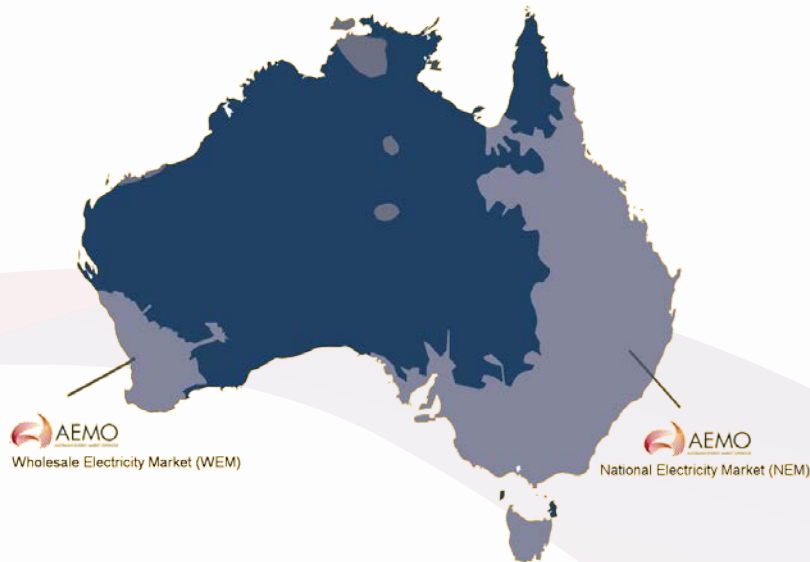


Navigating the transition to the fourth revolution



Audrey Zibelman
Managing Director and Chief Executive Officer

About AEMO



We operate Australia's National Electricity Market and power grid in Australia's eastern and south-eastern seaboard, and the Wholesale Electricity Market and power grid in south-west WA.



Both markets supply more than 220 terawatt hours of electricity each year.



We also operate retail and wholesale gas markets across south-eastern Australia and Victoria's gas pipeline grid.



Collectively traded more than A\$20 billion in the last financial year.



Ownership

40%

Market participants

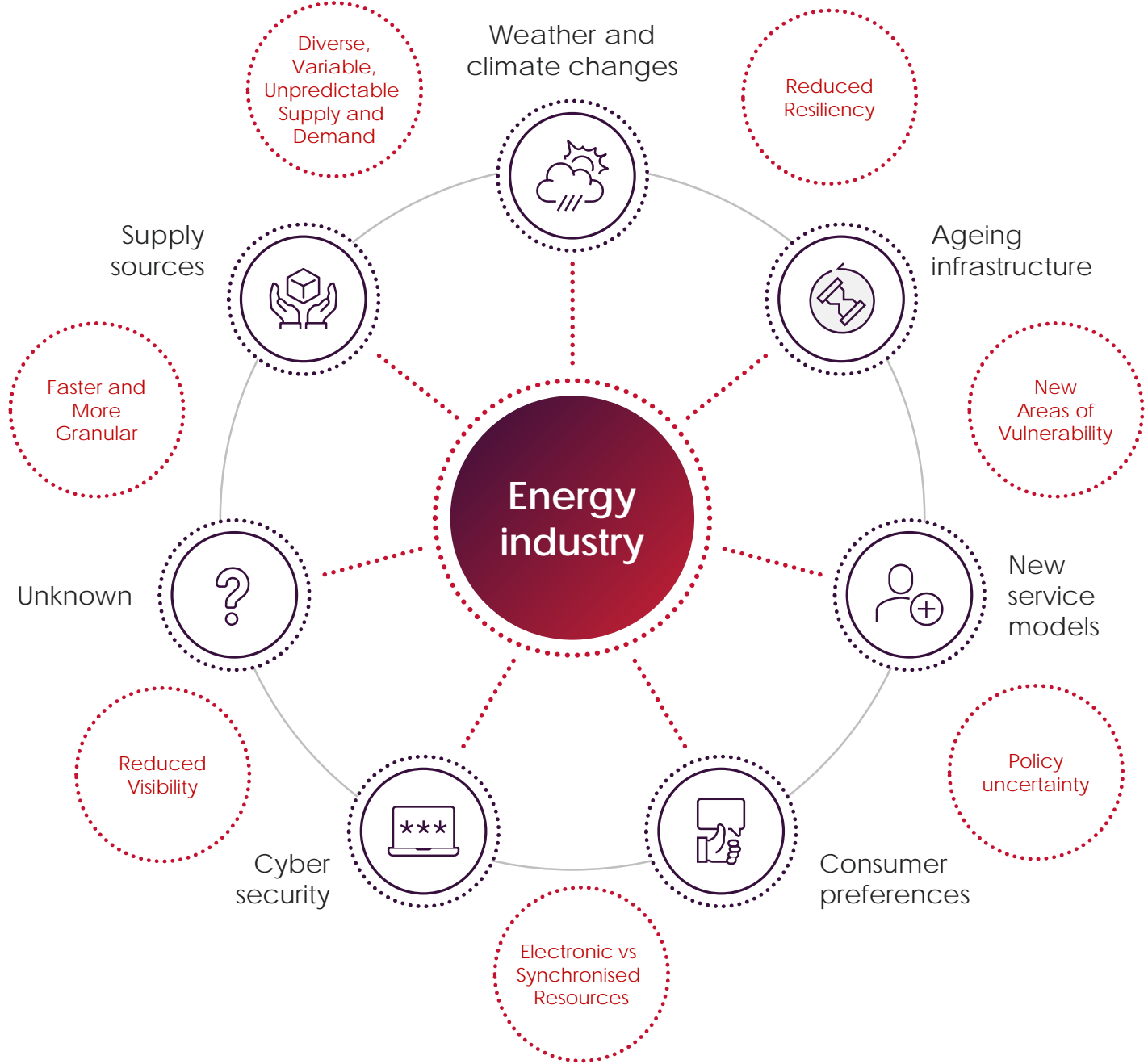
60%

Governments of Australia

Our industry is in disruption

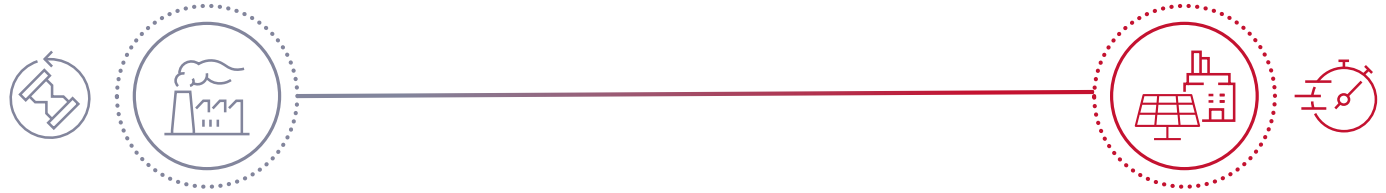


Drivers of disruption









Changes in resources



In **2013** there were **22 active projects** totaling **1,231 megawatts**

Fast forward to **2018**, there are currently over **136 connection requests** totaling **19,507 megawatts**

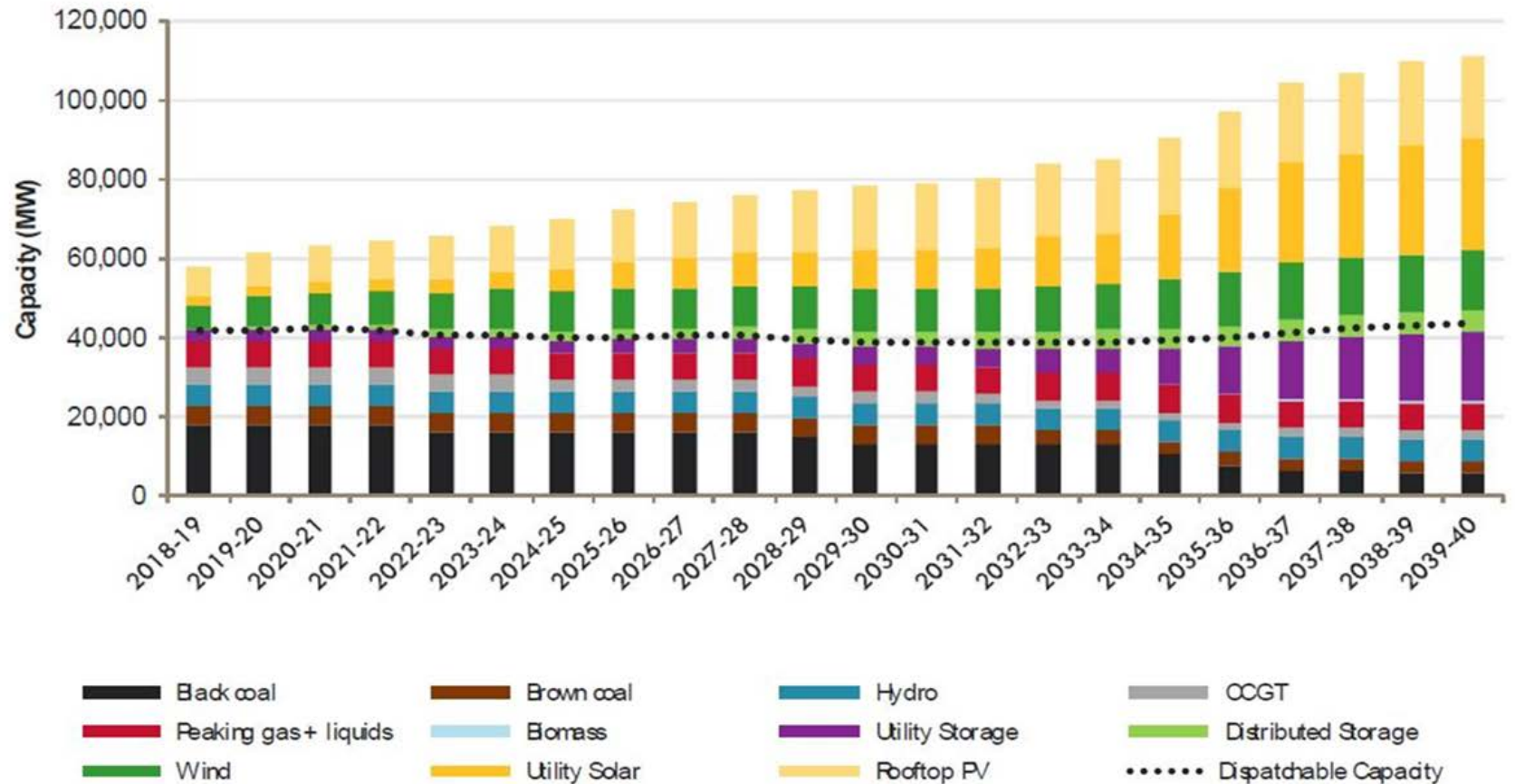
New South Wales

Peak demand		14,700 MW
Current capacity		18,900 MW
New connections		47,000 MW
Coal retirements		1,680 MW in 2022



Projected changes in scale of resources

More capacity required to deliver demand

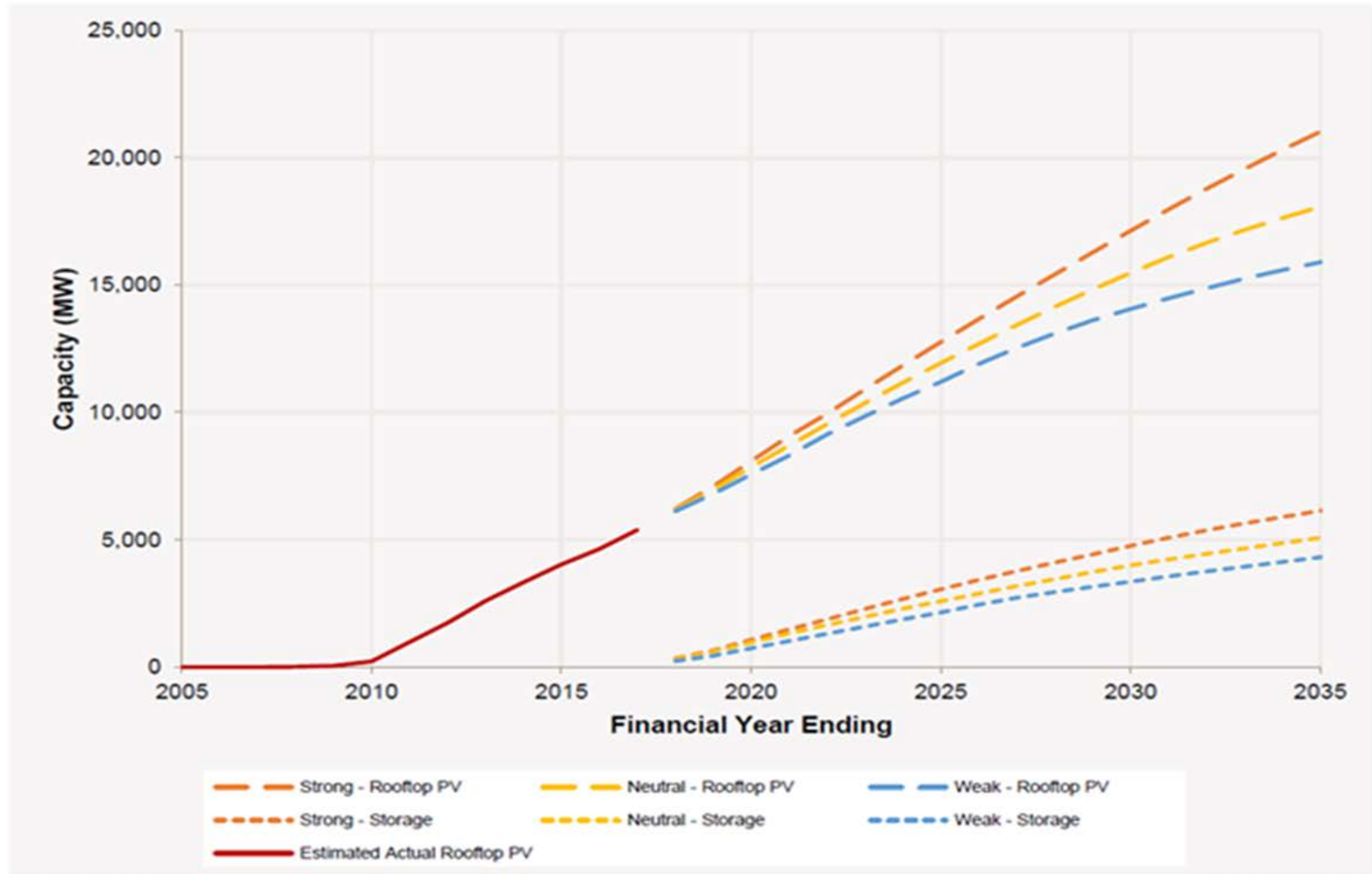




Changes in customer behaviour

A solar panel is being installed every 6.5 minutes in Australia

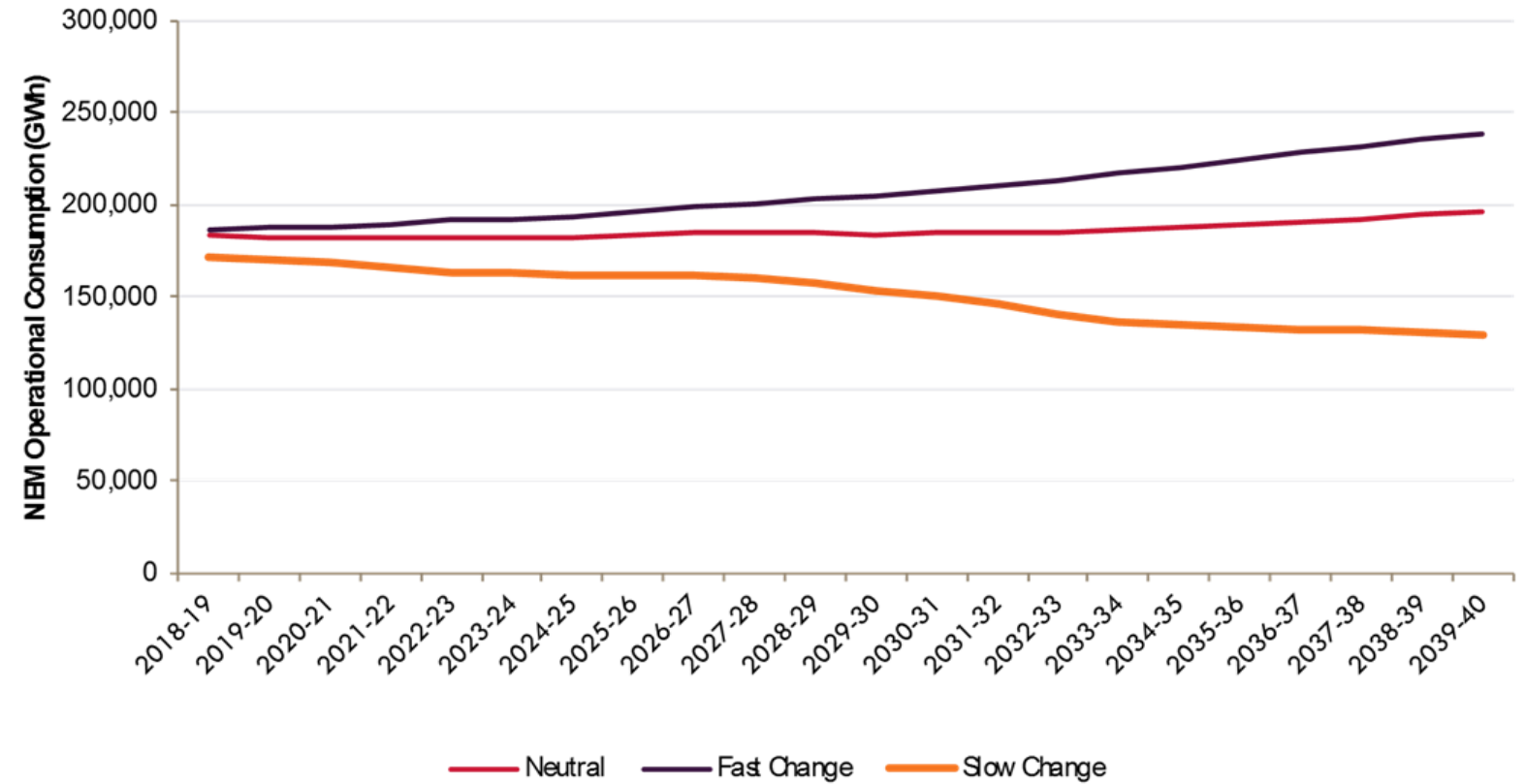
The rapid solar and storage consumer uptake





Changes in
customer
behaviour

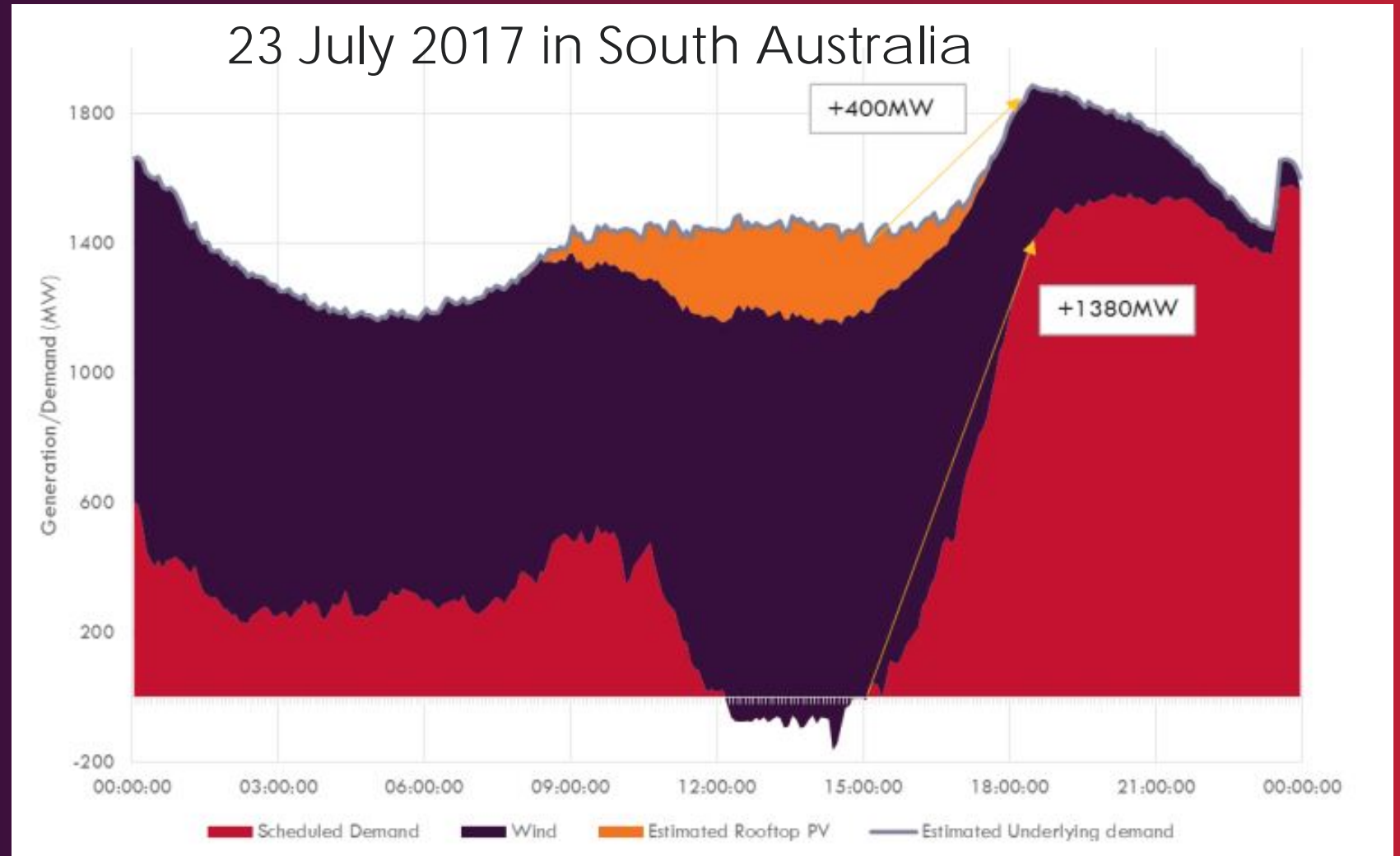
...contributing to a flat demand outlook





Changes leading to operational challenges

Increased variability and flexibility

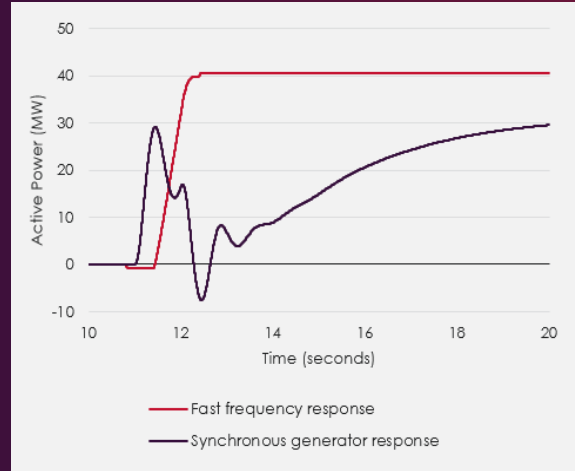


Needing a real focus on frequency and strength

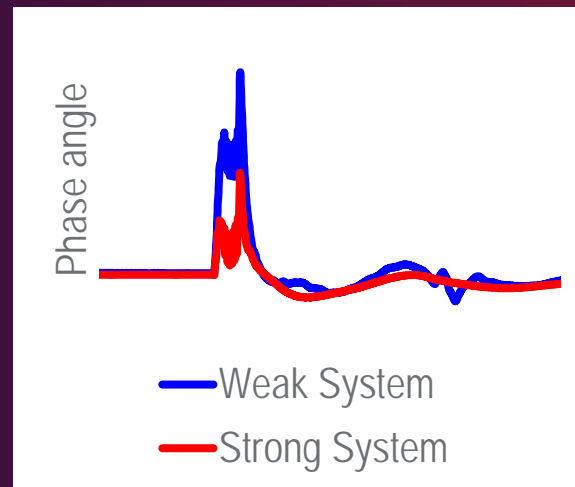


Changes leading to operational challenges

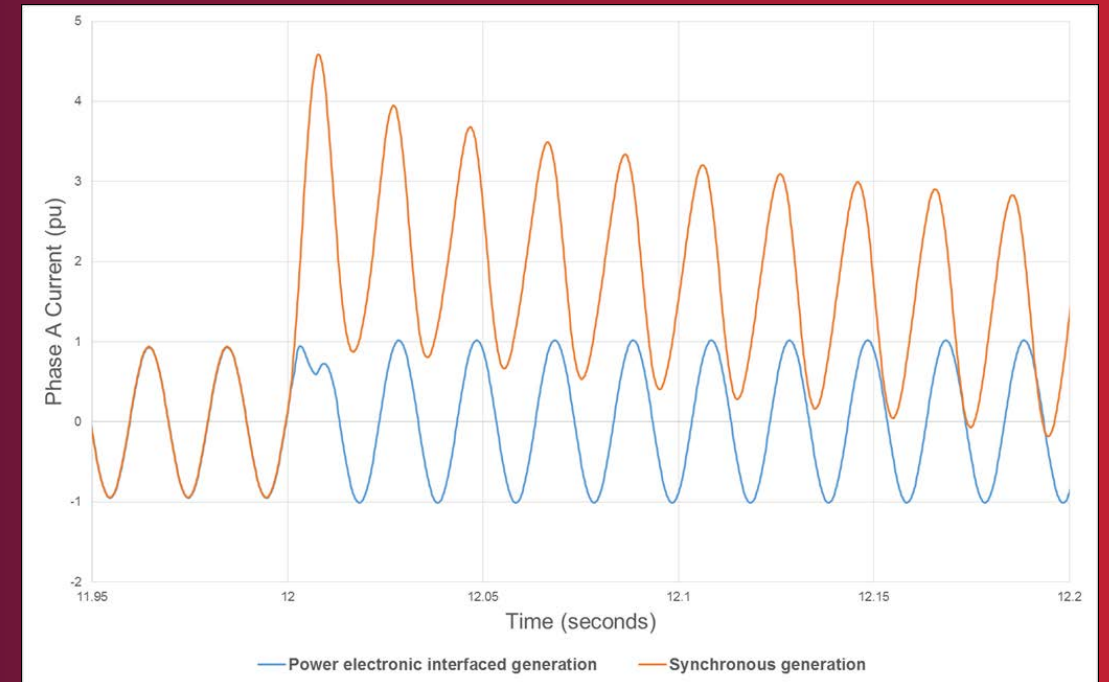
Fast Frequency Response



Voltage phase angle



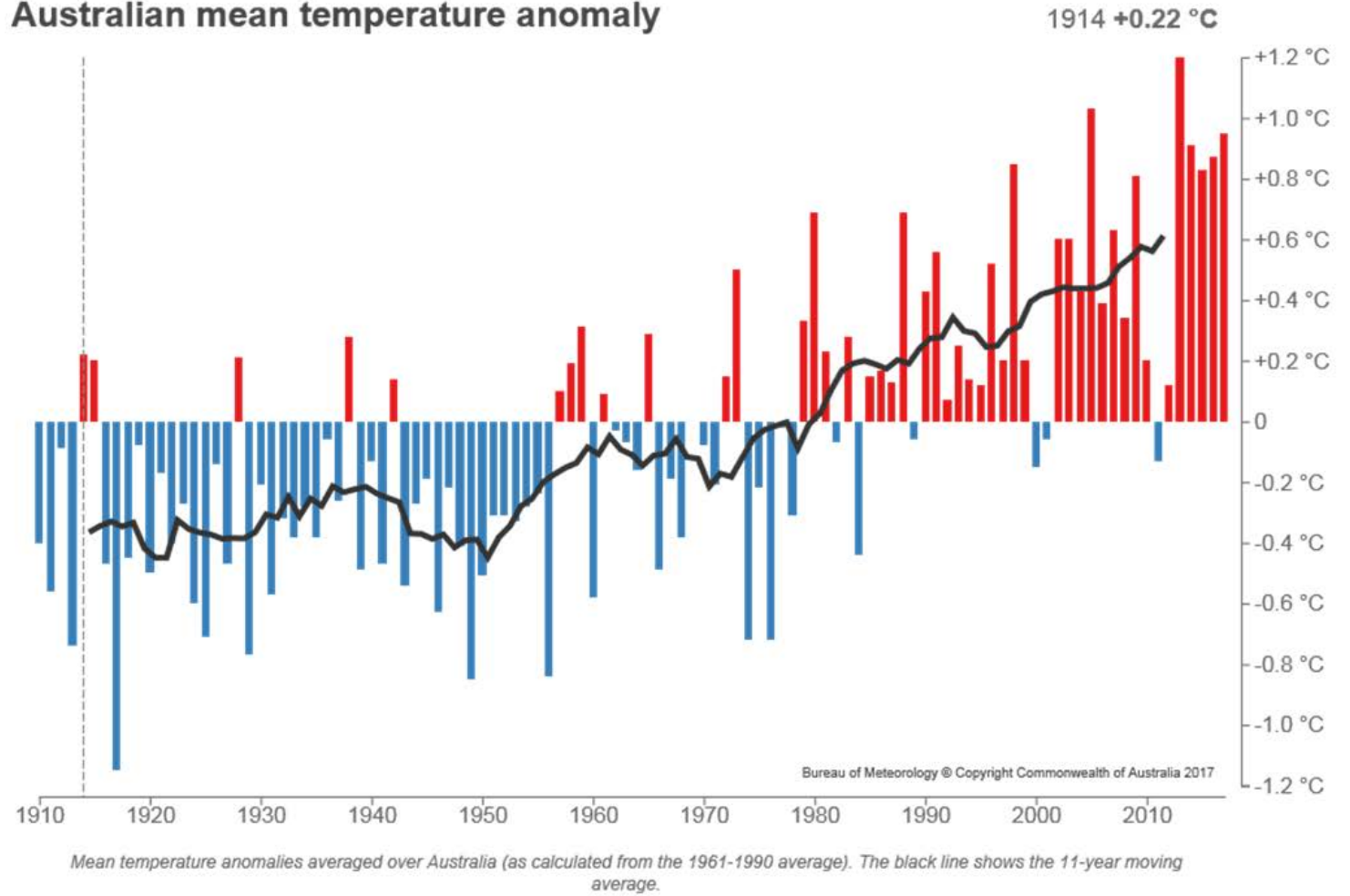
Fault current





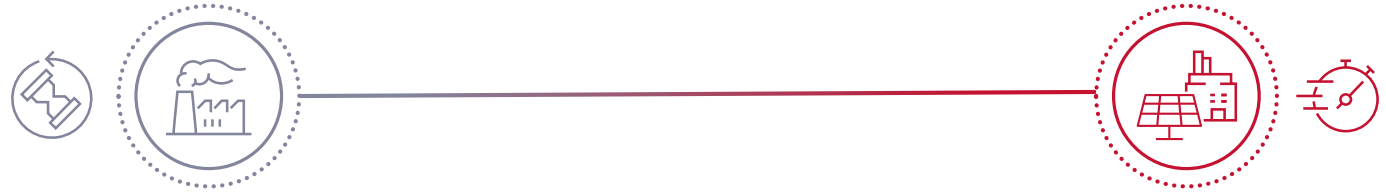
Climate change

Australian mean temperature anomaly





Rate of change



In the **1990s** it took **6+ years** to build a 200 megawatt power plant.

Fast forward to **2018**, it takes **9 months** to build a 200 megawatt solar plant, complete with approvals.



The time taken to determine regulatory reforms has not changed

18-36 months

18-36 months



Cyber security





No worries!

The imperative to adopt 4th industrial thinking



1st

Mechanisation,
water power,
steam power



2nd

Mass production,
assembly line,
electricity



3rd

Computer and
automation



4th

Fusion of physical,
digital and
biological
systems



70 years



5 years



4 years



3 years

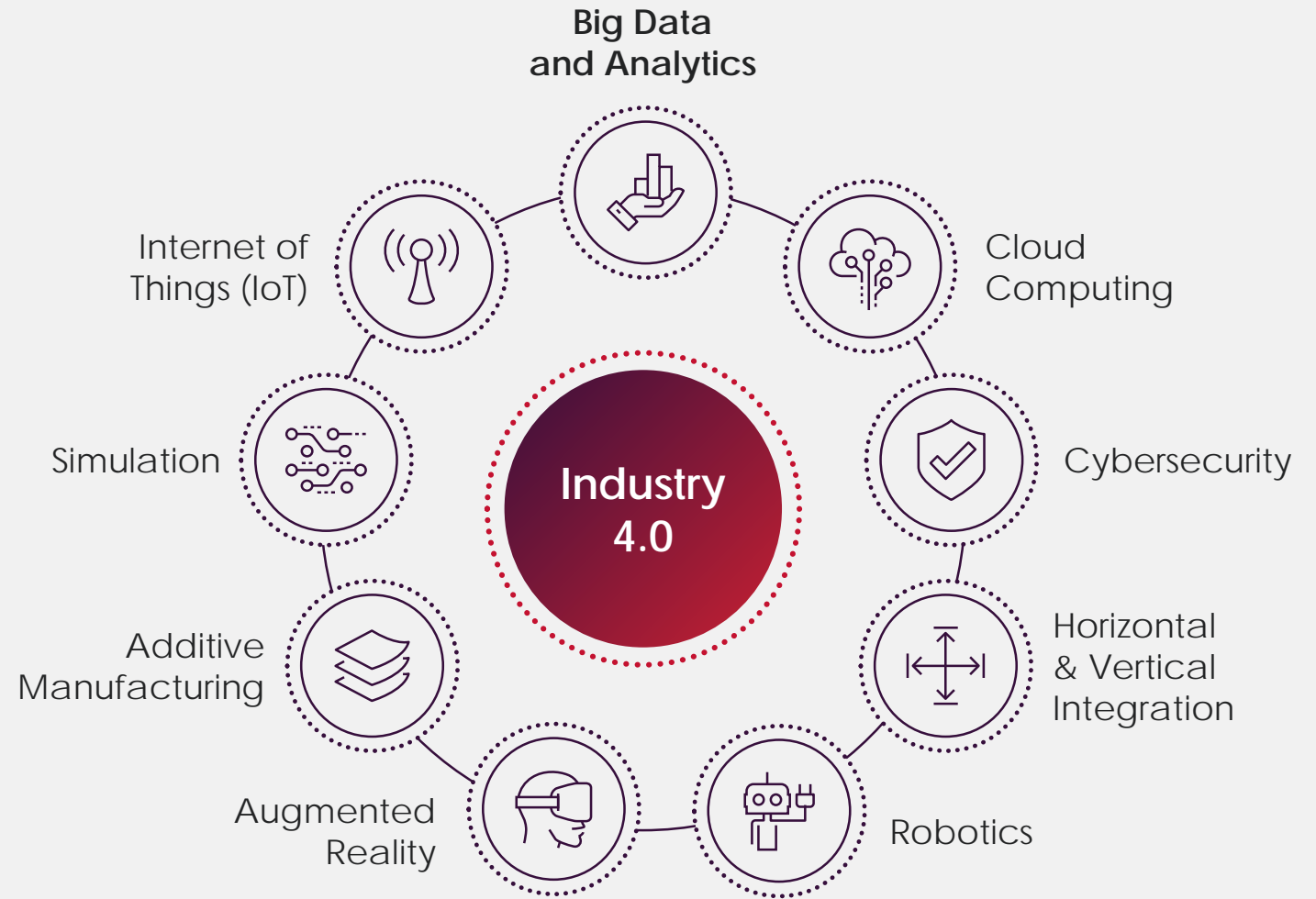


1 year

*“We won’t experience 100 years of progress in the 21st century – it will be more like 20,000 years of progress”
Kurzweil*

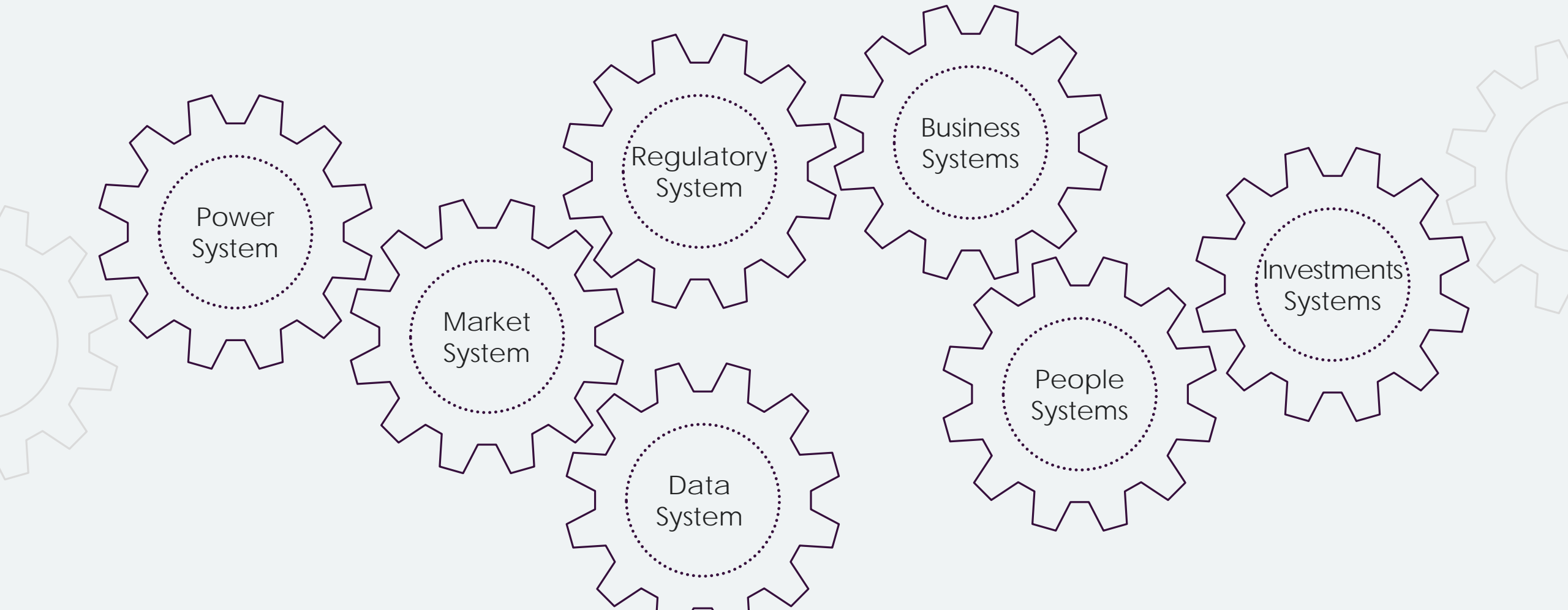
Characteristics of industry 4.0

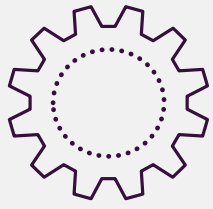
- Dynamic
- Extreme pace of change
- Interconnected economies
- Integrated systems
- People systems



Applying 4th revolution approaches

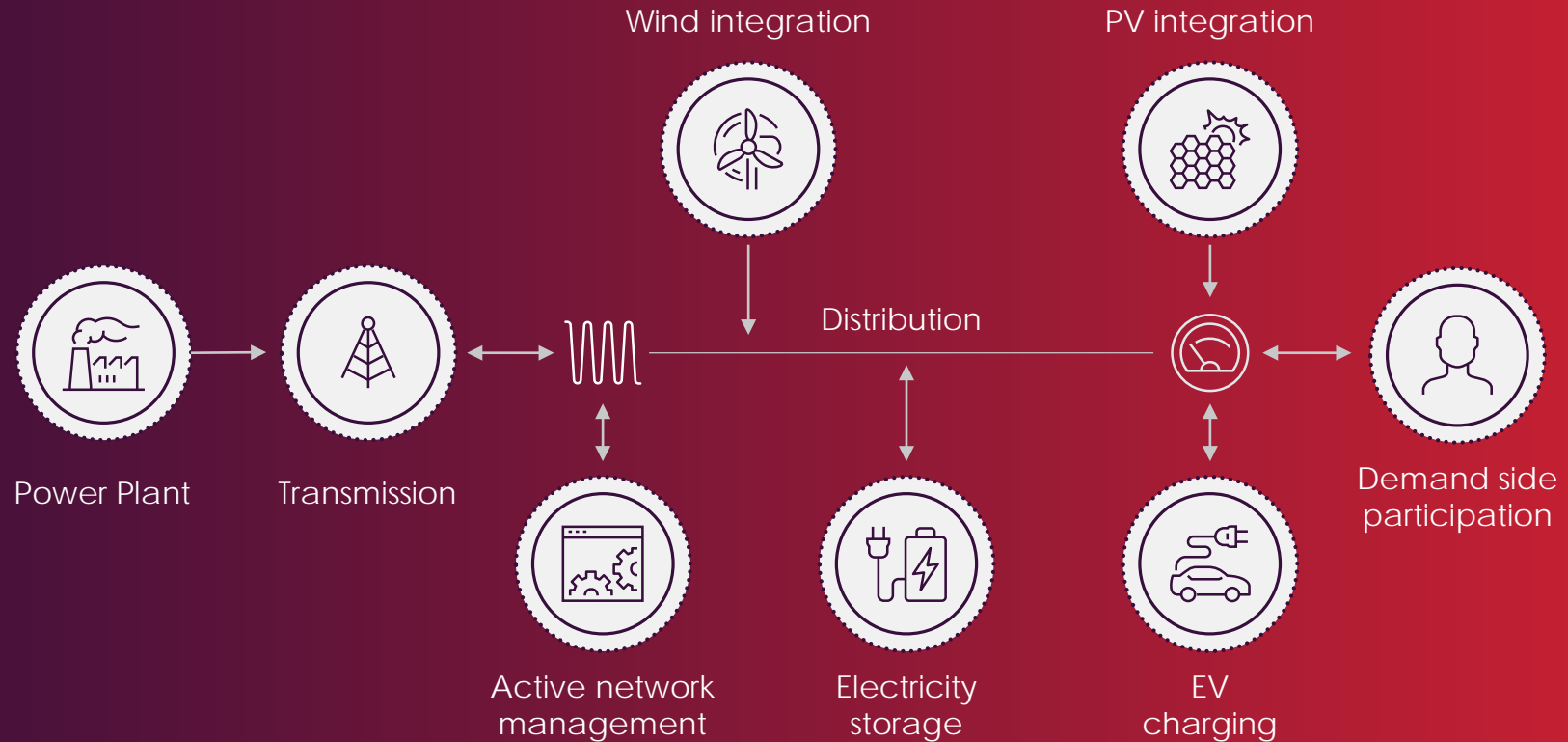
Adopting a system of systems approach





Power system

- Huge computational models for forecasting
- Multiple data inputs from more sources
- Digitalisation allows value to be determined at more granular level
- Optimisation of entire supply chain





Market system

Market models that:

- value **flexibility** and **availability**
- support multi directional flows
- reward household level generating resources
- facilitate aggregators, prosumers and new and emerging business models

The evolution of the energy ecosystem demands an evolution to the market system



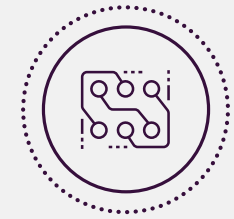
Market constructs

need to be flexible and neutral to adapt and enable new entry entrants



Markets designed

to enable the optimisation of all available resources



Zero marginal cost generation

need to value necessary flexibility and support services where energy is 'free'



Data systems

Applying AI to systems solutions for situational awareness

Pre 2010

6 data points per customer meter read

2015

9,000 data points – for five minute reads

2021

Over 100,000 data points – near real time reads



Huge growth in big data – from 6 data points to over 100,000 data points annually



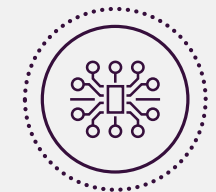
Reducing barriers to entry by investing in whole grid



Harnessing digitalisation to make things work



Using data to manage the system in an efficient way



Leveraging technology and assets



Business systems

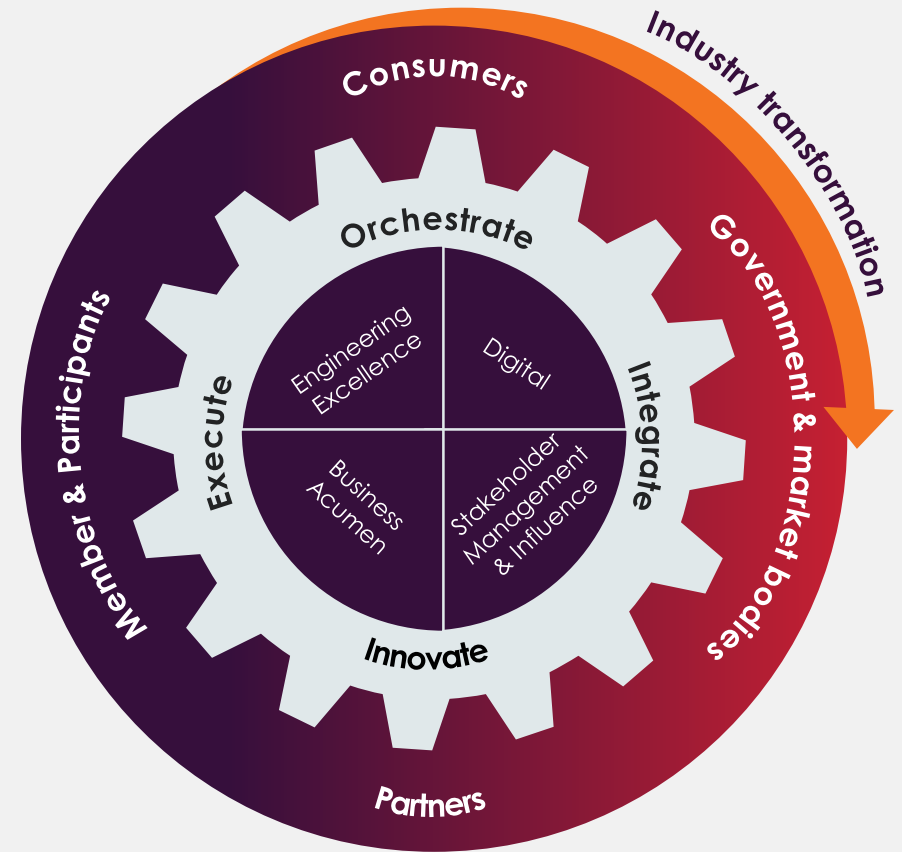


Apply design thinking to our approach.



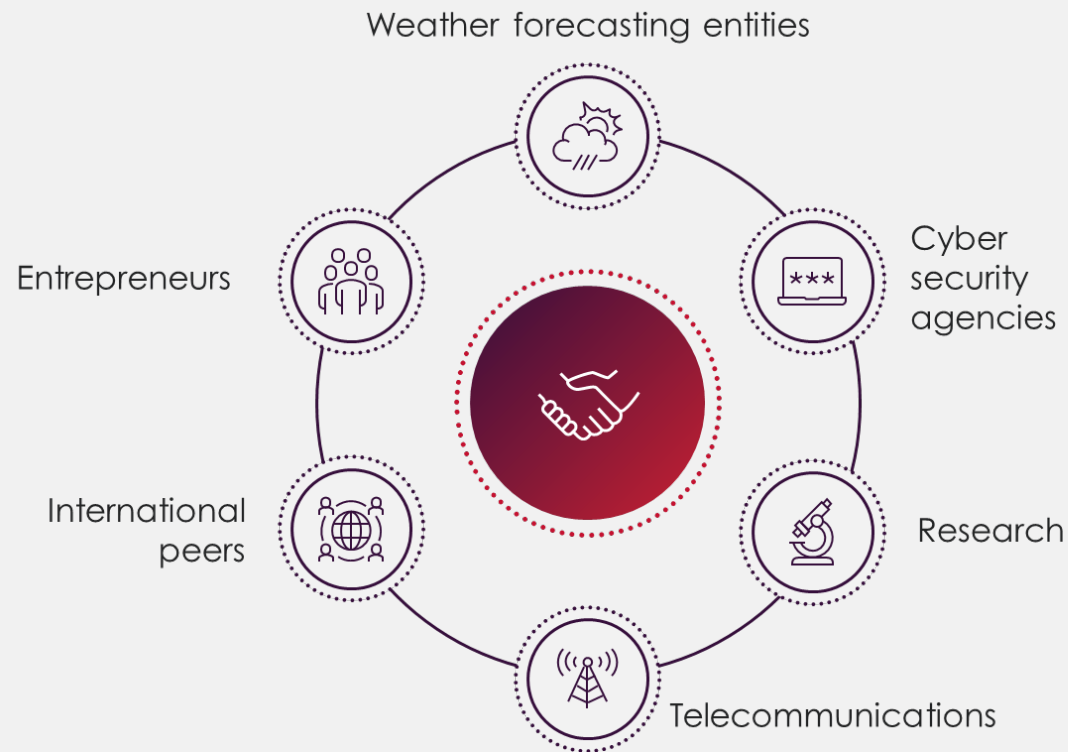
Can no longer solely look at challenges through our own lens – need situational awareness to meet the needs of our stakeholders and consumers

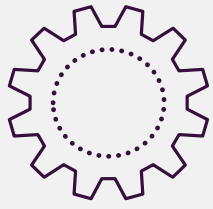
Adopting a consumer focus



Strategic partnerships will be crucial

Collaborate and partner with range of stakeholders to leverage capabilities where synergies exist

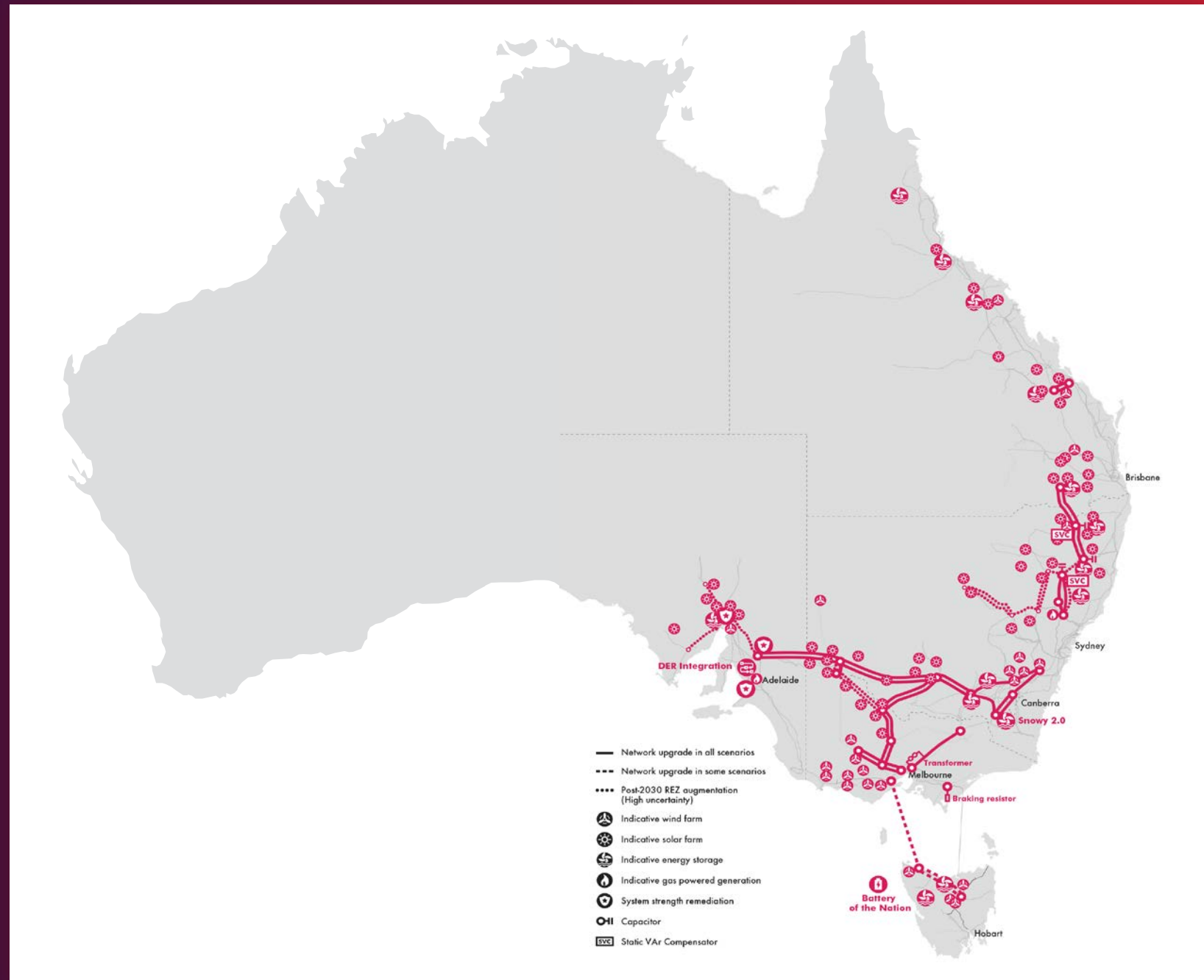




Investment system

Need to optimise capital investment

Where investments can be made to leverage assets and resources, creating value for consumers.

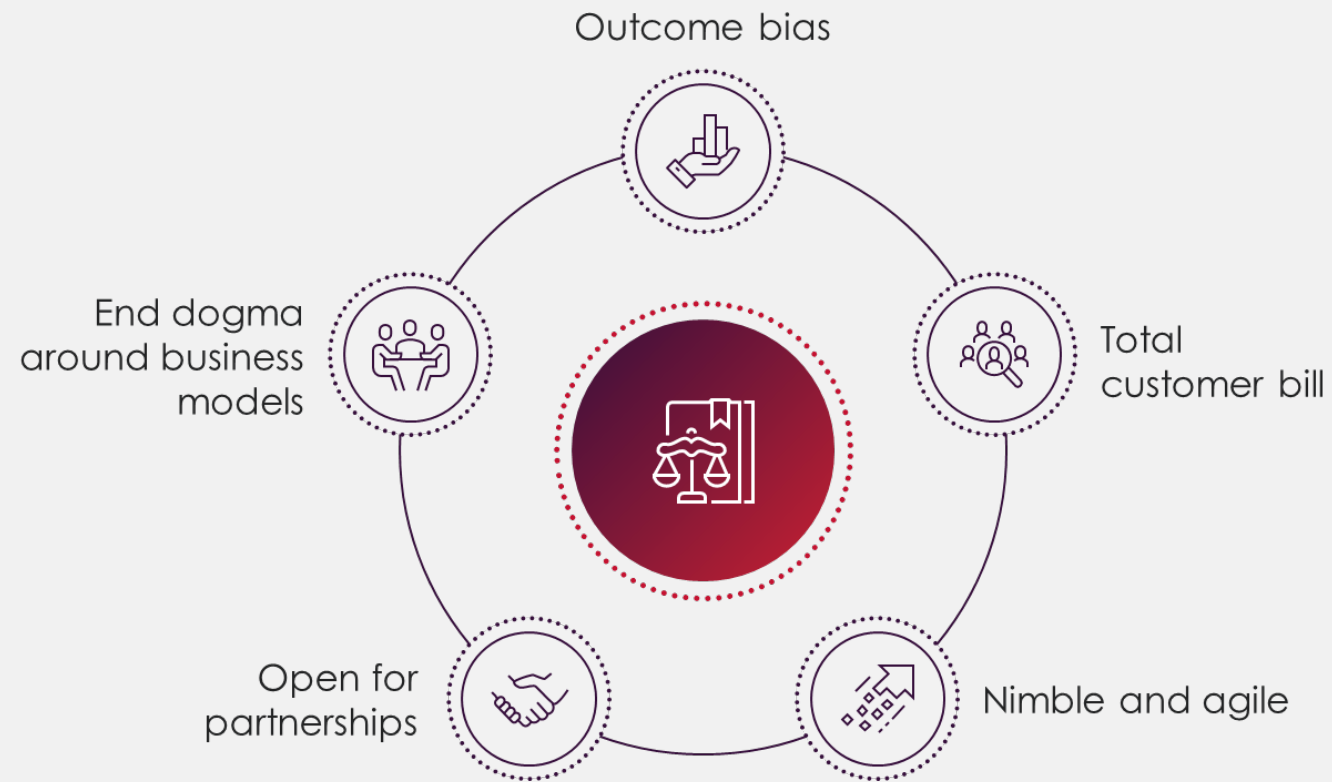


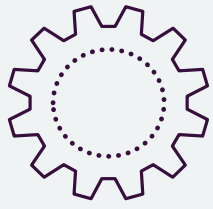


Regulatory systems

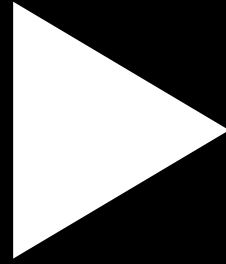
Creating an adaptive entity requires adaptive regulation and policy

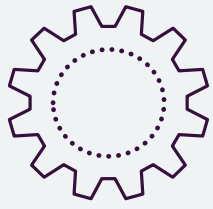
Adaptive regulation and policy





People systems





People
systems

