ADAPTING TO THE MAJOR CHANGES RESHAPING THE ELECTRIC ENERGY INDUSTRY

EESA – NSW/ACT Chapter - NSW Annual Electric Energy Conference and Exhibition

27 NOVEMBER 2018

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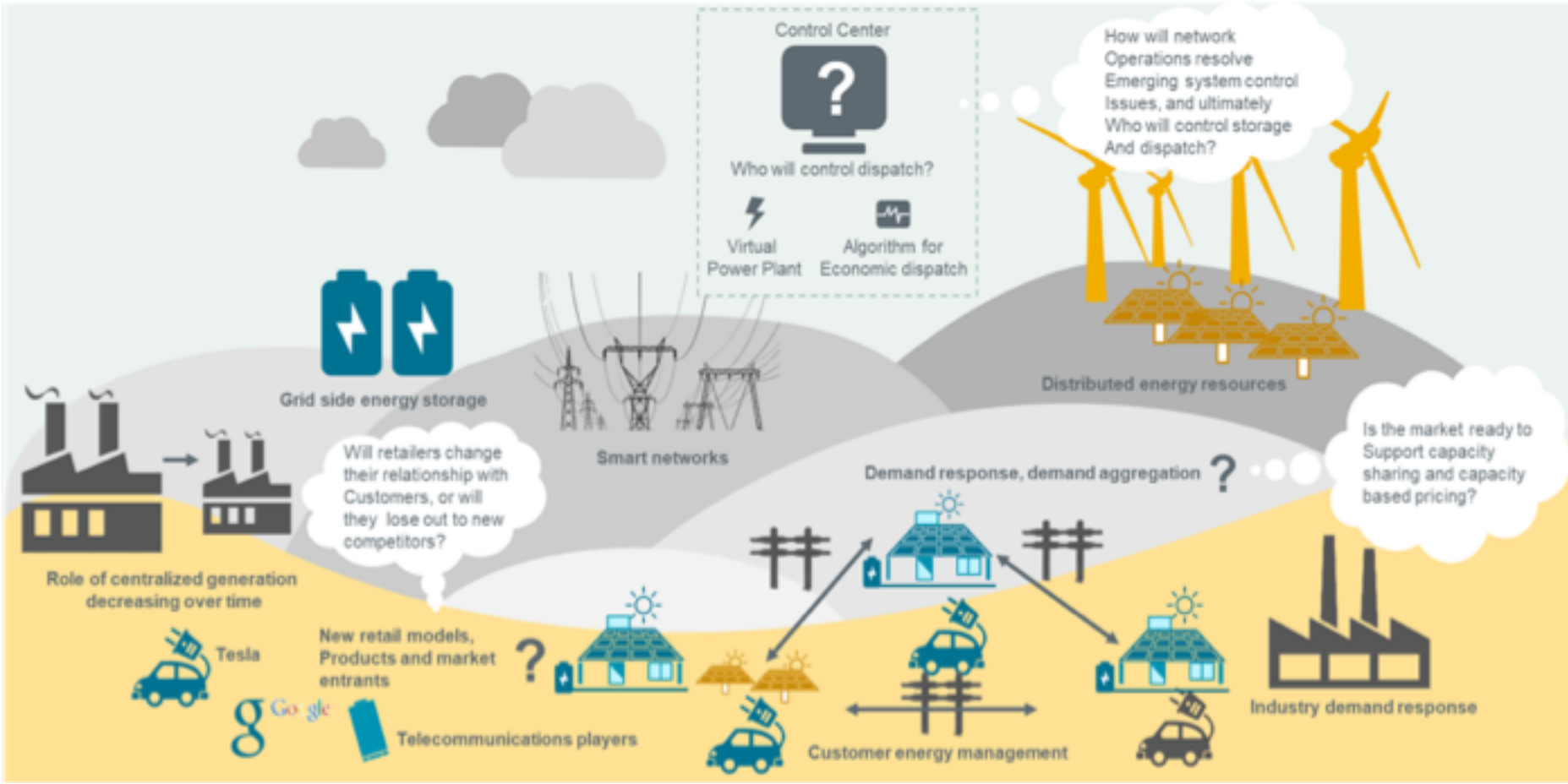
A NEW ENERGY ECO-SYSTEM IS HERE TO STAY WITH TWO-WAY FLOWS ENABLING CUSTOMERS TO HAVE GREATER CHOICE AND CONTROL



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WHAT ARE THE IMPLICATIONS?

- The growth of embedded generation, battery storage and innovative retail arrangements is leading to **increased operational complexity**.
- There is a **fundamental reshaping** of how the network is used.
- Regulatory outcomes are putting **more pressure on regulated revenues** leading to the imperative to understand and manage both network assets and risks in real time.
- Growth of **cyber intrusion risk**.

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DO THESE CHANGES PRESENT THREATS OR OPPORTUNITIES?

Global threats:
- *Economic uncertainty in global markets*
- *Technological disruption challenging existing business models*

***Pricing uncertainty**, driven by regulators yet to decide on how best to structure price signals to enable customer response*

***Growth in clean energy** investment globally – increasing every year*

***Electric vehicles** Offer long term growth in consumption & charging infrastructure*

Industry-specific threats:
- *Changing customer expectations*
- *New competition*
- *Rising costs*
- *Cyber security threats*

***Peer to Peer energy trading** Customers looking at forming virtual power plants*

***Distributed Energy Resources (DER)** Opportunities for DNSPs to manage DER to address network constraints*

***Microgrids present an opportunity** for new business relationships with developers & technology providers*

Threats ? **Opportunities**

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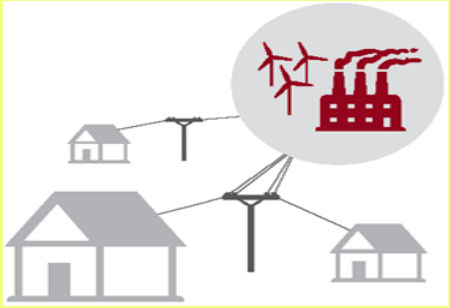
CUSTOMERS NOW HAVE FOUR MAIN OPTIONS EMERGING FOR THEIR ELECTRICITY SUPPLY

1

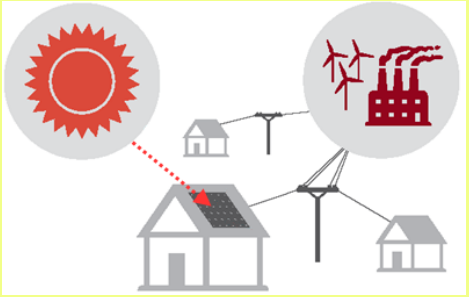
Grid Connected Customer



~ 1 million customers and increasing

2

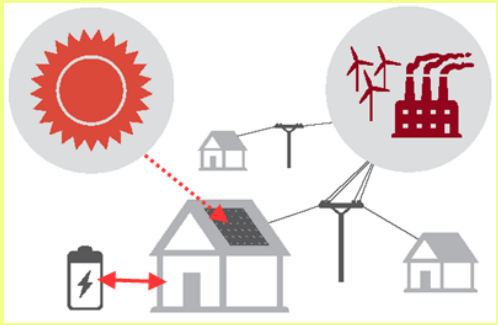
Grid Connected with Solar Generation



~132,000 customers and increasing

3

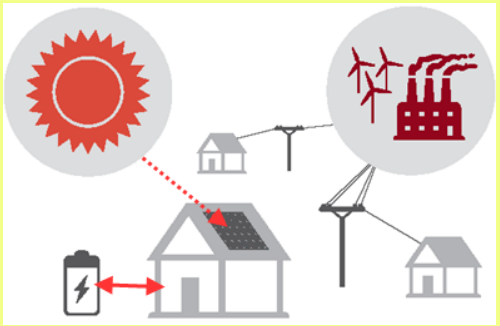
Grid Connected with Solar & Storage



~ 100s of customers and increasing

4

Off Grid Customer



No increase or change in existing customers leaving the grid. Only examples are where new grid connections are non-economic

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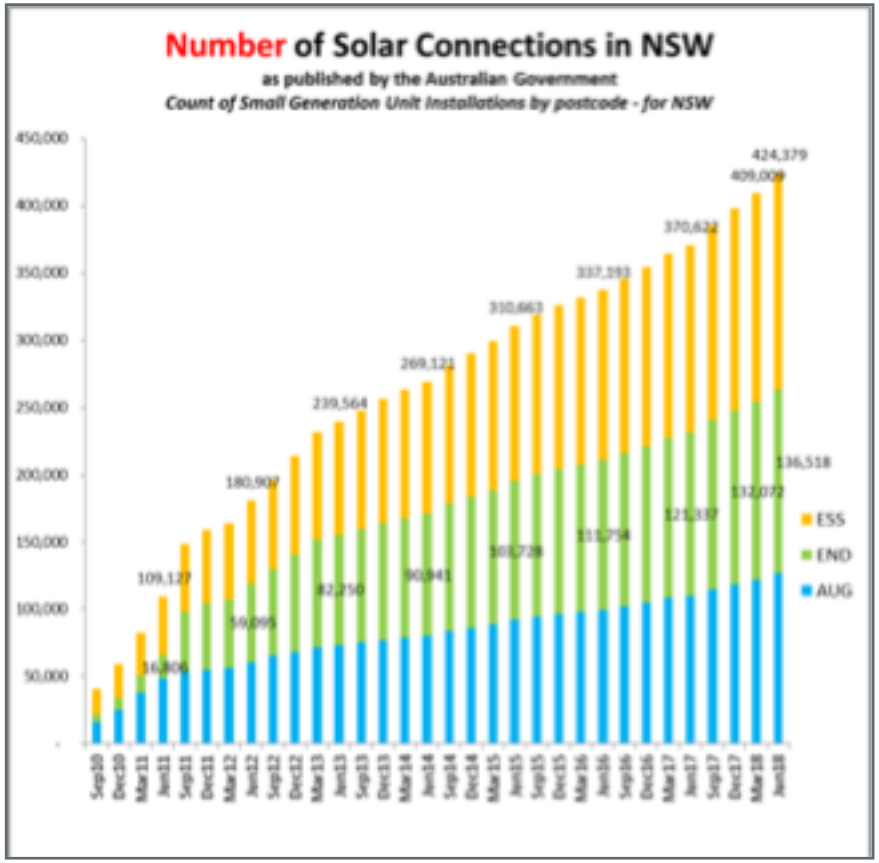
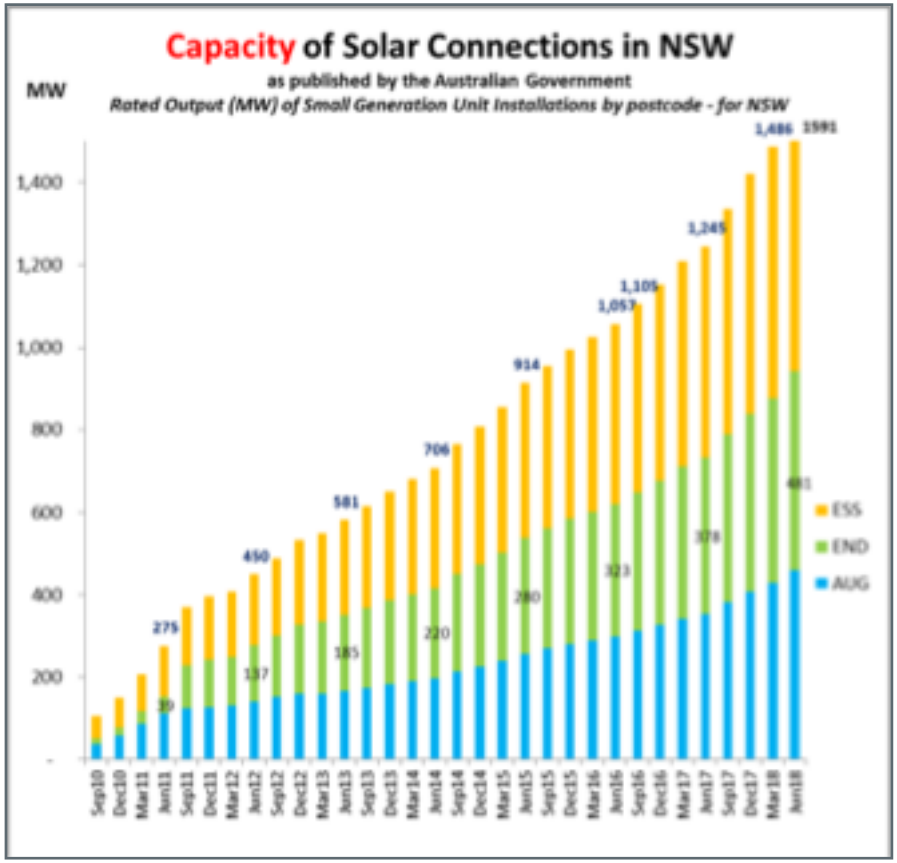
ROOFTOP SOLAR PENETRATION IS NOW ~13% FOR ENDEAVOUR AND CONTINUING TO GROW



~ 13.6 % for Endeavour Energy at the end of June 2018



~ 12.6 % for Endeavour Energy at the end of June 2018

Data as at 31 July 2018

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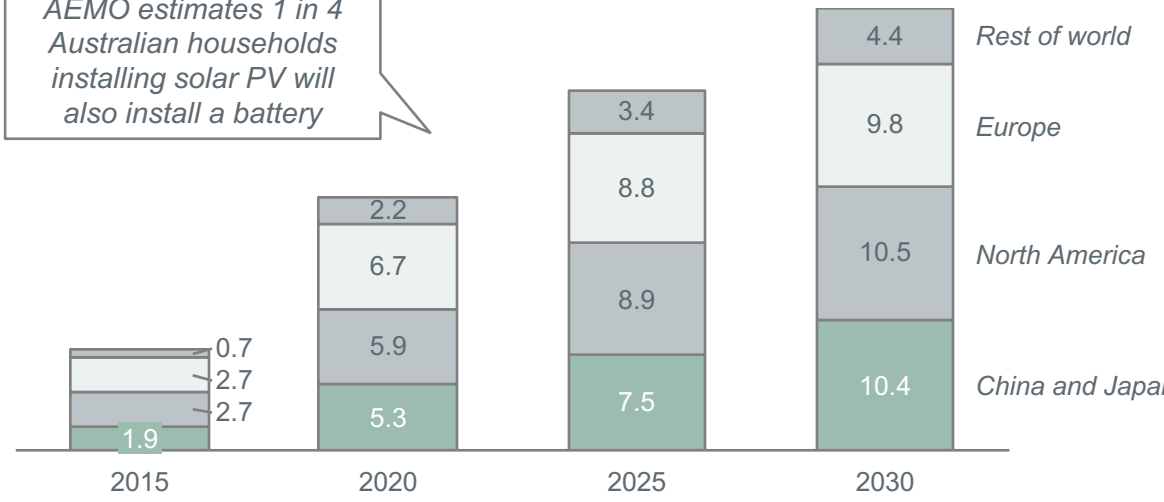
IMPROVING ECONOMICS FOR BATTERIES WILL PROVIDE FUTURE ENERGY STORAGE POSSIBILITIES

AEMO estimates 1 in 4 Australian households installing solar PV will also install a battery



Projected annual sales of storage technologies
2015 – 2030, US$B

Energy storage milestones — cost reductions in the storage market are enabling new applications

2014: Remote applications replacing expensive diesel gensets, backup power and water pumping

2015: Participating in open ancillary services markets and behind-the-meter ancillary services

2016: Peak shaving and power use optimization for commercial and industrial users

2017: Increased coupling with residential solar PV

2021: Time of use shifting applications for energy price savings in the commercial sector

2022: Increased penetration of EVs offers opportunities for:
- Second-use batteries in stationary applications
- Vehicle to building (V2B) and Vehicle to grid (V2G) applications.
- 2026: Industrial applications with DG coupling will start to appear at pricing around €125/MWh

2026: Industrial applications with DG coupling will start to appear at pricing around €125/MWh

Sources include: Navigant Research. IHS. Bloomberg, IEA, EY proprietary data and analysis

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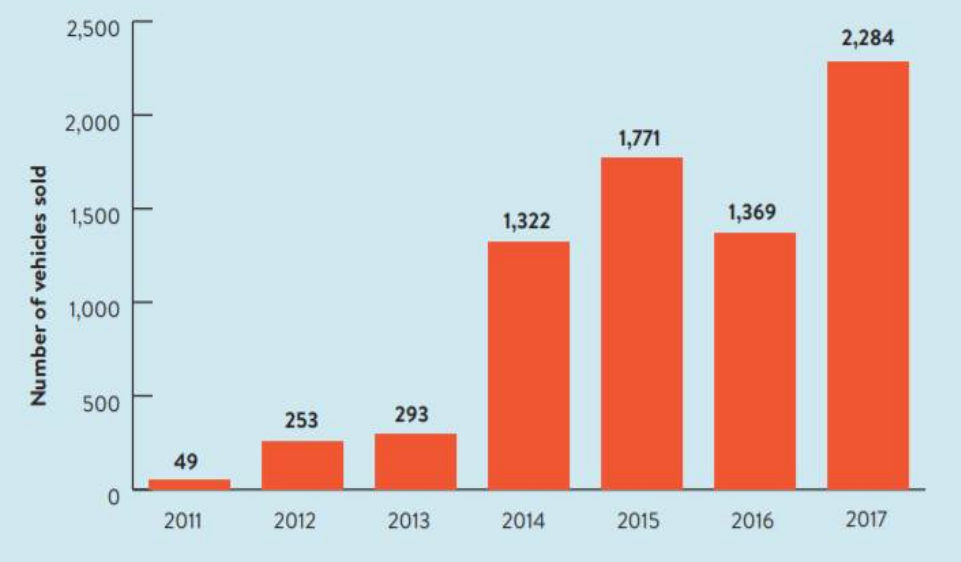
IMPROVING ECONOMICS IS INCREASING ELECTRIC VEHICLE UPTAKE IN AUSTRALIA



Data as of June 2018 from 'The State of electric vehicles in Australia' report.

		ACT	NSW	NT	QLD	SA	TAS	VIC	WA
Total number of charging stations		20	161	5	162	76	21	216	122
Charging stations per 100,000 residents		3.17	2.04	2.03	3.27	4.40	4.02	3.40	4.72
Total #	AC	17	148	5	138	70	21	208	107
	DC	3	13	0	24	6	0	8	15
Total #	Capital City	20	86	3	58	32	4	114	77
	Regional	0	75	2	104	44	17	102	45

Source: PlugShare (2018) and Australian Bureau of Statistics (2018)

Public charging infrastructure in Australia.

- If managed well, electric vehicles provide a benefit due to network utilisation during non-peak periods, thus increasing revenue without additional infrastructure.
- The uptake of electric vehicles and charging infrastructure in the Endeavour Energy supply area follows the general trends seen throughout Australia and NSW.
- NRMA, is planning to establish Australia's largest electric vehicle fast charging network. The first charger is already installed in Western Sydney (Olympic Park).

Source: www.mynrma.com.au "Electric vehicle fast charger network"
NRMA: The **National Roads and Motorists' Association** is an Australian organisation offering motoring services in NSW and the ACT.

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FUTURE NETWORK IMPLICATIONS - OUR INITIATIVES ARE ALIGNED WITH THE ENA/CSIRO INDUSTRY TRANSFORMATION ROADMAP

ELECTRICITY NETWORK TRANSFORMATION ROADMAP: FINAL REPORT 2017-27

How are we meeting the milestones set in the transformation roadmap:

Customer Oriented Electricity

Required Milestone: By 2021, investments are based on customer value; improving service performance

Required Milestone: By 2024, be active enablers of expanding products and services

By 2021, our Demand Response Management System (DRMS) enhancements will allow trialling various demand response initiatives. We are currently investigating an increased availability of information from monitors and smart meters to allow more efficient investments. Trials to investigate a targeted response to issues allows customers to assist.

Our current residential battery trial identifies customer uptake levels. Current Smart inverter integration & current Demand Response (AS4755) trials which integrates home automation technology will enable smart appliances.

From 2019, new and upgrading residential and small business customers will be assigned to new cost reflective electricity tariffs.

Required Milestone: By 2021, residential and small business customers are assigned to a new range of cost reflective tariffs

From 2019, stand alone power systems and other new services will be assigned to cost reflective electricity tariffs.

Required Milestone: From 2021, new prices are introduced to reflect services including 'Standalone Power system tariffs'

Currently stand alone power systems are being investigated for customers where grid connection is non-economic. By 2021, technology support systems will be available that interact with microgrids.

Required Milestone: From 2021, deploy or procure micro-grids or SAPS as a substitute for traditional models

Current initiatives such as AS 4755 DRED Demand Response Trials; Smart Meters and third party load control will provide customers incentives for selling their DER services to networks. By 2027 an automatic platform for procuring DER services will be enabled.

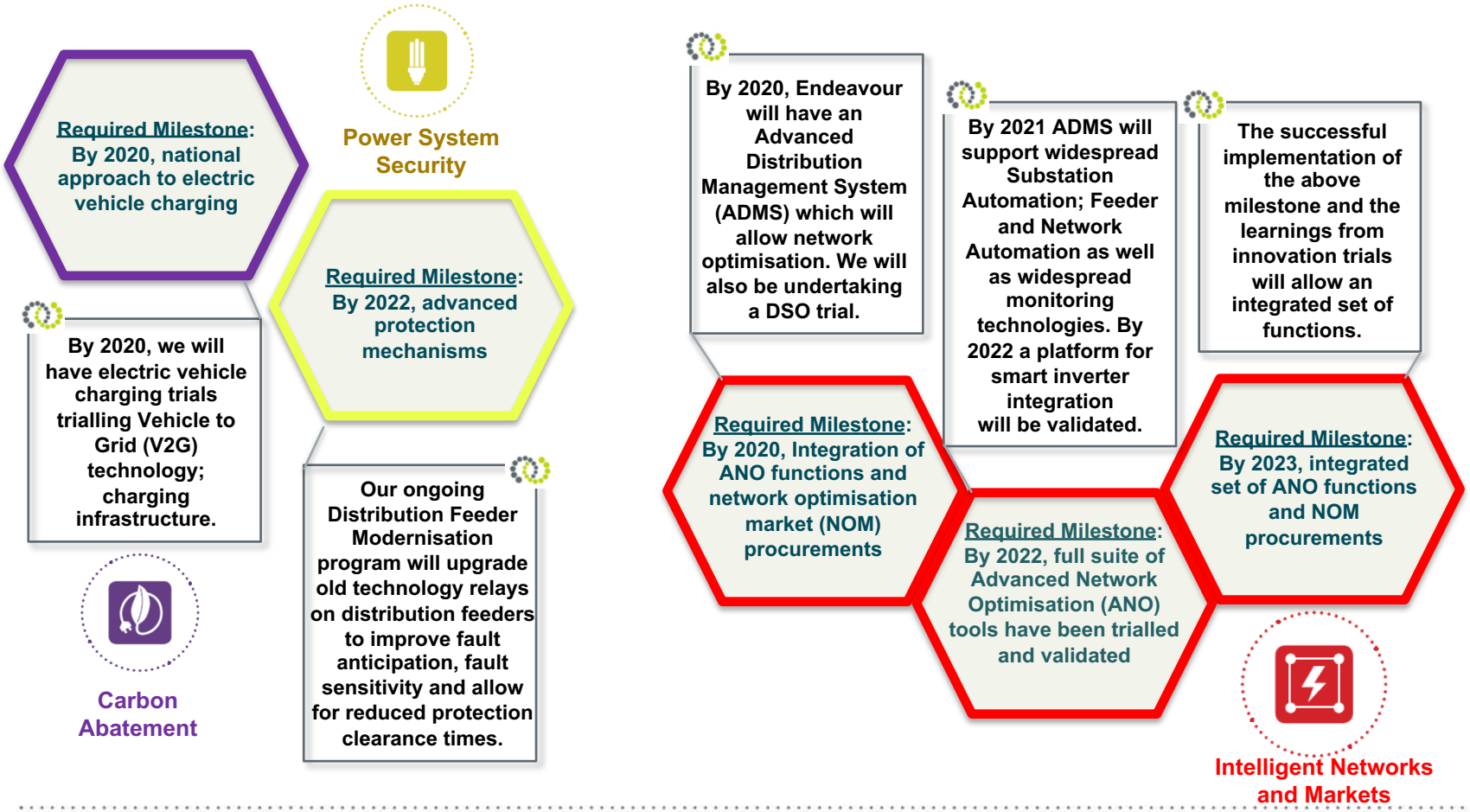
Required Milestone: By 2027, customers will be selling their DER to networks on a dynamic, locational basis

Incentives and Network Regulation

FUTURE NETWORK IMPLICATIONS - OUR INITIATIVES ARE ALIGNED WITH THE ENA/CSIRO INDUSTRY TRANSFORMATION ROADMAP

ELECTRICITY NETWORK TRANSFORMATION ROADMAP: FINAL REPORT 2017-27

How are we meeting the milestones set in the transformation roadmap (continued):



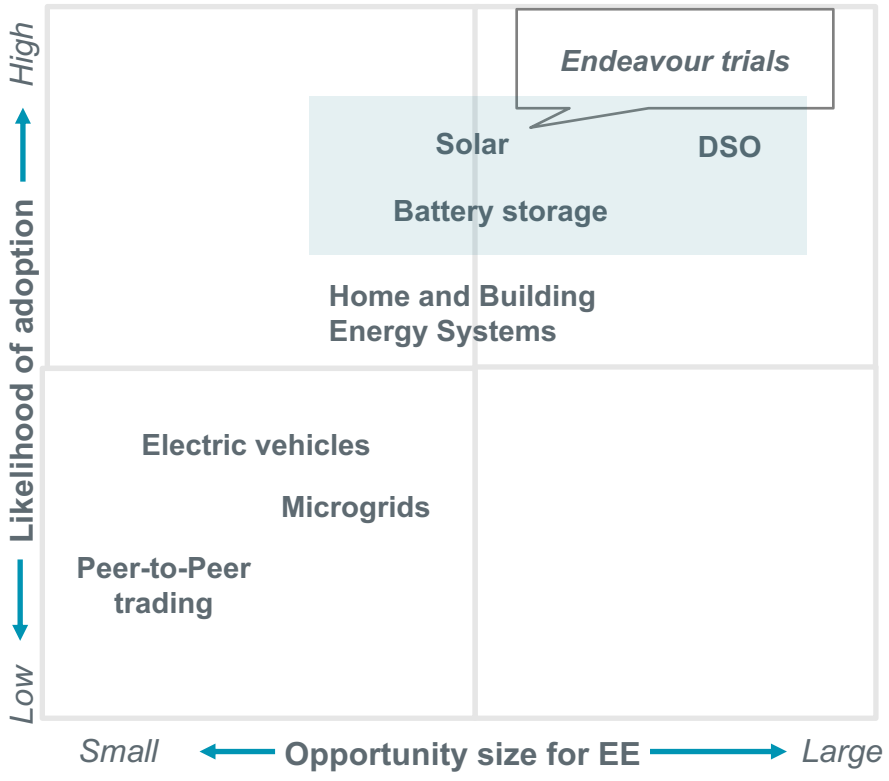
CHANGING CUSTOMER ENERGY NEEDS AND TECHNOLOGY ADVANCEMENTS WILL HAVE SIGNIFICANT IMPACTS ON OUR NETWORK - INNOVATIVE TRIALS ARE CURRENTLY UNDERWAY

Emerging Technology *Summary*

Solar PV	Solar PV is the technology of converting sunlight into electricity.
Battery Storage	Batteries are used to store electrical energy (stationary as well as EV batteries).
Micro-grids	A group of distribution energy resources (DER) and loads with clear network boundaries, can operate in island-mode and are controllable as a single entity.
Electric vehicles	Plug-in passenger EVs including EV charging technology.
DSO/ Home and building energy system	Energy management system that enable measure, monitor, control, and optimisation of energy consumption in most efficient and cost-effective way.

New emerging technology

Likelihood of adoption vs Opportunity size



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LOOKING FORWARD:
WHAT ARE THE JUDGEMENTS OF SIGNIFICANCE?

- What is our role in tomorrow's network?
  - Is it to maintain our role as an asset operator?
  - Is it to enable innovation?
  - Is it to grow unregulated opportunities?

- Where do you want to be on the technology adoption curve?
  - An early adopter or an early majority player (fast follower)?

- How do we leverage technology to become better asset managers?
  - Poles and wires asset manager
  - Broader supply options

THANK YOU

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