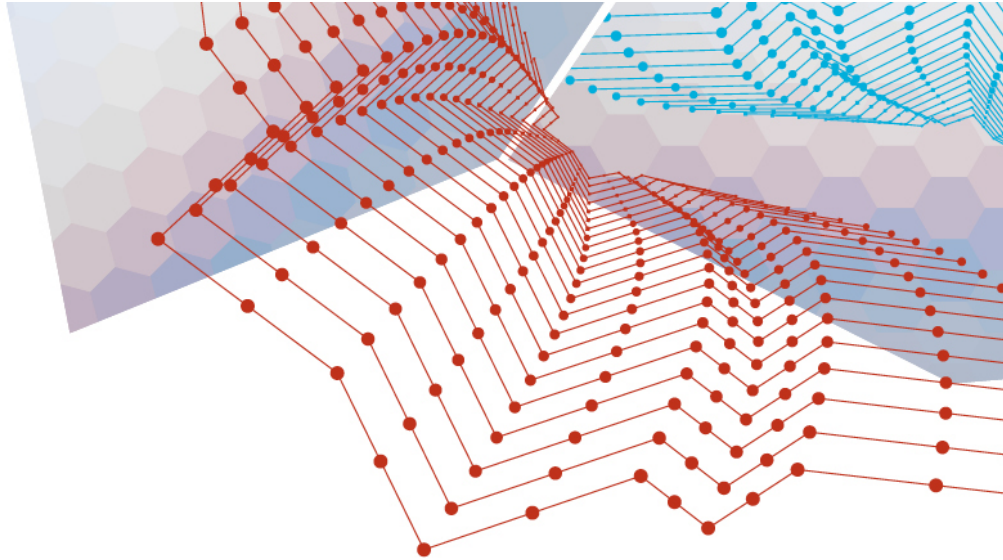
Table 1: Summary of future residential customer segments based on what they value most

	Autonomous	Tech focused	Hands on	Be my agent	Service dependent
Distinctive features	**Independent**: Wants full control, granular cost management and the ability to configure the operation of the electricity solution. Will often involve disconnecting from the grid entirely, and may be motivated by locational cost or reliability issues.	**Empowered**: Has a strong affinity with technology and desires control. Wants to influence directly the design and operation of the customised solution. System cost is important but maximising returns on investment from trading energy services with the grid is critical.	**Active**: Wants to understand what each available option has to offer and to be involved fully in the selection process. Willing to maintain a moderate to high involvement in the ongoing operation. System cost and return on investment from interacting with the grid to trade energy services are both important.	**Passive**: Prefers electricity solutions that provide ease and convenience at a reasonable cost. Desires an agent to provide a shortlist of options that make sense, are easy to deliver and require a minimum of ongoing involvement. May invest in additional cost saving measures if simple and convenient.	**Dependent**: Needs affordable network services and help to identify the most suitable options. Includes vulnerable customers experiencing energy hardship. Also includes households that cannot adopt new electricity solutions, given rental property constraints or a lack of access to capital.

Prospective 2025 Market Segments - Commercial & Industrial

	Empowered/ Autonomous	Active	Passive	Vulnerable
Focus on energy	**High**	**Medium/High**	**Low**	**High/Medium**
Ability to act	**High**	**Medium**	**Medium**	**Low**
Descriptor	**I want to act and I can**		**I don't need to act**	**I need to act but can't**
	Highly empowered set of business customers who will be very interested in how technology can reduce their costs, improve their green image or improve operational efficiency. Heavily focused on innovation and environment. They will seek highly configured and customised solutions and will spend more effort in research/engaging with complicated price structures or solutions. Value is important, because they need to know they are achieving their objectives.	Highly engaged and motivated to maximise savings and efficiency by engaging more with the energy system. This group is likely to be large. Willing to invest in technologies and accept a higher level of complexity, so long as they can offset the additional time and (potentially) investment with a positive return on their investment, reflected either in ongoing cost savings and/or a positive environmental impact. May be motivated to reduce carbon footprint, but only if the cost of carbon is passed onto	Extremely busy customers and have little time to understand their energy costs or needs. Any extra complexity is a challenge for these end-users, who are busy maintaining or growing their business. Require a simple set of solutions that take the worry and effort (time to manage, risk of interruption, potential cost savings or loss) out of energy – will remain largely passive to the energy system. Business is not concerned with energy costs and will accept any reasonable offer of	Service dependent customers who are highly dependent on grid supply to keep their business running. Need help because they are unable to engage with new technologies or offers and will have a high level of cost sensitivity. Want to concentrate on running their business and keeping solvent, and increased energy costs or complexity are a barrier. Like residential customers, they want a basic and efficient service to maintain essential business operations.

Customer-orientation of Networks



- Future market segments are not perfect ‘predictions’ of customers in 2025 but do enable **future strategic options** to be explored in detail

- An increasingly competitive operating environment means that a strong customer orientation will be vital for network businesses and their ‘value-network’ partners to:

  – **Comprehend and anticipate** changing customer expectations;

  – Optimise existing services to foster **social license**, **trust** and **loyalty**; and,

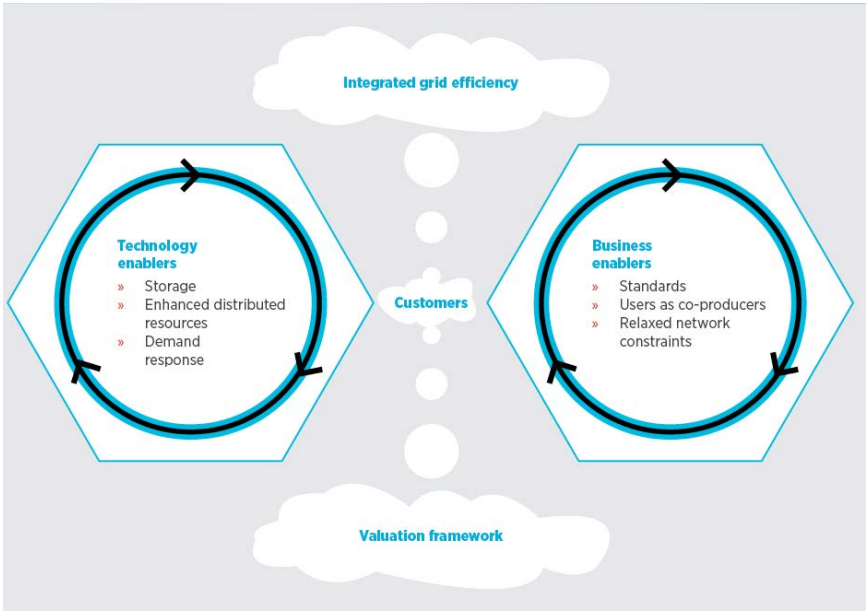
  – **Innovate new electricity solutions** and **business models**, often in concert with value network partners.

Challenges and Opportunities of Distributed Energy Resources

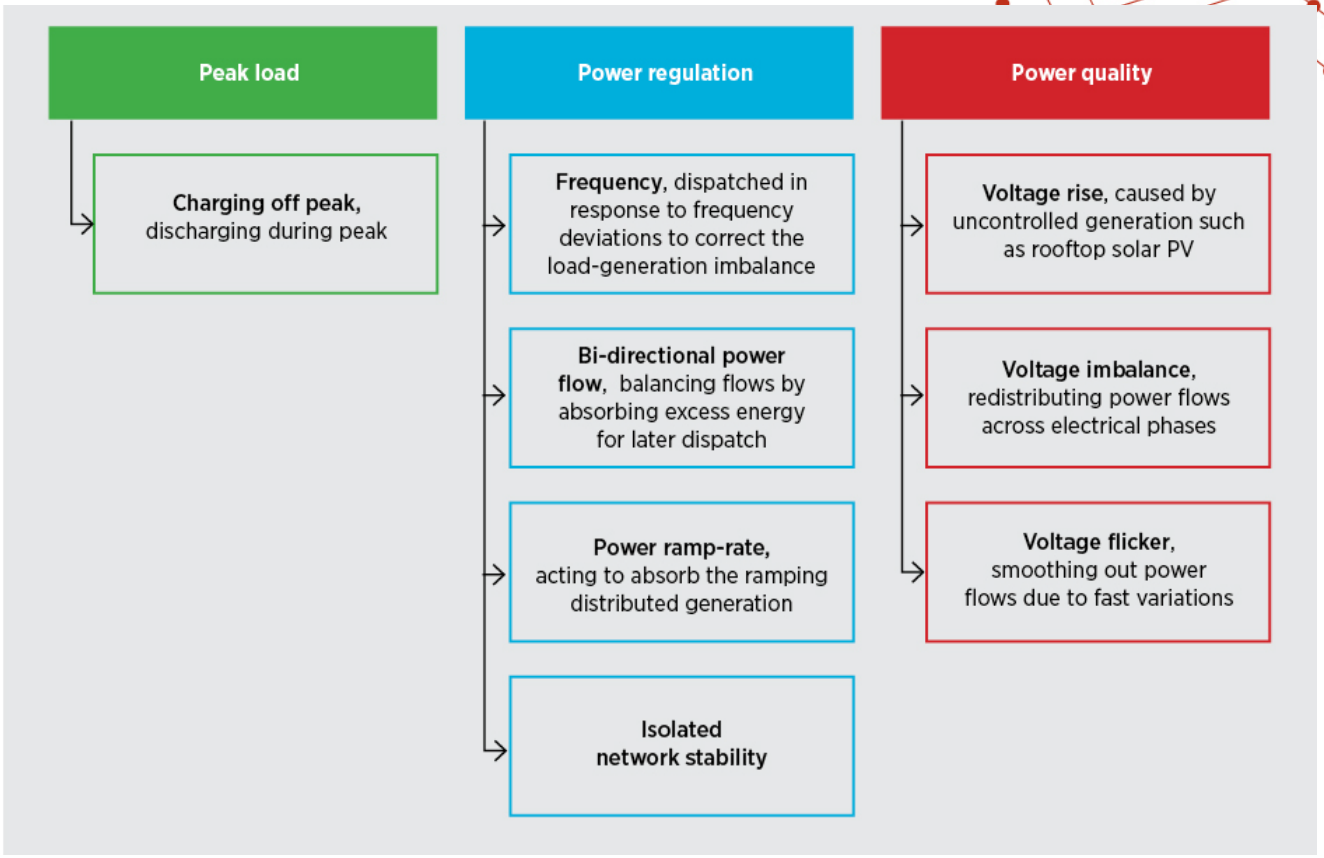
Integration of Distributed Energy Resources requires a careful operational response to challenges such as voltage management, frequency regulation and network stability.

However, well-integrated DERs can also provide solutions for addressing these network challenges and improving network efficiency. This is likely to require:

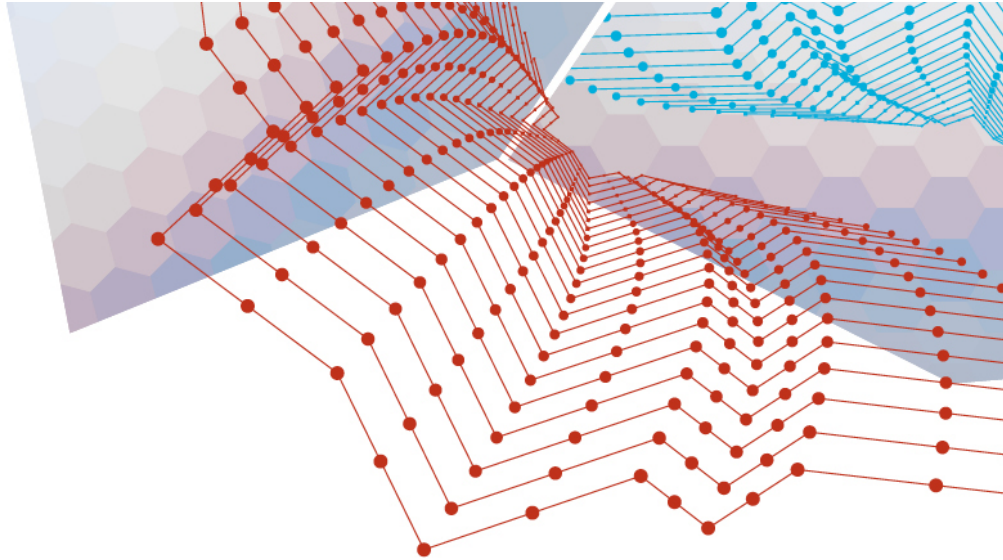
- New regulatory frameworks;
- Enhanced standards; and
- Commercial responses which unlock the potential of energy storage, demand response services and power electronics solutions.



A key role for Energy Storage in DER integration



Other Integration Tools



Intelligent Distributed Resources:

- Smart Energy Resources such as power electronics
- Voltage Control

Adaptive Systems – Demand Response and Prediction:

- Demand Response
- Net Load Prediction

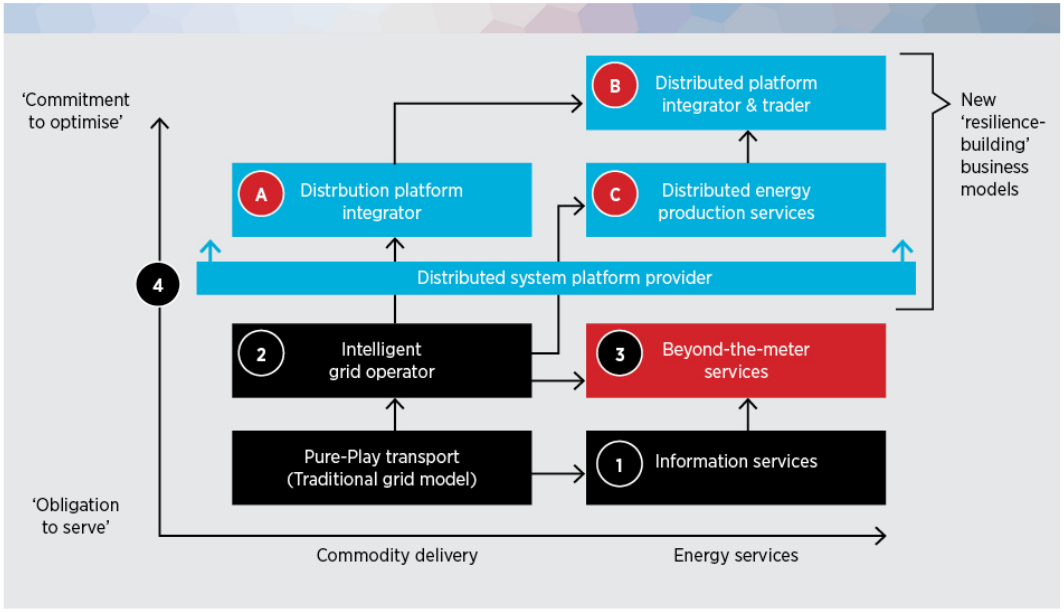
Advances in Standards:

A number of new technical standards have been identified that are critical to the efficient and safe deployment of technology enablers of the integrated grid. These include:

- Storage Safety Standards
- Electric Vehicle Standards
- Inverter Standards
- Protection Relay standards
- Smart Meter Standards

Advanced business models

Figure 5: Accenture's progressive electricity distribution network business model approaches



Source: Accenture 2015, *Network business model evolution: an investigation of the impact of current trends on DNSP business model evolution*, Accenture, Melbourne, p. 12.

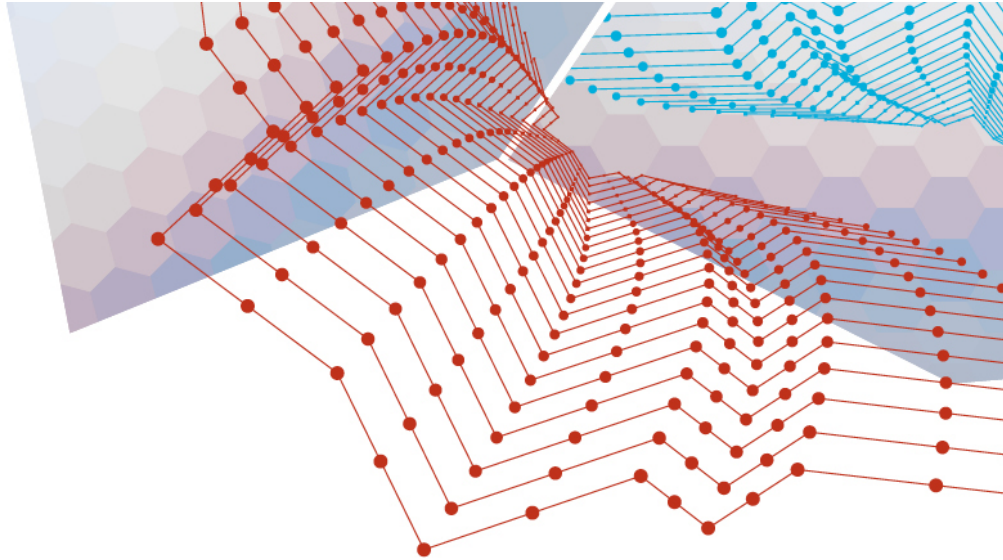
Accenture: Advanced business model responses by energy networks may see a focus on "**Platform-Enabled" services**, supported by **key operating principles**:

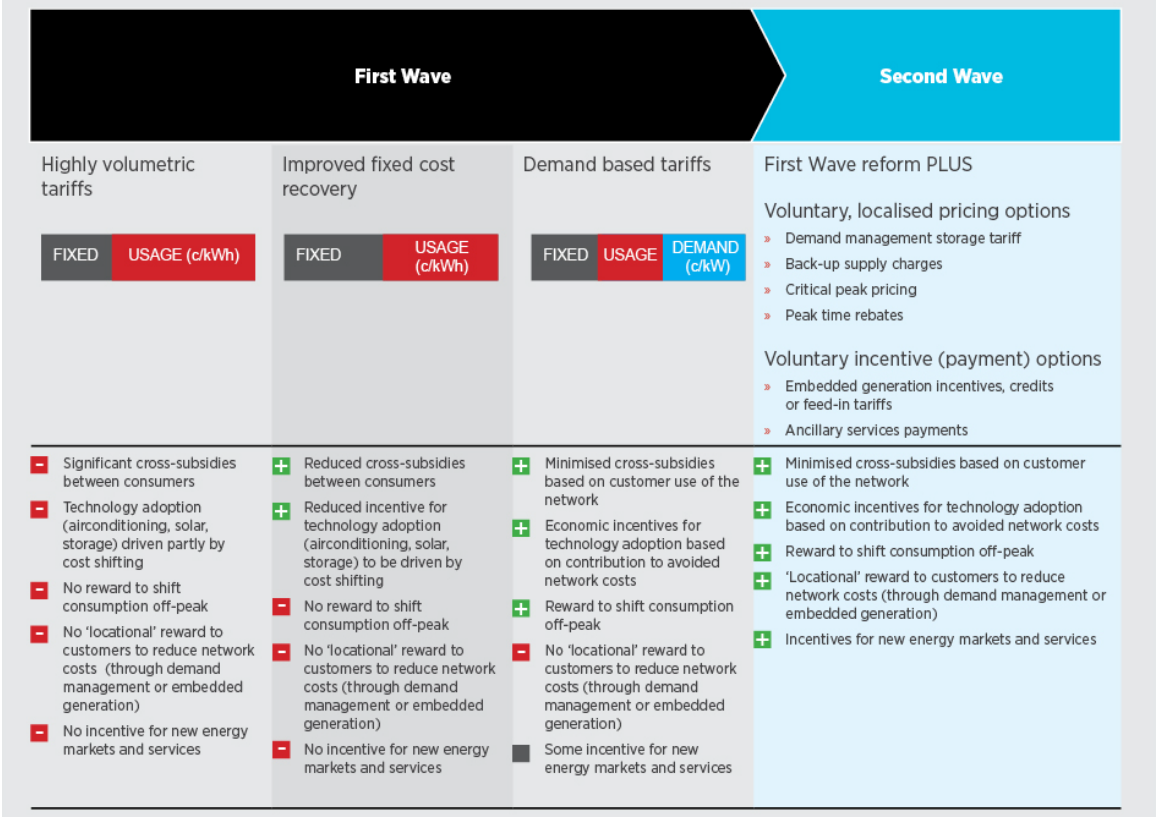
- Being able to integrate all types of generation;
- Enabling consumers to provide services back to the grid;
- Offering enhanced or optional services;
- Being agnostic about supply; and
- Facilitating retail markets.

Effective Tariffs and Incentives

‘First Wave’ reform from 2017 – NSPs meet their **universal responsibility** to all customer segments improve fairness and efficiency, **with the right support and tools**.

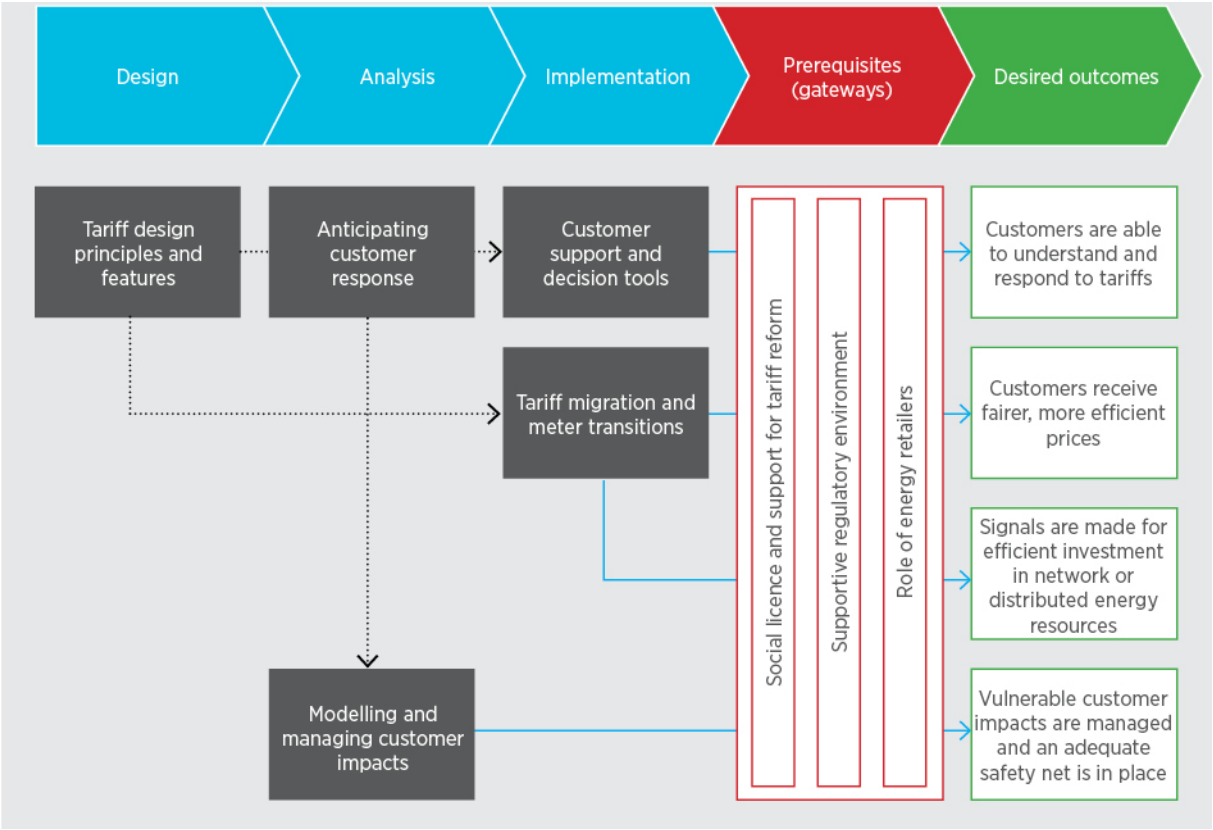
‘Second Wave’ may see customers participate in new pricing options or markets, which are likely to be **voluntary location-specific and dynamic in real time**.



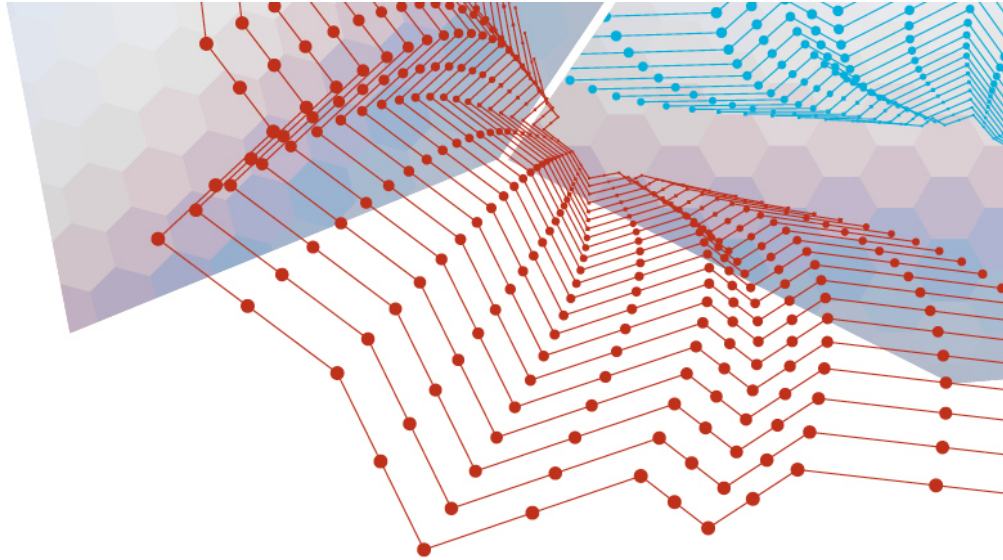


Achieving Successful Electricity Tariff Reform

ENA's forthcoming network tariff reform guide to support a national, collaborative and integrated approach to reform, with a range of stakeholder engagement.



Effective Tariffs and Incentives



Stage 2 of the Roadmap will:

- Leverage ENA's forthcoming network tariff guide;
- Further evaluate **second wave pricing and incentive reform** measures; and
- Look for further opportunities to use **behavioural economics techniques** to enhance network tariff reform measures.

Priority Directions in Energy Policy & Regulation

Key elements of Australia's energy regulatory framework are robust, however a managed – rather than ad hoc - approach to regulatory reform is required to support:

- flexibility and innovation;
- the introduction of contestability;
- new approaches to risk allocation; and
- the transition to more fit-for-purpose regulation.

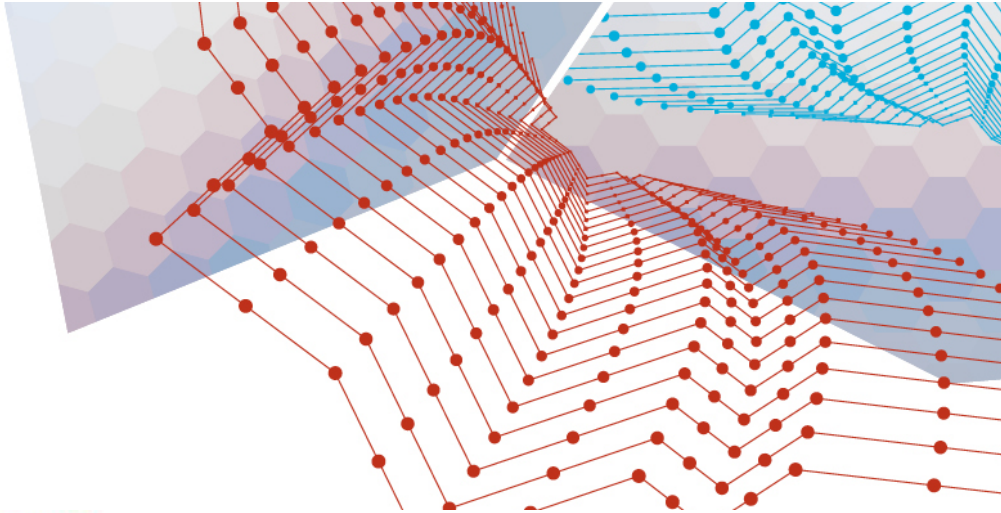
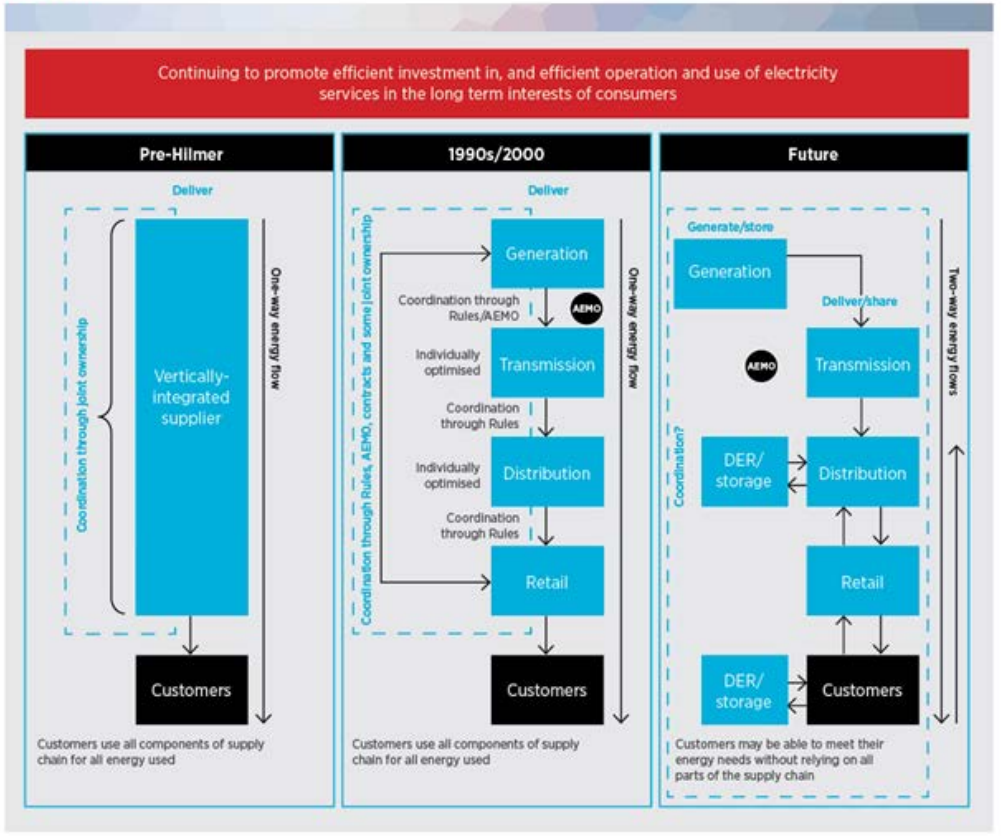
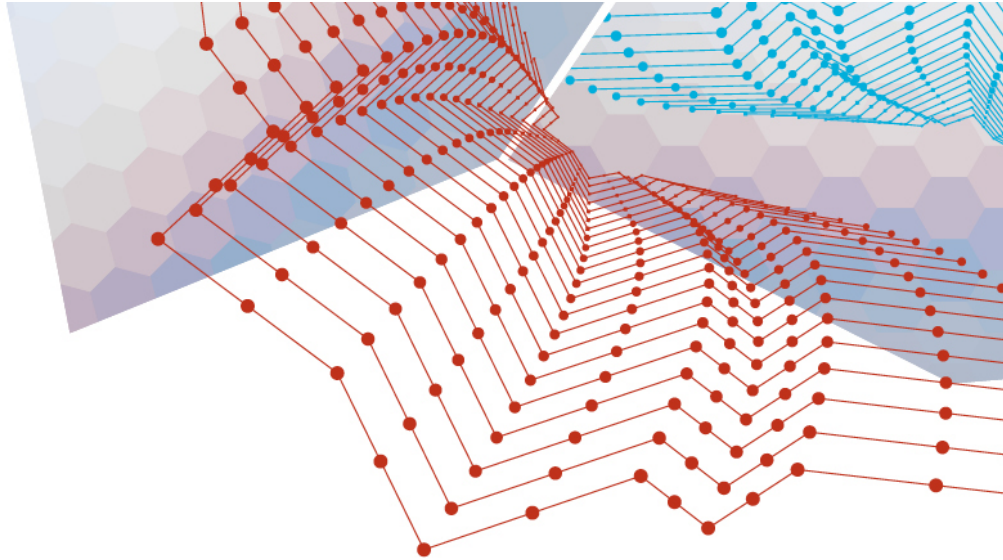


Figure 4.1: Electricity system transformation



NOTE: DER = distributed energy resources

Australia's energy regulatory framework

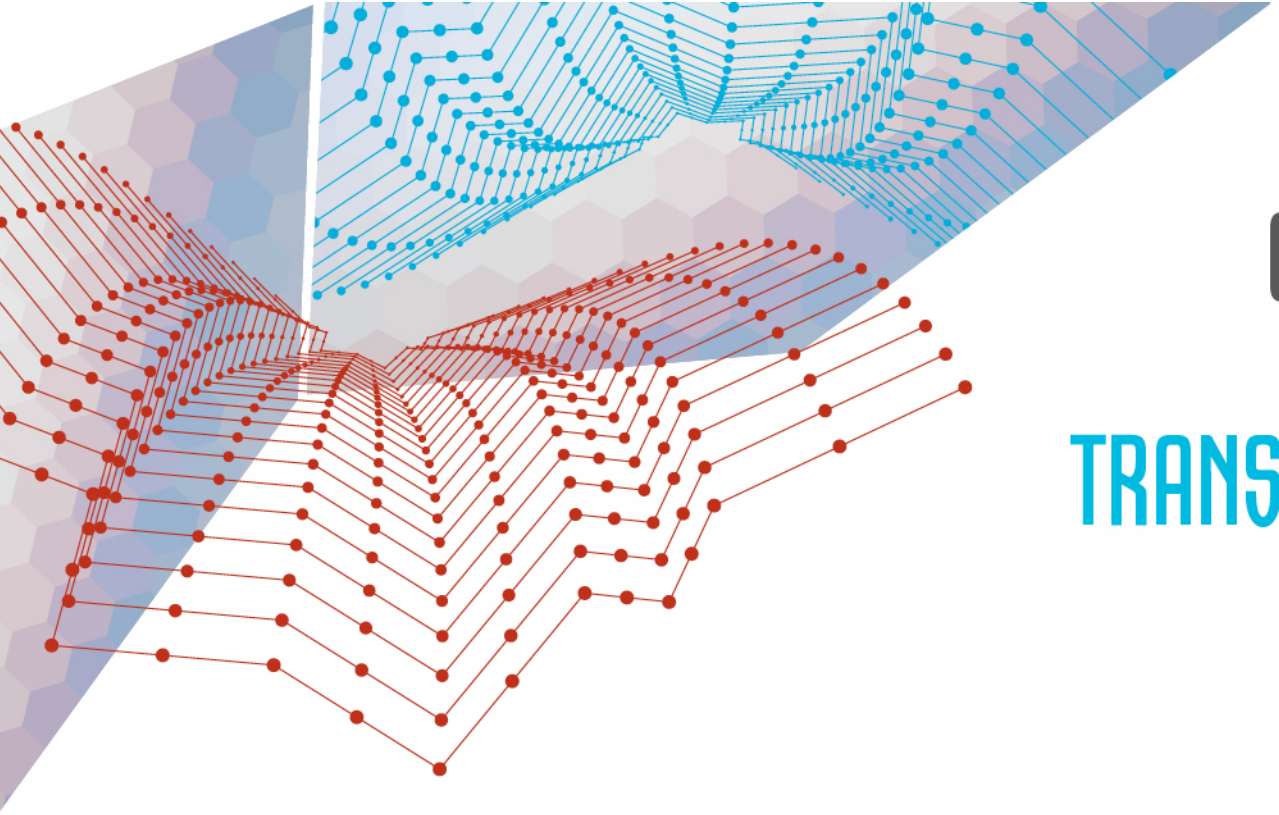


Proposed design principles for regulatory framework:

a. Focused on the long term interests of customers
b. Flexible and enabling for emerging technology, technology diffusion, new competition
c. Able to align network incentives with long term customer value
d. Proportional and bounded
e. Non-discriminatory
f. Consistent, coherent and knowable for all participants
g. Independent and accountable.

Stage 2 of the Network Transformation Roadmap is expected to include:

- ***Options for structuring and delivering universal service obligations*** in a disrupted or transformed energy market
- Ways to ***transition to new forms of regulation***, and moving to ***reliance on greater competition*** for network and energy services
- An ***evaluation of regulatory approaches to drive innovation*** and new technologies through the grid



ELECTRICITY NETWORK TRANSFORMATION ROADMAP

2015-25

Future Grid Forum scenarios update

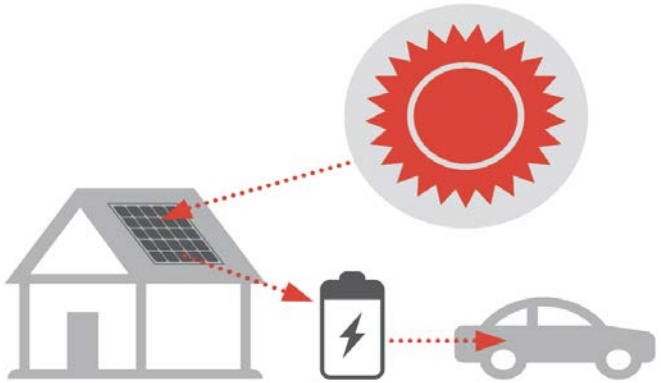
Paul Graham

ena energy networks association

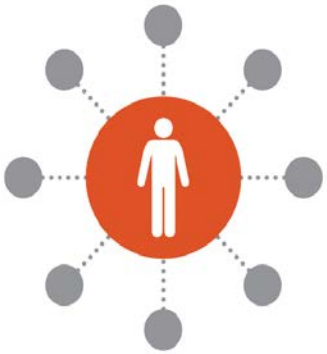
CSIRO

Future Grid Forum modelling update

Set and forget

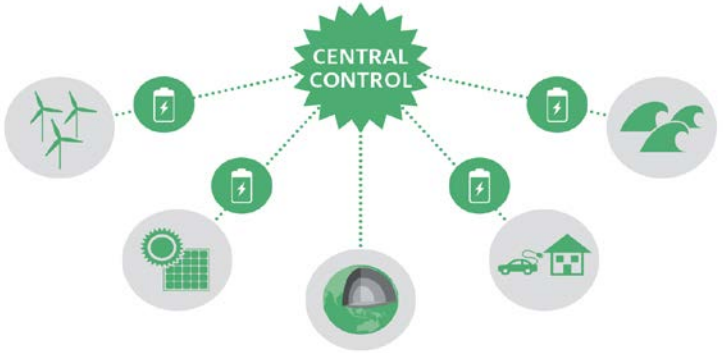


Leaving the grid



Customer-centric model
where customers consume, trade, generate and store electricity.

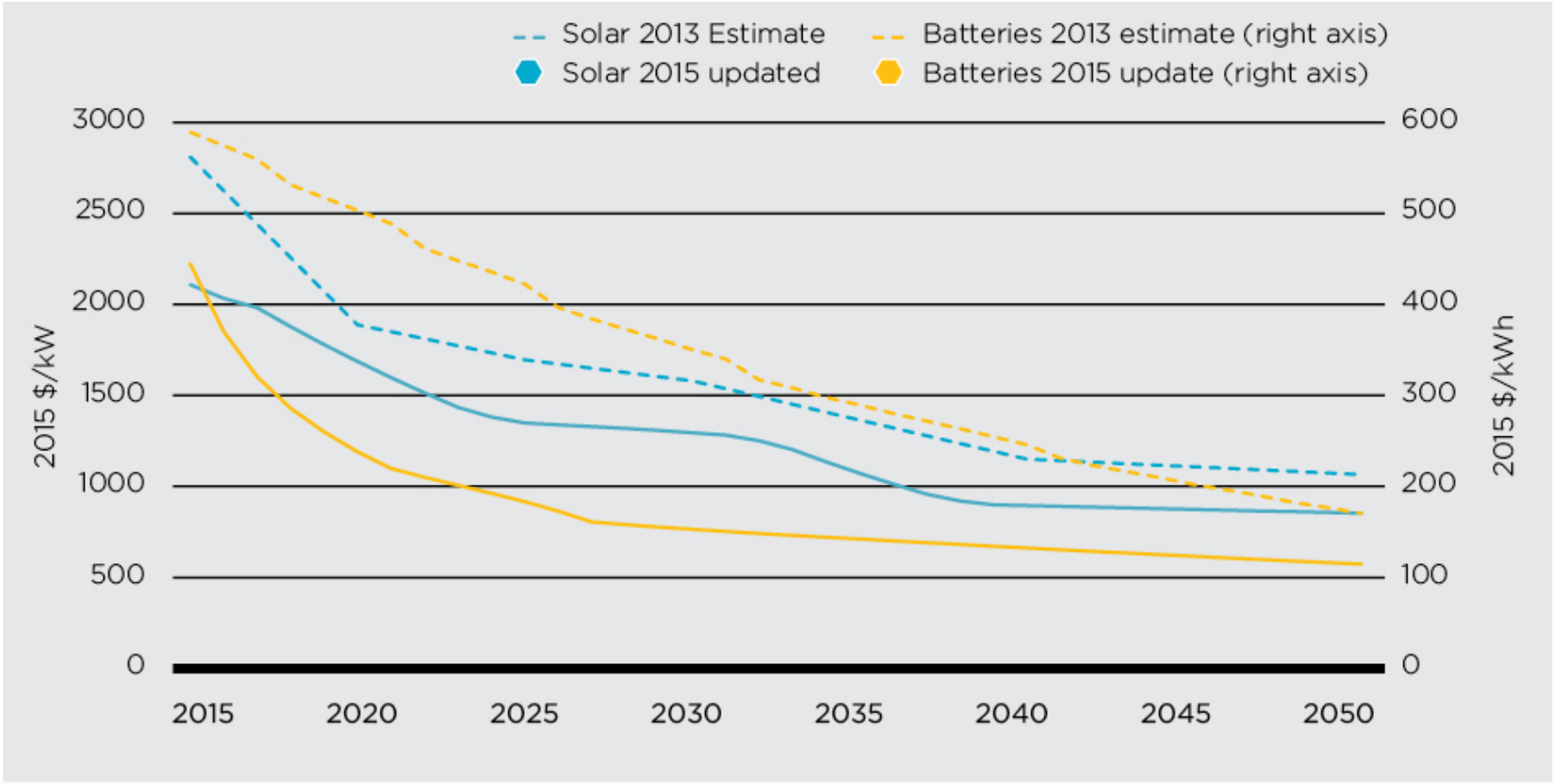
Rise of the ‘Prosumer’



Renewables thrive

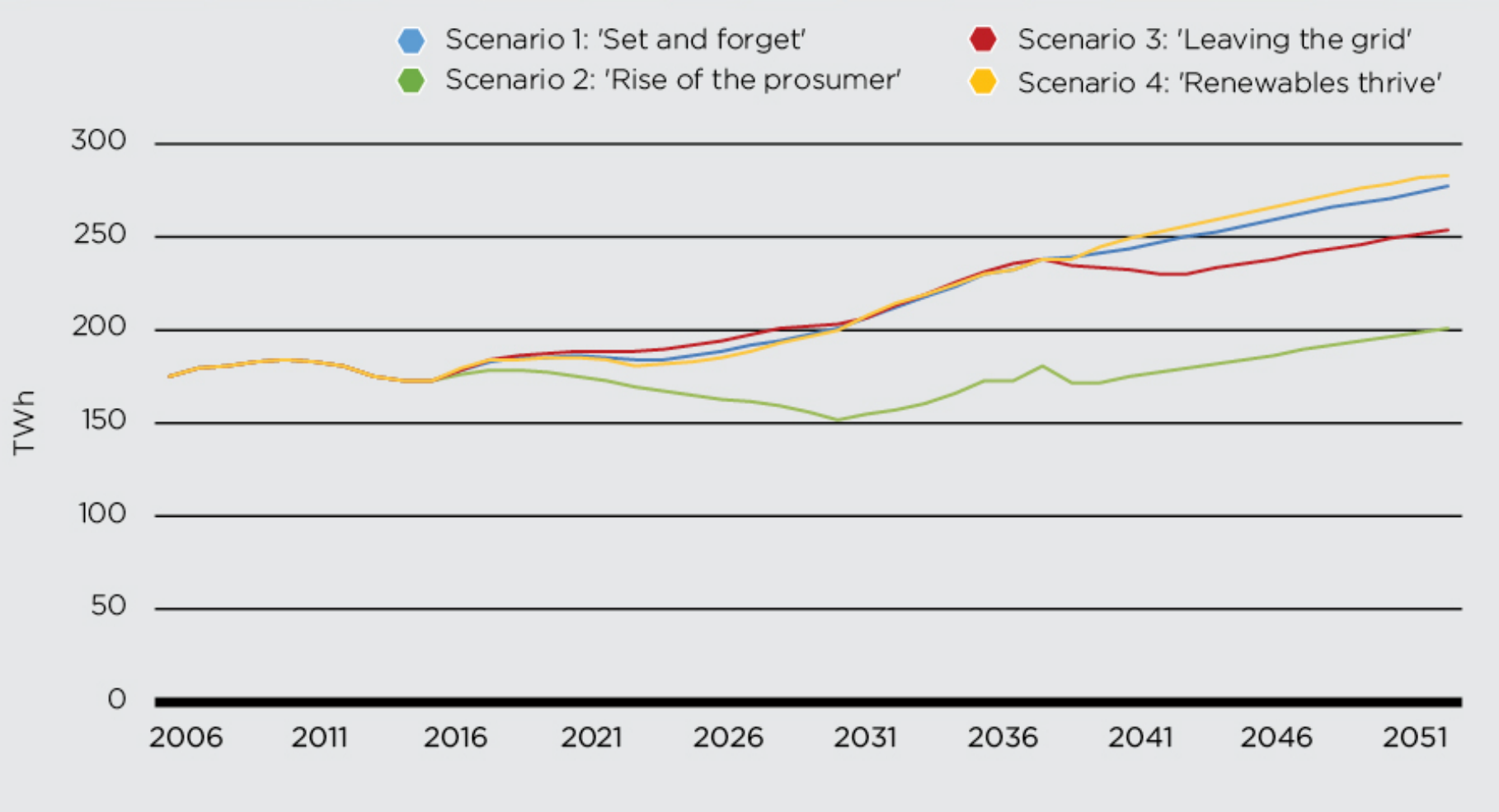
High levels of solar panels and storage are *more* plausible

The key transformation drivers – competitive on-site generation and storage – have each strengthened their competitive position since 2013 by about 20%



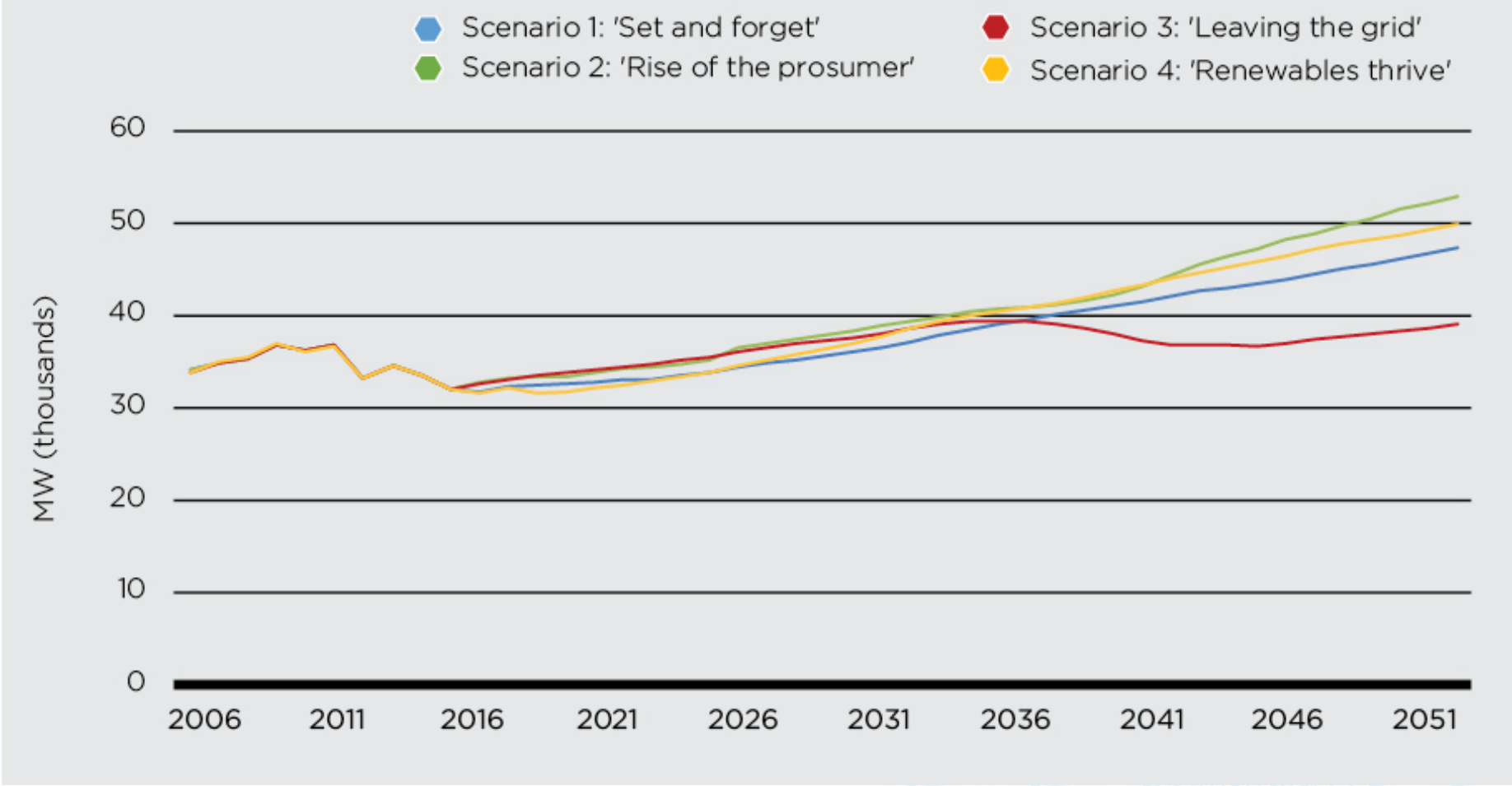
Electricity consumption will be flat to rising

- To project consumption, we start with AEMO and IMO's projection, and adjust for each scenario's on-site generation and electric vehicle adoption



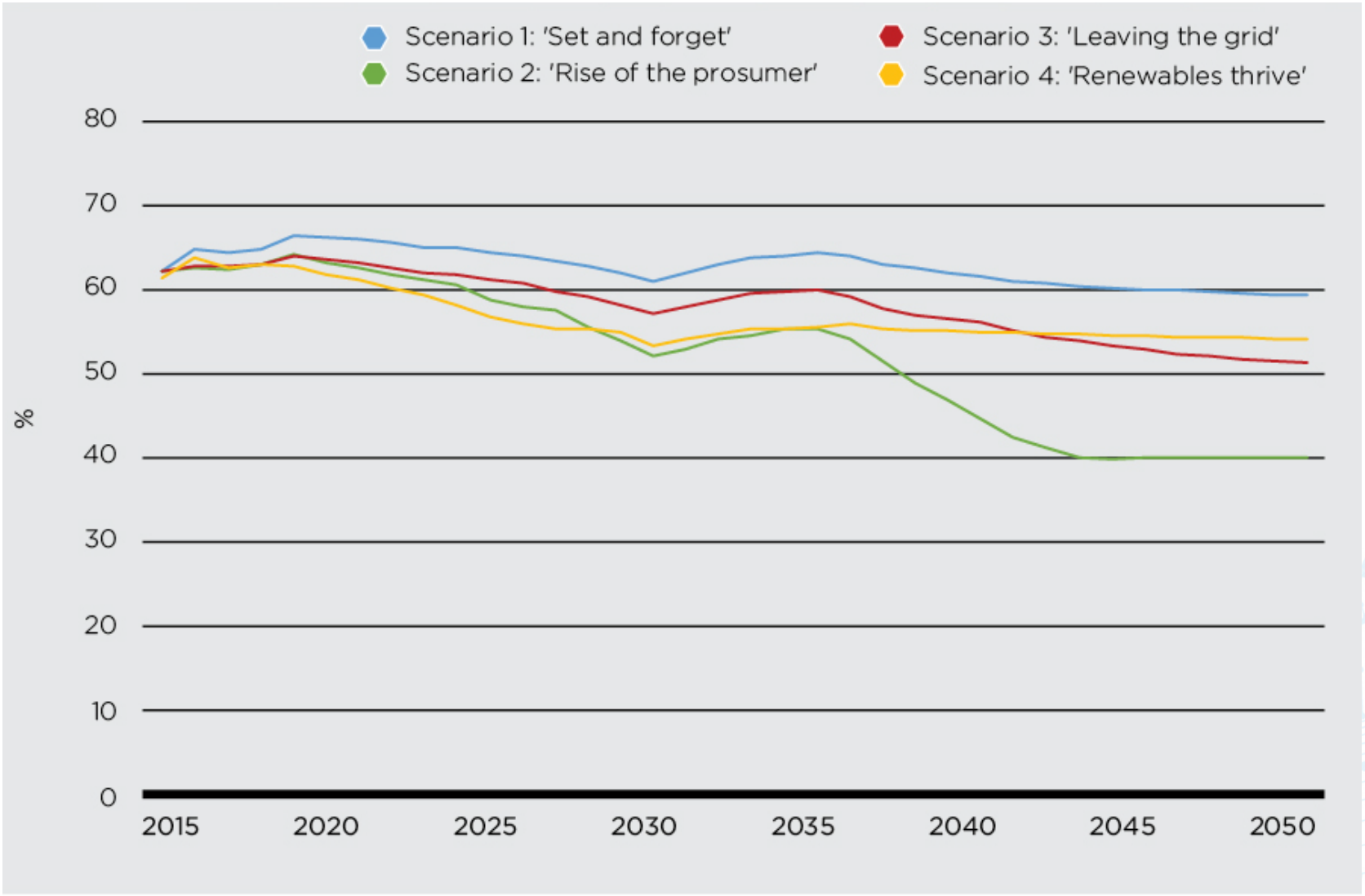
Peak demand growth will also be subdued

- To project peak demand, we start with AEMO and IMO's projection, and adjust for each scenario's battery storage and other demand management adoption



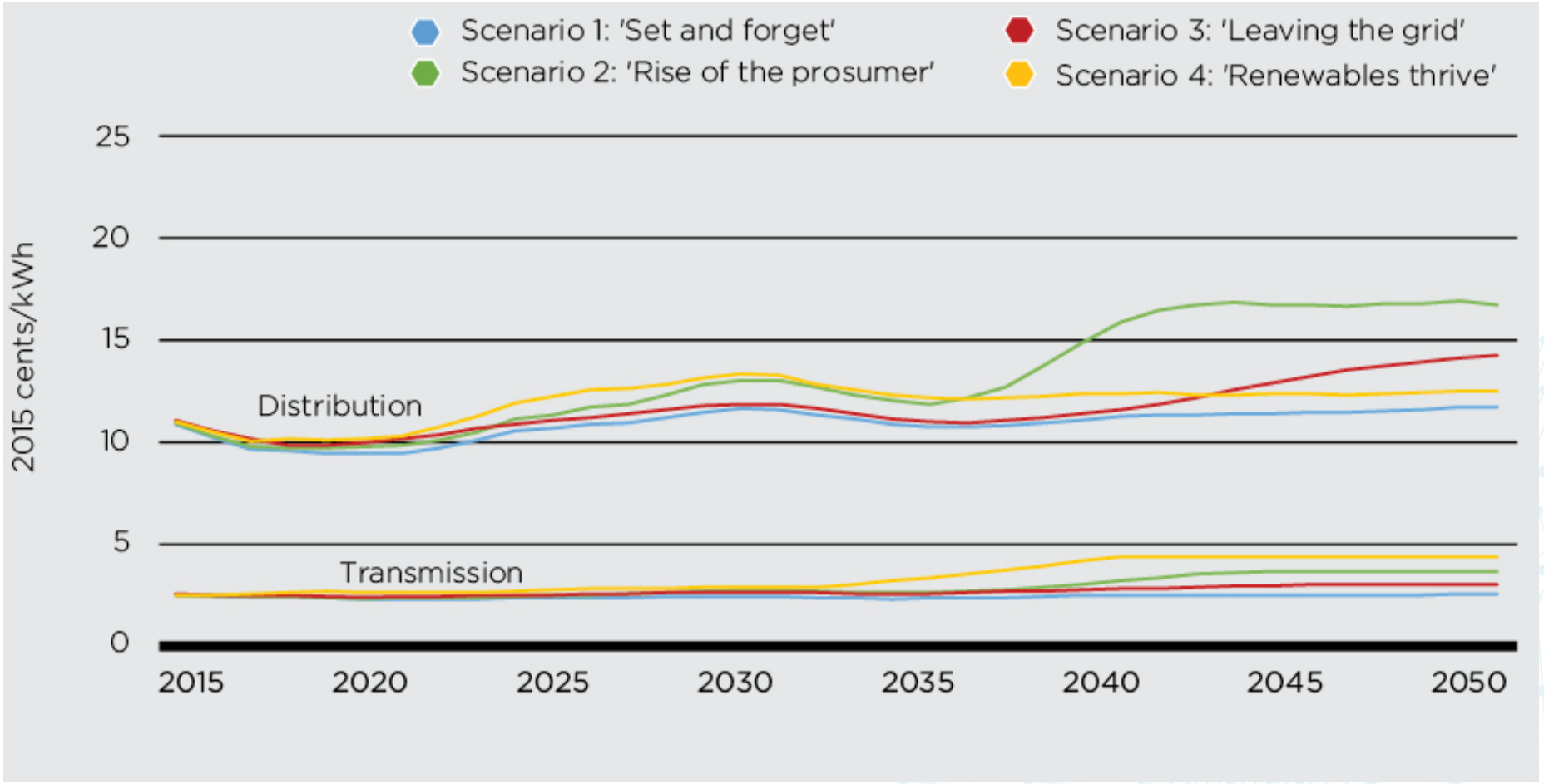
Grid under-utilisation is still a risk

- Declining utilisation remains a risk but these results are around 5-10 percentage points better than in the 2013 modelling in the three worst cases, due to improved outlook for demand management

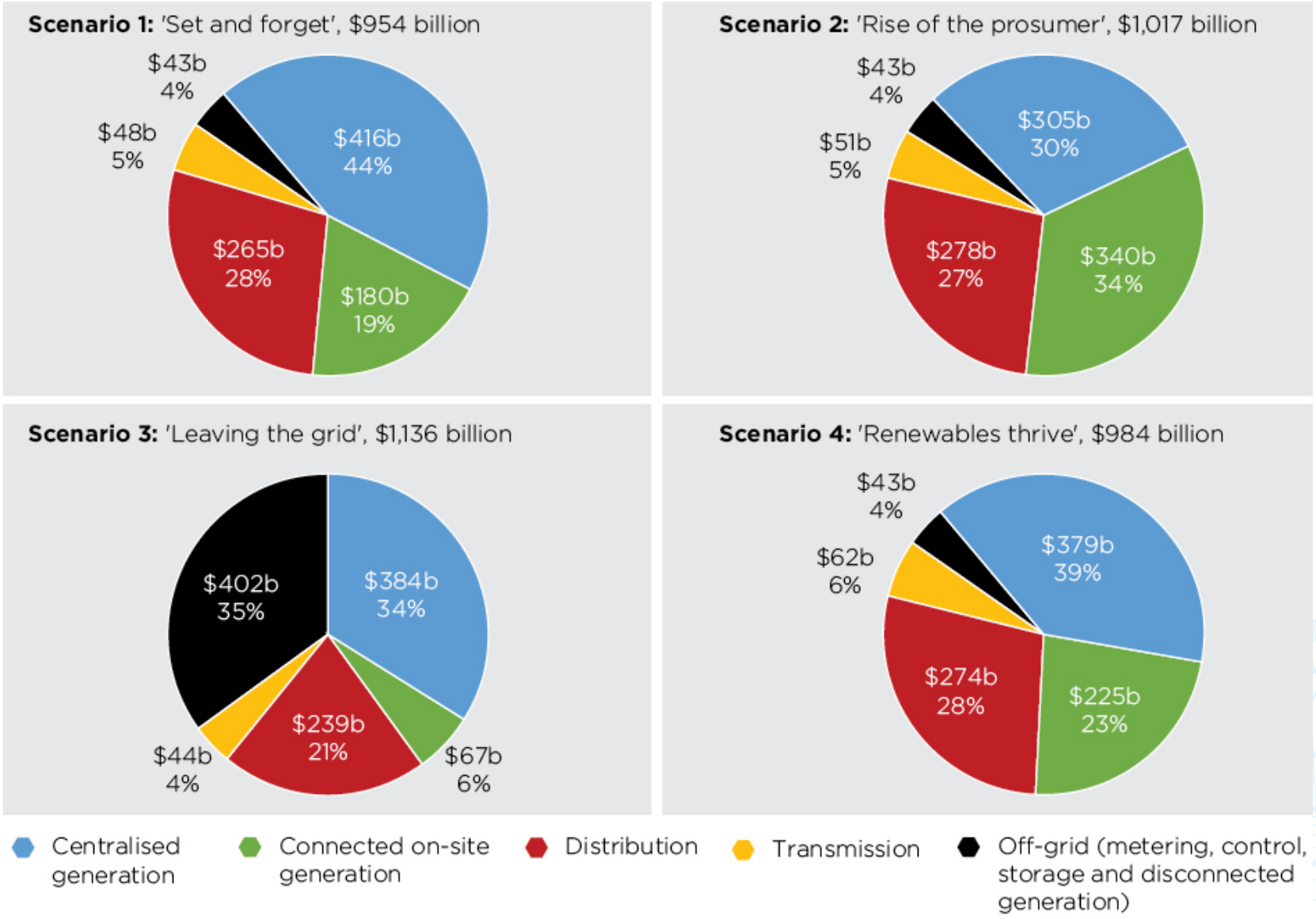


The outlook for networks costs is improved

- The improved outlook for utilisation means that the outlook for network costs has improved, with long term costs 3-10c/kWh lower across the scenarios

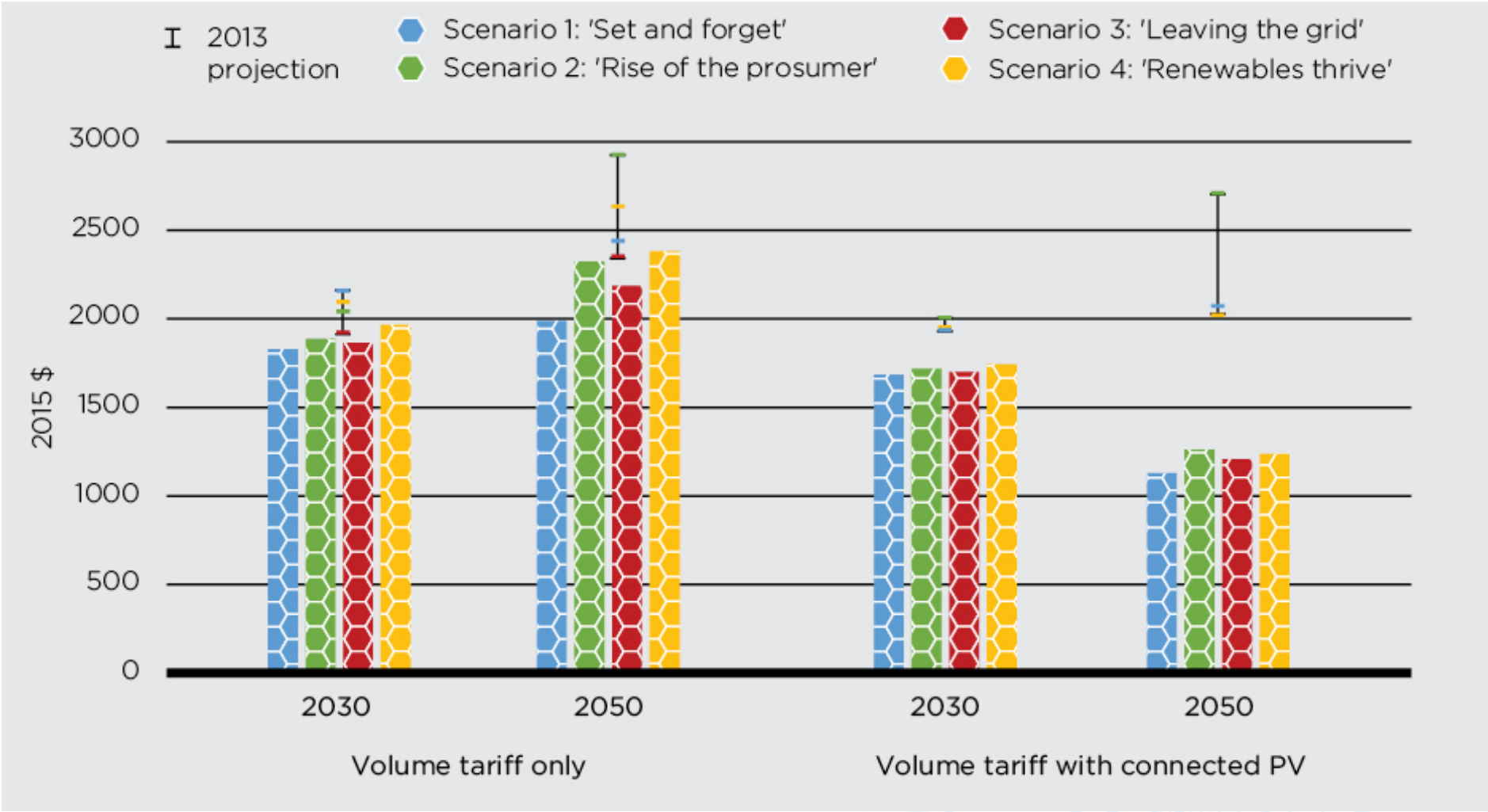


Cumulative system expenditure shares are diverse



Residential electricity bills are lower than expected in 2013

However the potential for inequality between solar owners and non-owners is greater



Going off-grid?

We updated our economic modelling of a household off-grid system for an existing connected customer. While system costs had improved so has the outlook for grid electricity prices such that the economic point of disconnection remains exactly where it was: in the late 2030s

Solar panel and battery storage costs are lower

The price of retail electricity from the grid is lower

What we would welcome from you …

1. Your further feedback on the NTR Interim Program Report, including:
   - Your comments on the analysis and findings in the report; and
   - Your views on the Key Questions for Stakeholder Feedback found at the conclusion of each of the Chapters

   Send to: ntr@ena.asn.au

   Requested by: 29 January 2016

   so as to assist us with Phase 2.

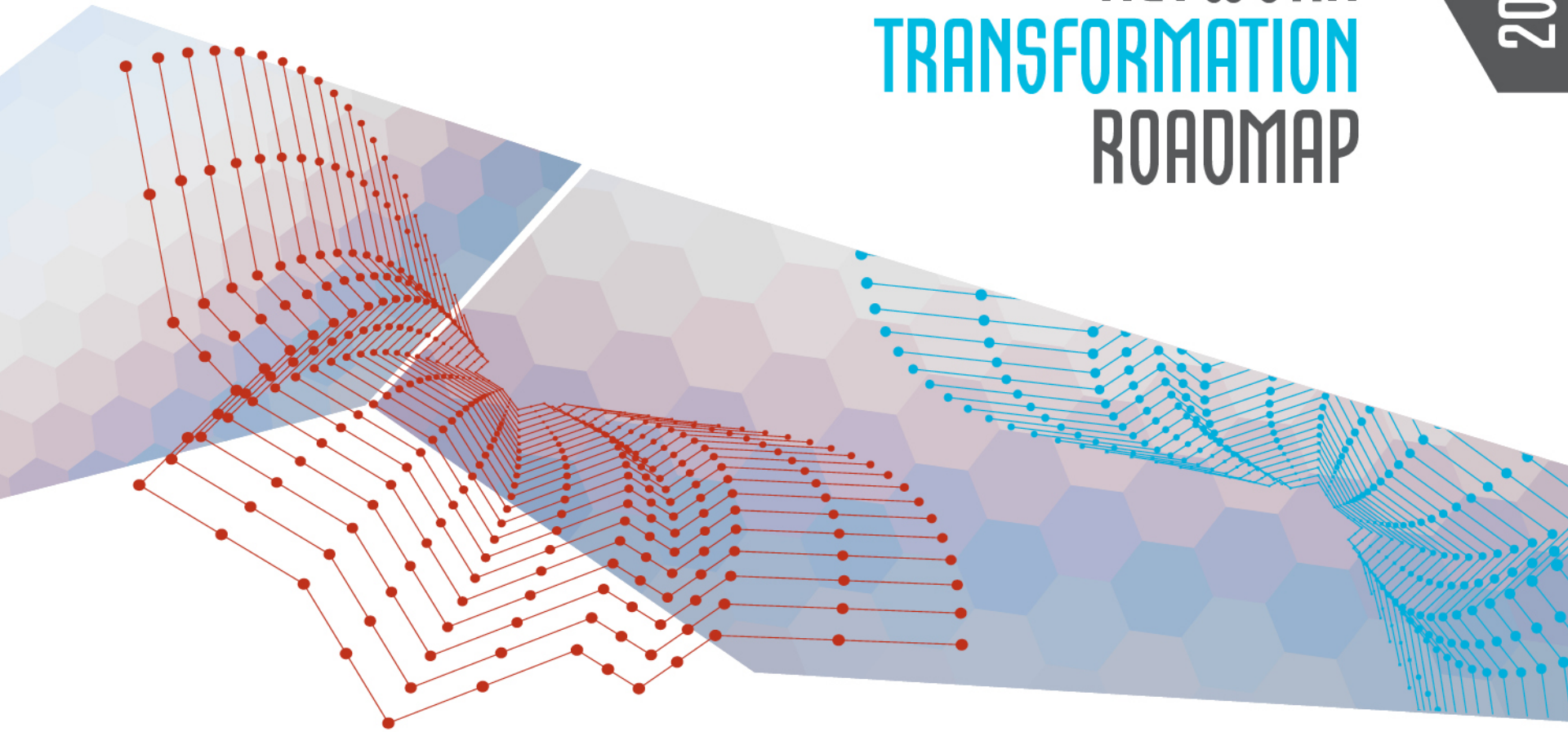
2. Your continued engagement with ENA/CSIRO on our NTR program.

ena
energy networks association

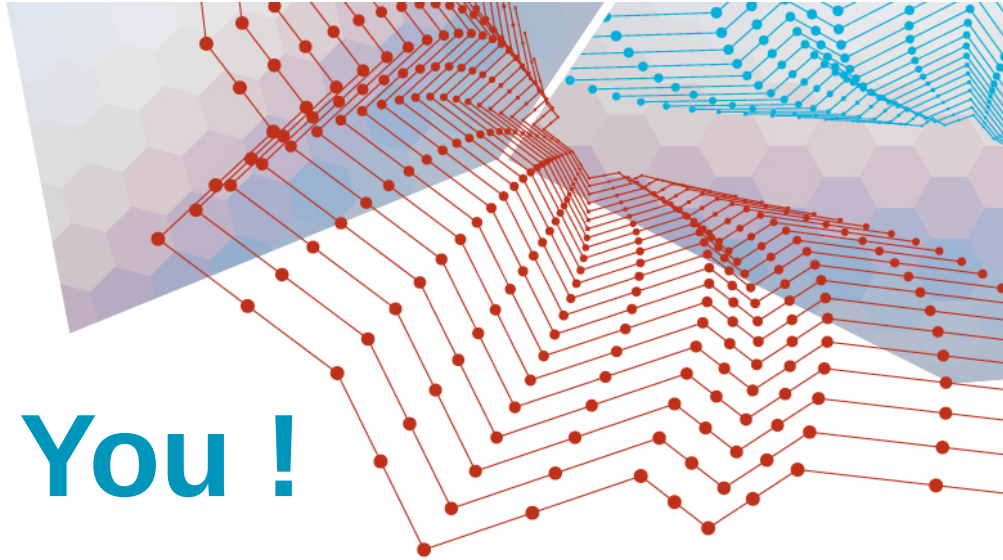
CSIRO

ELECTRICITY NETWORK TRANSFORMATION ROADMAP

2015-25



A partnership between the ENA and CSIRO



Thank You !

Want to know more?

For more information on the Electricity Network Transformation Roadmap Project, please contact

Dr Stuart Johnston at ENA
at **ntr@ena.asn.au** or 02 6272 1555