Energy Networks Australia

CSIRO

ELECTRICITY NETWORK TRANSFORMATION ROADMAP: KEY CONCEPTS REPORT

2017-27

SUMMARY DECEMBER 2016

A partnership between Energy Networks Australia and CSIRO

A TRANSFORMED ELECTRICITY SYSTEM BY 2050

- **Customers retain security and reliability essential to lifestyle and employment**
- **Networks pay distributed energy resources customers over $2.5 billion per annum for grid support services by 2050.**
- **Electricity sector achieves zero net emissions by 2050**
- **$16 billion in network infrastructure investment is avoided by orchestration of distributed energy resources**
- **Reduction in cumulative total expenditure of $101 billion by 2050**
- **Network charges 30% lower than 2016**
- **$414 annual saving in average household electricity bills (compared with the *Roadmap* counterfactual and business as usual scenarios)**
- **A medium sized family who cannot take up distributed energy resources is over $600 per annum better off through removal of cross subsidies**

A VISION TO 2027 AND BEYOND

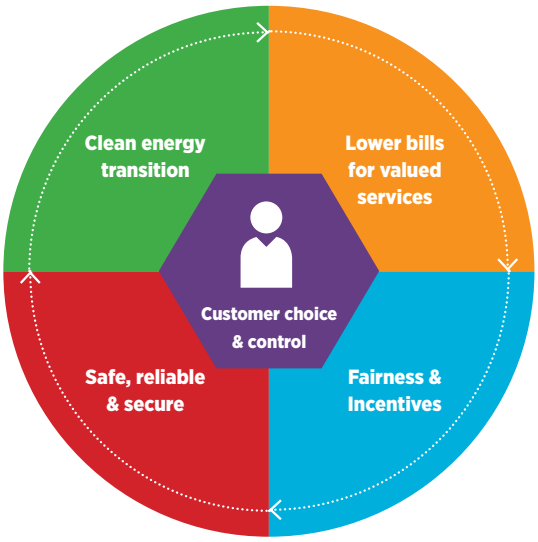
Australia's electricity system supports our economy and lifestyle and it is changing at an unprecedented scale. The transformation is driven by customers, as they embrace new technologies, take control of their energy use and support action on climate change.

Australians are installing rooftop solar at world leading rates. It is estimated customers - not utilities - will determine over $200 billion in system expenditure by 2050. The full value of these customer installed energy resources can only be realised through a *connected future* enabling multilateral exchanges of energy, information and value. This co-optimisation allows future network investments in 'poles and wires', to be lower than otherwise anticipated, while also supporting the creation of more value for customers through the platform of smarter electricity networks.

A customer oriented transition must focus on carefully balancing key customer outcomes. The electricity system must achieve decarbonisation at least cost for customers without jeopardising power system security. Equally, it must also incentivise and enable new customer choice and control, while appropriately protecting consumers and avoiding unfair impacts on vulnerable customers.

The *Electricity Network Transformation Roadmap* has been developed to guide a structured transformation over the 2017-27 decade and to equip networks to deliver the five customer outcomes of the Balanced Scorecard below. It has been informed by CSIRO's energy system analysis and wide stakeholder collaboration.

Figure i: Balanced Scorecard of Customer Outcomes



The Critical Role of the Integrated Grid

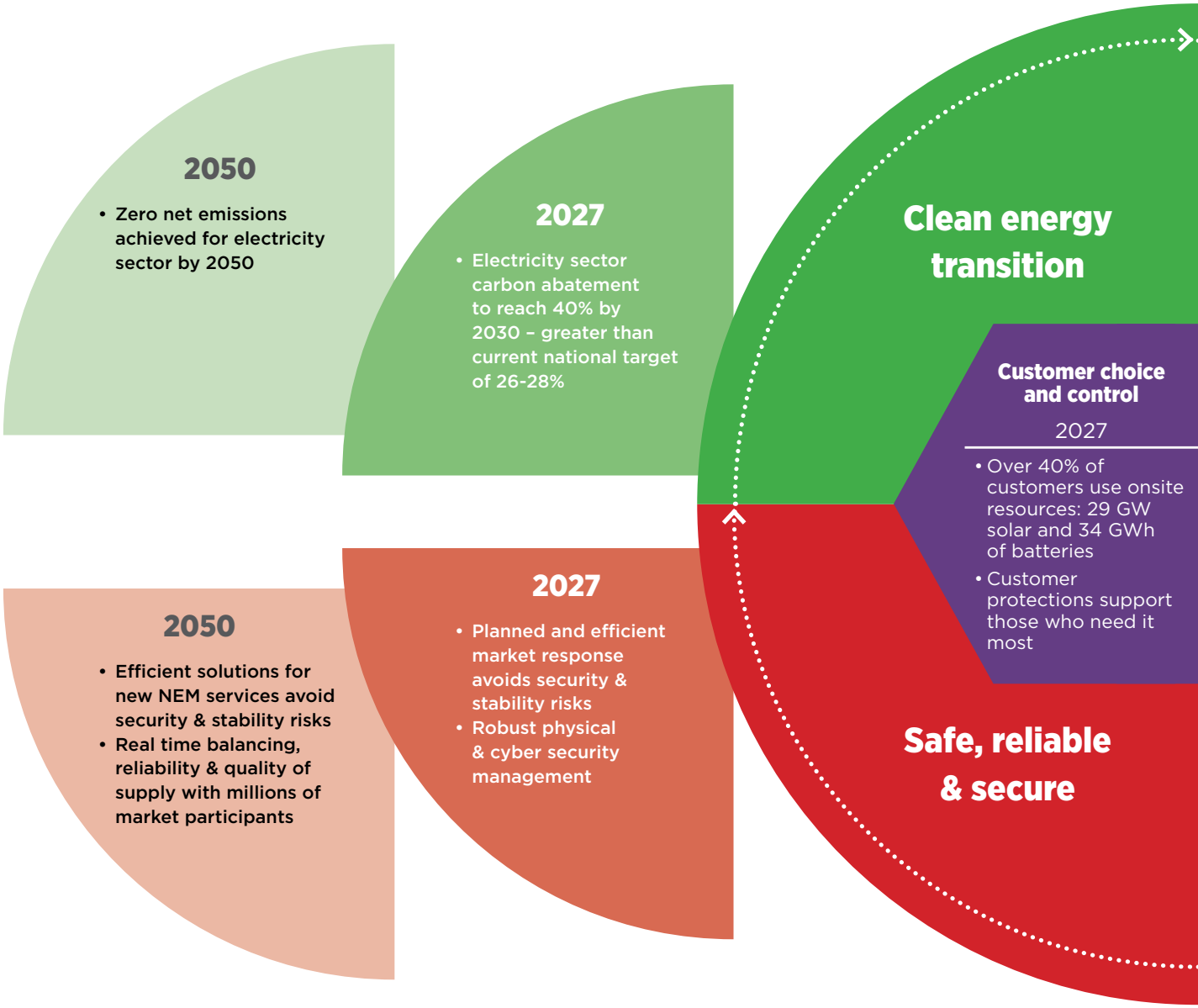
The next decade to 2027 is likely to see a step change in the rapid adoption of new energy technologies, driven by falling costs and global carbon abatement measures. This decade provides a limited window of opportunity to reposition Australia's electricity system to deliver efficient outcomes to customers.

The agility with which networks connect, integrate and incentivise new, lower carbon energy choices will directly influence the cost, fairness, security and reliability of the electricity system for customers. Urgent regulatory and policy changes will be required to maintain power system security, while reducing customer costs by enabling the efficient use of distributed energy resources, stand alone systems and micro-grids. Timely development of technical standards and new platforms will animate new distributed energy resource markets and permit more efficient customer services and participation.

The right balance can be achieved

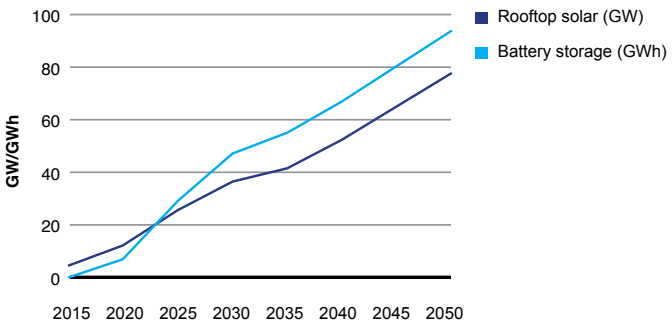
With a clear *Roadmap*, Australia's electricity sector can outperform current abatement targets, keep the lights on and deliver lower costs. Australia can increase the levels of both centralised and decentralised renewable and low emission generation sources enabled by transmission and distribution networks. Total system costs can be reduced by over $101 billion through network service platforms enabling distributed energy resources to participate in increasingly dynamic electricity markets. Together, *the Roadmap* activities can achieve a positive energy future for Australian energy customers enabling choice, lower costs, high security and reliability and a clean electricity system to 2050.

A BALANCED SCORECARD FOR CUSTOMERS



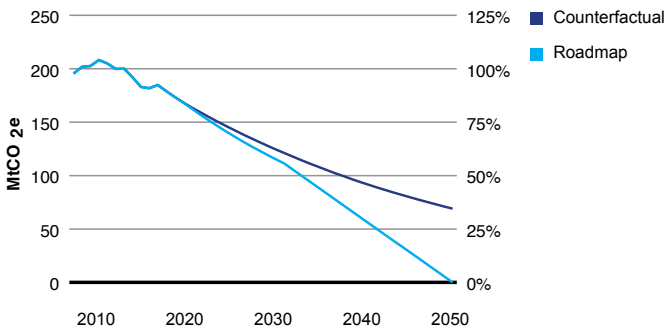
Rooftop solar and battery storage adoption

Projected uptake of solar PV and battery storage to 2050



Carbon abatement

Assumed greenhouse gas pathways under *the Roadmap* and Counterfactual scenarios (Left axis: emissions, Right axis: percent abatement relative to 2005 emissions)



Lower bills for valued services

2027

- Over $1.4 billion in network investment avoided
- Average network bills 10% lower than 2016

2050

- Total system spending reduced by $101 billion by 2050
- Average household saving of $414 pa compared with business as usual scenario
- Network charges 30% lower than 2016

Customer choice and control

2050

- Almost 2/3 of customers have distributed energy resources
- 1/3 customers on 'stand alone power system' tariff
- Concession schemes fit for purpose

Fairness & incentives

2027

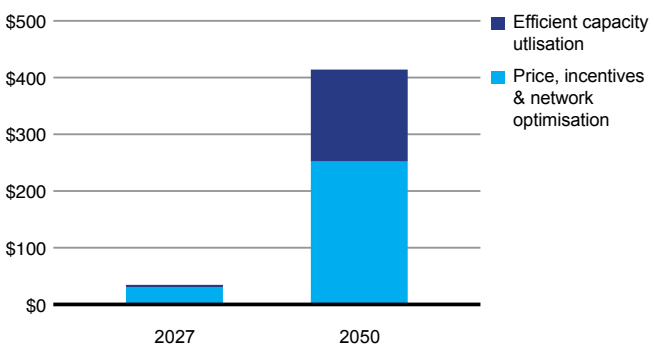
- Networks pay over $1.1 billion pa for distributed energy resource services
- Over $1.4 billion in cross subsidies avoided, saving over $350 pa for mid-size family without distributed energy resources

2050

- Over $18 billion in cross subsidies avoided
- $600 pa saving for mid-size family without distributed energy resources through removal of cross subsidies
- Networks pay over $2.5 billion pa for distributed energy resource services

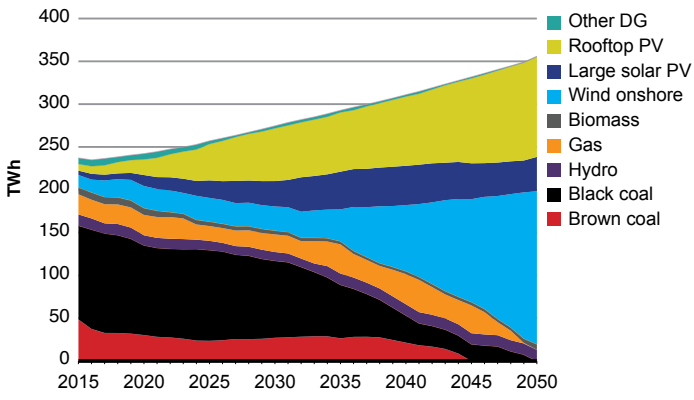
Savings for customers

Projected savings in average residential bills (in real terms) under the Roadmap scenario



Electricity generation mix

Projection of Australia's changing electricity generation mix to 2050



THE KEY CONCEPTS ROADMAP: IMPLEMENTATION PATHWAY

CUSTOMER ORIENTED ELECTRICITY

Customers are placed at the centre of Australia's future electricity system. They are empowered with greater choice, control and autonomy while enjoying the security and benefits of a grid-connection. Transformed electricity networks actively connect customers with a growing range of market actors and customised electricity solutions that are supported by a modernised customer safety net designed for the 21st century energy system.

FOUNDATION BY 2022

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

IMPLEMENTATION BY 2027

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

Electricity networks and the power system as a whole are enabled to support an expanding diversity of energy sources, at both the customer and transmission levels of the system. System safety, security and reliability are a central focus and customer distributed energy resources are enabled to become an integral part of network optimisation and whole-of-system balancing.

FOUNDATION BY 2022

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

IMPLEMENTATION BY 2027

Harmonised system operations at all levels

- Transmission networks support system stability with new services.
- Distribution networks provide visibility of distributed energy resources and potentially also enable Frequency Control Ancillary Services (FCAS) and delegated balancing services
- Real time communication and controls

CARBON ABATEMENT

Incentive based policy options capable of enabling least cost carbon abatement are supported by options for maximising capacity utilisation. The transformed electricity system is positioned to efficiently maintain system reliability, support renewable energy growth and achieve zero net carbon emissions by 2050.

FOUNDATION BY 2022

A stable carbon policy for higher targets

- Develop nationally integrated carbon policy framework
- Implement Emissions Intensity, 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

IMPLEMENTATION BY 2027

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

INCENTIVES & NETWORK REGULATION

A fairer system through active implementation of tariff reform and modernised regulation and competition frameworks. More customer oriented outcomes are supported ensuring those without distributed energy resources are treated fairly, while those with distributed energy resources are able to receive incentives for providing network support services that improve the efficiency of the grid for all.

FOUNDATION BY 2022

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 stand alone systems and micro-grids as a substitute for traditional delivery models
- New innovation incentives in Regulation and Competition frameworks

IMPLEMENTATION BY 2027

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 stand alone systems and micro-grids to stay connected to the grid
- New and more adaptive regulatory approaches that are customer focused

INTELLIGENT NETWORKS & MARKETS

An expanding range of new energy technologies and services are supported while continuing to efficiently provide a range of traditional electricity services. Advanced network planning, operation and intelligence systems ensure the safe and efficient integration of large scale renewable generation, hundreds of micro-grids and millions of customer distributed energy resources. Market based mechanisms reward customers with distributed energy resources for providing network support services, orchestrated either directly or through other market actors.

FOUNDATION BY 2022

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

IMPLEMENTATION BY 2027

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 distributed energy resources services for network support
- A flexible and agile workforce to support the new optimised energy system

CONTACT DETAILS

We value your feedback. Please provide feedback or raise any queries by emailing **ntr@energynetworks.com.au** by 16th February 2017

Electricity Network Transformation Roadmap publications can be downloaded from **www.energynetworks.com.au/roadmap**

Citation

CSIRO and Energy Networks Australia 2016, Electricity Network Transformation Roadmap: Key Concepts Report, Summary.