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

Significant increase in av. retail bills since 2008

Highest per capita emissions, generation sector reliant on coal

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

Blunt incentives to DER, regardless of location, time.

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

Clean energy transition

Lower bills for valued services

Customer choice & control

Safe, reliable & secure

Fairness & Incentives

1.5 million microgenerators, 15% average Solar PV penetration
A better future…

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

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

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

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

- 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

Clean energy transition
Lower bills for valued services
Customer choice & control
Safe, reliable & secure
Fairness & Incentives
# Overview of the Electricity Network Transformation Roadmap

<table>
<thead>
<tr>
<th>FOUNDATION</th>
<th>IMPLEMENTATION</th>
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<tbody>
<tr>
<td><strong>Customer Oriented Electricity</strong></td>
<td><strong>Networks provide a service platform</strong></td>
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<tr>
<td>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</td>
<td>◦ 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</td>
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<tr>
<td><strong>Power System Security</strong></td>
<td><strong>Harmonised System Operations at all levels</strong></td>
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<tr>
<td>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 &amp; cyber security</td>
<td>◦ 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</td>
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<tr>
<td><strong>Carbon Abatement</strong></td>
<td><strong>Reviewing scope for greater efficiency</strong></td>
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<tr>
<td>A stable Carbon Policy for higher targets ◦ Develop nationally integrated carbon policy framework ◦ Implement emissions Baseline &amp; 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</td>
<td>◦ Review technology specific incentive schemes to focus on least cost abatement ◦ Review scope for more efficient economy wide carbon pricing where consensus is achieved ◦ Review Australia’s emissions reduction target (2027)</td>
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<tr>
<td><strong>Incentives &amp; Network Regulation</strong></td>
<td><strong>Unlocking value of distributed energy resource orchestration</strong></td>
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<tr>
<td>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</td>
<td>◦ 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</td>
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<tr>
<td><strong>Intelligent Networks &amp; Markets</strong></td>
<td><strong>Networks optimised with distributed energy resources</strong></td>
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<tr>
<td>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</td>
<td>◦ 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.</td>
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### Overall Customer outcomes by 2027

<table>
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<tr>
<th>CUSTOMER CHOICE AND CONTROL</th>
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<tr>
<td>◦ Over 40% customers use onsite resources: 29 GW solar and 34 GWh of batteries ◦ Concessions to support those who need it most.</td>
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<tr>
<th>LOWER BILLS FOR VALUED SERVICES</th>
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<td>◦ Avoid over $1.4 BN in network investment. ◦ Average network bills 10% lower than 2016.</td>
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<th>FAIRNESS &amp; INCENTIVES</th>
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<tr>
<td>◦ 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.</td>
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<tr>
<th>SAFETY, SECURITY, RELIABILITY</th>
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<td>◦ Planned and efficient market response avoids security &amp; stability risks ◦ Robust physical &amp; cyber security management.</td>
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<tr>
<th>CLEAN ENERGY TRANSITION</th>
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<tr>
<td>◦ 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.</td>
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Comparing the roadmap Outcomes

Projected savings in average residential bills under the roadmap scenario

Cumulative electricity system total expenditure to 2050 – Roadmap & counterfactual

Counterfactual: $988 billion
The Roadmap: $888 billion

- Centralised generation
- Connected on site generation
- Distribution
- Transmission
- Off grid (metering, control, storage and disconnected generation)
## Comparing the Roadmap Outcomes

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

<table>
<thead>
<tr>
<th>Household Type</th>
<th>Counterfactual</th>
<th></th>
<th>The Roadmap</th>
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<th>The Gap $</th>
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<tr>
<td></td>
<td>Active $</td>
<td>Passive $</td>
<td>The Gap $</td>
<td>Active $</td>
<td>Passive $</td>
<td>The Gap $</td>
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<tr>
<td>Working Couple</td>
<td>$1,346</td>
<td>$1,811</td>
<td>$465</td>
<td>$1,123</td>
<td>$1,422</td>
<td>$299</td>
<td></td>
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<tr>
<td>Medium Family</td>
<td>$1,816</td>
<td>$2,601</td>
<td>$785</td>
<td>$1,428</td>
<td>$1,988</td>
<td>$560</td>
<td></td>
</tr>
<tr>
<td>Large Family</td>
<td>$2,794</td>
<td>$3,950</td>
<td>$1,156</td>
<td>$2,346</td>
<td>$2,734</td>
<td>$288</td>
<td></td>
</tr>
<tr>
<td>Single, Retired</td>
<td>$1,058</td>
<td>$1,730</td>
<td>$672</td>
<td>$883</td>
<td>$1,355</td>
<td>$472</td>
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### ENTR Supporting Report Library

<table>
<thead>
<tr>
<th>Program Quantification</th>
<th>Customer-oriented Networks</th>
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<td></td>
<td>Insights from Global Jurisdictions, New Market Actors &amp; Evolving Business Models, Accenture (2016)</td>
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<tr>
<th>Customer Safety Net</th>
<th>Carbon &amp; Renewable Policy Options</th>
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<tr>
<th>Efficient Capacity Utilisation</th>
<th>Pricing &amp; Incentives</th>
<th>Regulatory &amp; Policy Frameworks</th>
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<th>DER Markets &amp; Orchestration</th>
<th>Future Workforce Requirements</th>
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<th>Future Workforce Requirements</th>
<th>Technical Standards and Regulations</th>
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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.
Feedback summary

February/March stakeholder roadshow

30 briefings to 300+ people

ntr@energynet works.com.au

ENTR secretariat

All other channels
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

- **Energy Retailer**
  - Limited diversity in retail product offerings (cents/day cents/kWh)
  - Network service charge with additional margin for purchasing in energy services market

- **Energy Network**
  - Monopoly grid services
  - Limited opportunity for networks to purchase DER services from customers, resulting in more networks being built

- **Network Assets**

- **Large (NEM) Generation**

- **Customer (no-DER)**
  - Customer unable to unlock value from distributed energy resources

- **DER Customer**
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

Counterfactual
Roadmap
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:

New Content: Modelling Insights
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.
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.
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.
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.

Regional Modelling: The Role of State Interconnectors

Historical (2009-10) coincident wind generation capacity factors on winter and summer maximum demand days in selected states
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.
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.
Sydney view
Next Steps & Implementation
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:

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

Thanks!