2019-20 Forecasting & Planning Scenarios

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Purpose of this workshop

Scenario development

Provide overview of how the scenarios to be used in 2019-20 ISP have been developed

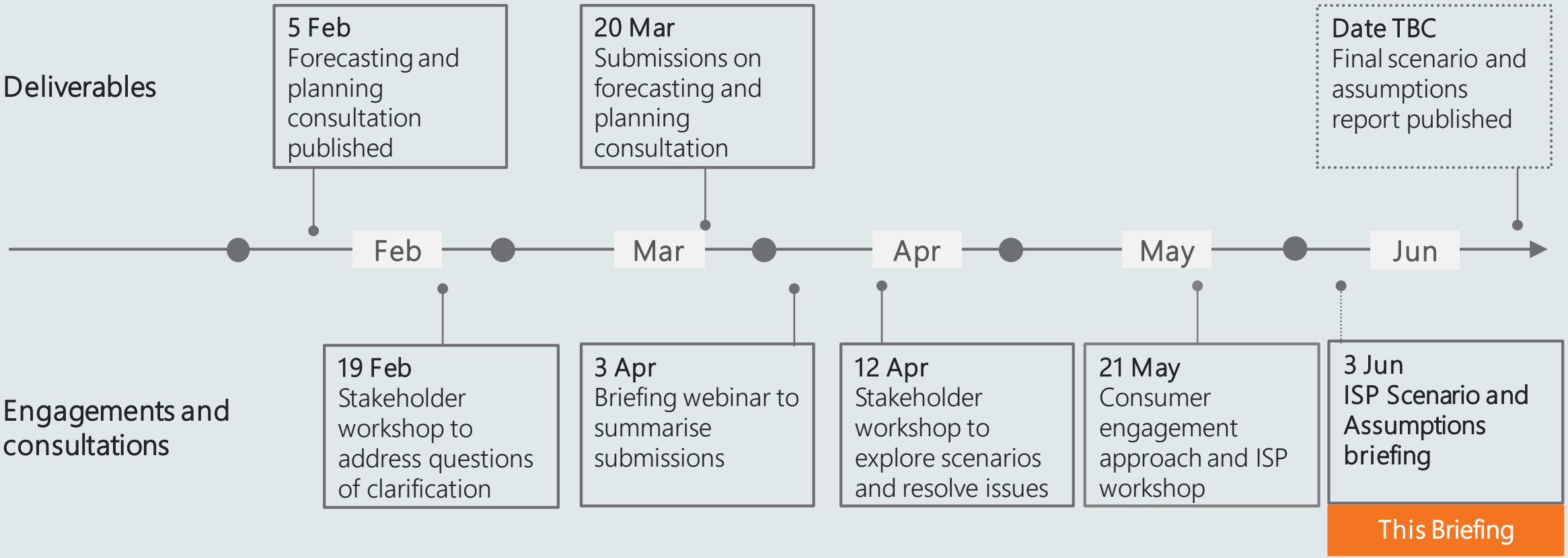
Designed in response to stakeholder feedback

Policy assumptions and inputs

Discuss key inputs that shape the scenarios, and outline next steps in the ISP process

Designed to understand risks and impacts

Stakeholder engagement and consultation process to date



Feedback received from consultation submissions

Theme	Frequency	Consensus
- The **consultation process** and the efforts being made to increase engagement with stakeholders are positive	High	High
1 **Emissions reduction modelling** needs to explicitly incorporate policies and account for stricter trajectories	High	High
2 The current **scenarios** do not sufficiently capture the range of possible energy futures	High	Medium
3 The modelling of **generator retirements** needs to account for earlier retirements, and be based on more than technical retirement age	High	Medium
4 Improvements can be made to the **Distributed Energy Resources** modelling approach	High	Low
5 A commercial **discount rate** should be used, as opposed to a social discount rate below the WACC	Medium	High
6 Increase the transparency and dynamism of **Marginal Loss Factor** modelling	Medium	Medium
7 The establishment of more **Renewable Energy Zones** and their modelling	Medium	Low
8 When modelling benefits, incorporate **ancillary benefits and services**, or establish a market for these services	Low	High
9 **System strength** is an important issue and improvements need to keep being made in terms of how to incorporate it effectively into the models	Low	Medium
10 **Resilience modelling** approach: Both HILP and mitigation options	Low	Low

From consultation to publication

- Additional consultation prior to commencement of ISP 2019-20:
  - June-July 2019
    - Renewable Energy Zone workshop
  - September 2019
    - Tentative timing for stakeholder forum on early draft modelling outcomes
  - December 2019
    - Draft ISP released, seeking feedback
  - January-April 2019
    - Consultation, remodelling
  - Mid 2020 (dates to be confirmed):
    - Final ISP released

Consultation prior to commencement of ISP 2020-21:

- Work starts on ISP 2020-21 (early tentative dates)
  - August 2019 - October 2019
    - Generator cost projections for 2020 forecasting
  - November 2019 – March 2020
    - Consultation, workshops on scenarios, assumptions and inputs for ISP 2020-21
  - April 2020
    - Final scenarios and assumptions report
  - December 2020
    - Draft ISP released, seeking feedback

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

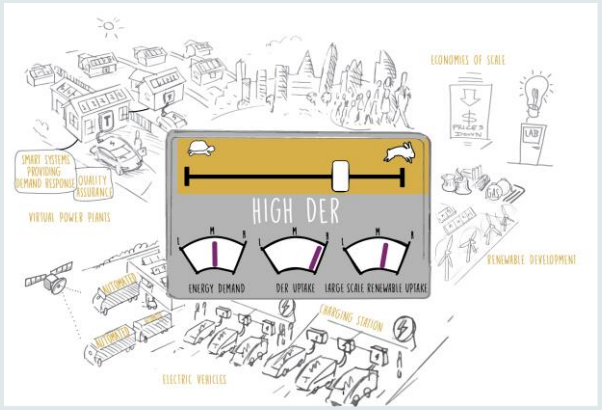
ISP scenario overview

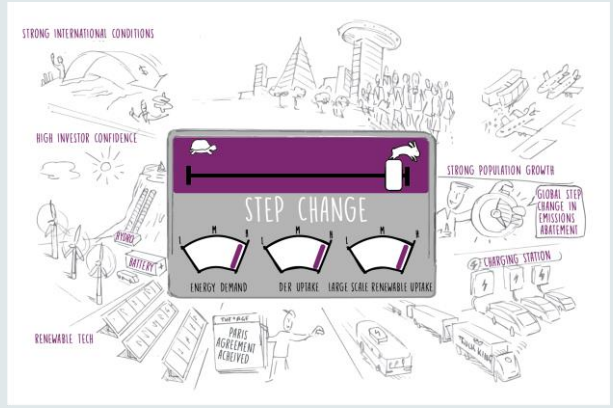
For 2019-20 ISP

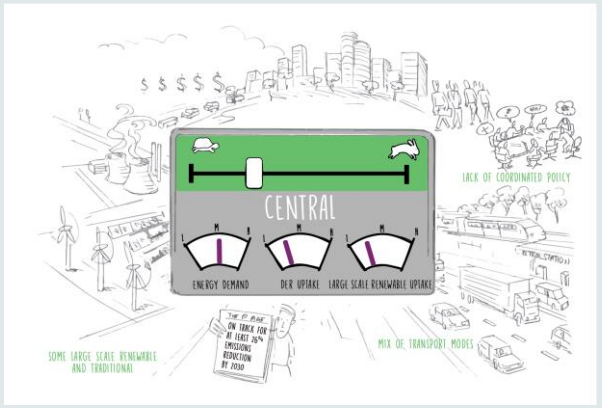
AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

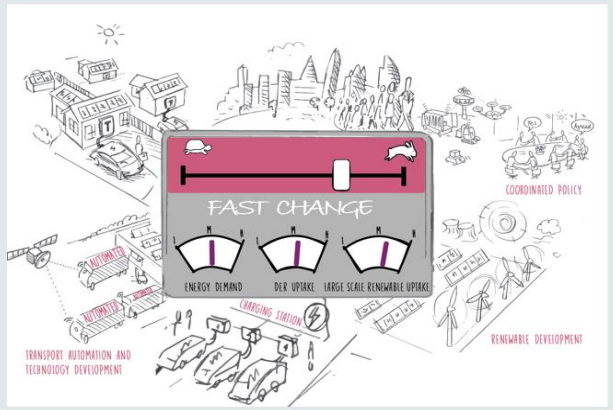
Five scenarios capturing key uncertainties

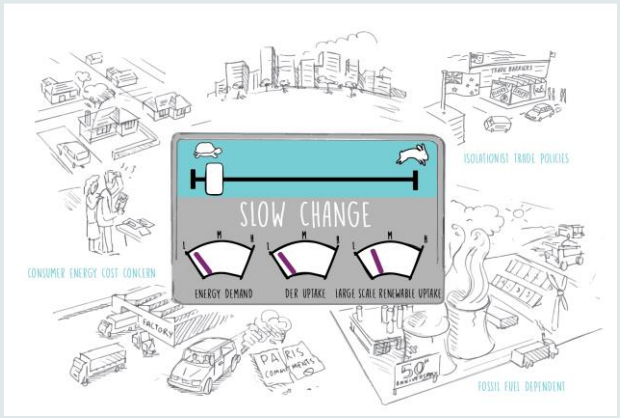
Decentralisation









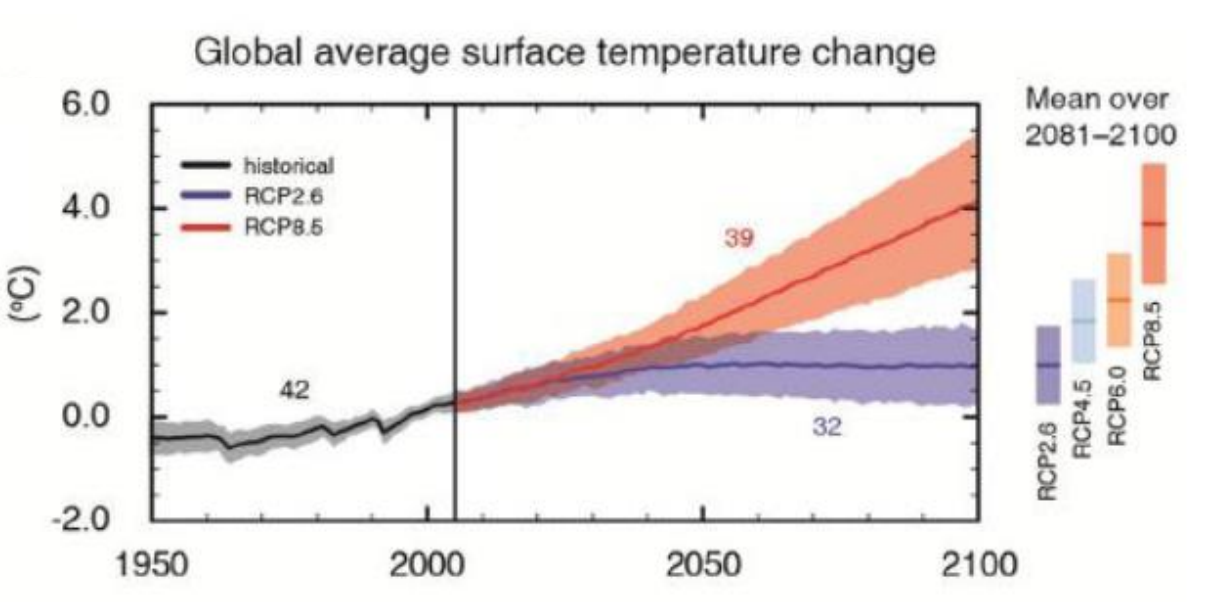


Decarbonisation

Scenarios framed by science based climate pathways…

Climate pathways

Adoption of Representative Concentration Pathways (RCP)

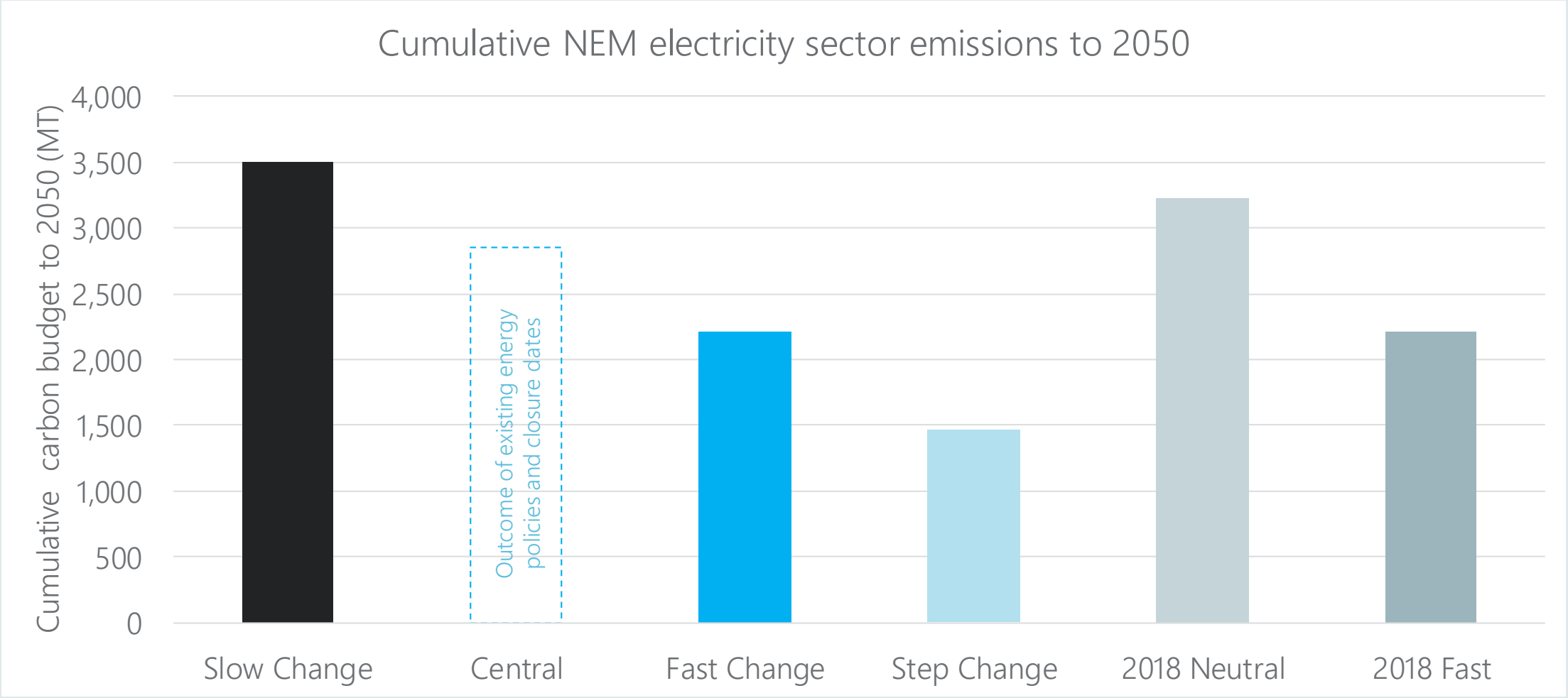


- Capture the physical symptoms of climate change
- The most likely current global emissions trajectory is consistent with RCP7.0, considering current global commitments to the Paris Agreement (e.g. 26% for Australia by 2030)

Scenario	RCP	Temperature impacts in southern Australia (assuming similar trends globally)
Step Change	RCP 2.6	1.7 – 1.8 ˚C
Fast Change	RCP 4.5	2.5 – 2.7 ˚C
Central	RCP 7.0	3.2 – 4.5 ˚C
Slow Change	RCP 8.5	>4.5 ˚C

* High DER will reflect the conditions of the Central scenario, with higher DER uptake.

…converted into NEM carbon budgets to 2050…



High DER will reflect the conditions of the Central scenario with higher DER uptake.

…with resultant emission trajectories determined from modelling

Scenario	Minimum emissions reduction by 2050 (relative to 2005)
Step Change	95%
Fast Change	90%
Central	TBC (26% by 2030)
Slow Change	33%

*High DER will reflect the conditions of the Central scenario with higher DER uptake.

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Central scenario incorporates current policy settings

- AEMO proposes to incorporate government environmental and energy policies into its Central scenario where:
  - (a) there is a current policy commitment with clear articulation of when and how it impacts the power system, ***and***
  - (b) any of the following criteria are met:
    - a commitment has been made in an international agreement;
    - the policy is legislated;
    - the policy has received funding in a State or Federal government budget;
    - there is evidence that the policy is highly likely to be implemented.
- Policies which are less certain, but reasonably likely, will be modelled as sensitivities.
- AEMO will develop its inputs with respect to government policy **in consultation with governments** and other stakeholders.

Central scenario incorporates current policy settings

Policies	Included?
26% emission reduction by 2030	✓
Victorian renewable energy target (50% by 2030)	✓
Queensland renewable energy target (50% by 2030)	✓
Large-scale renewable energy target	✓
Snowy 2.0	✓
Battery of the Nation	Sensitivity
Distributed energy resource and energy efficiency policies	✓

In other scenarios, policies that are not legislated will only be included if consistent with the scenario narrative.

Given there is not yet a specific mechanism for achieving QRET, a sensitivity around the central scenario without QRET will also be tested.

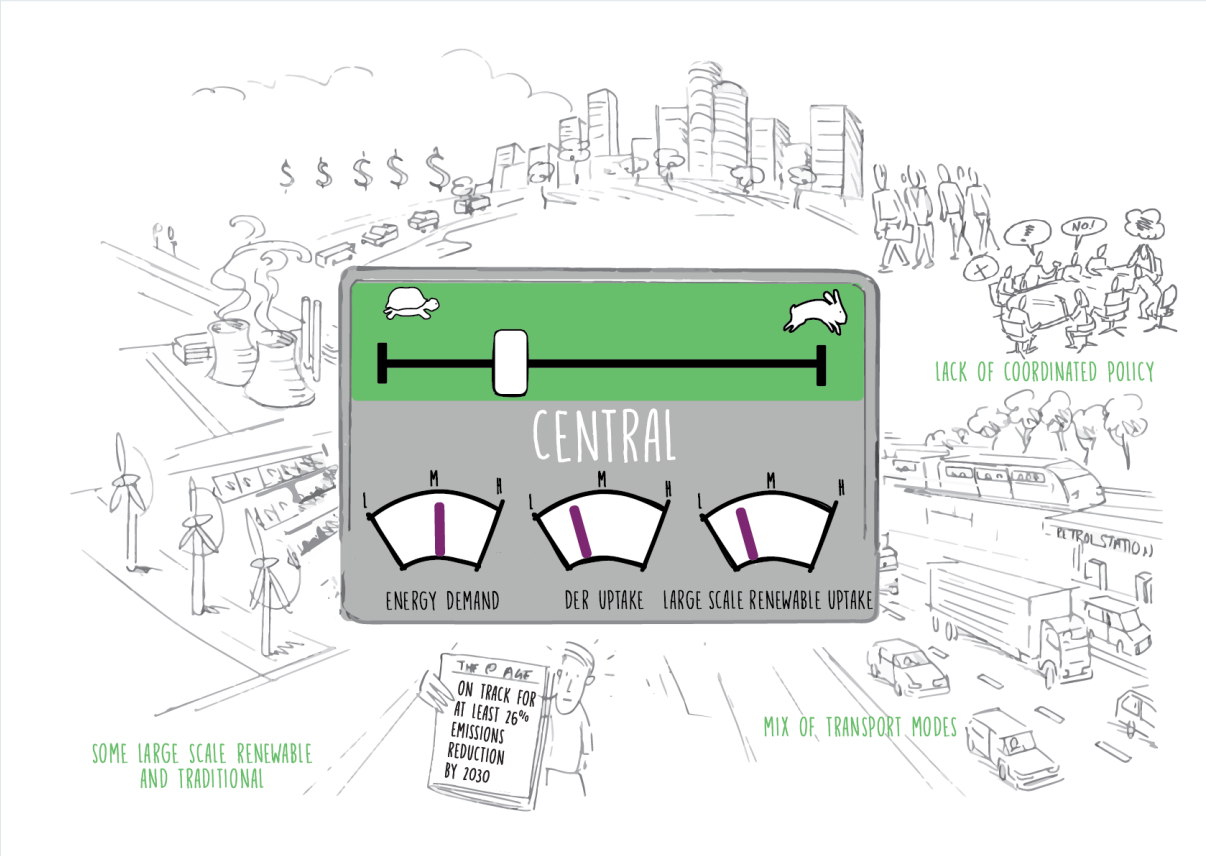
Scenarios narratives

For 2019-20 ISP

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

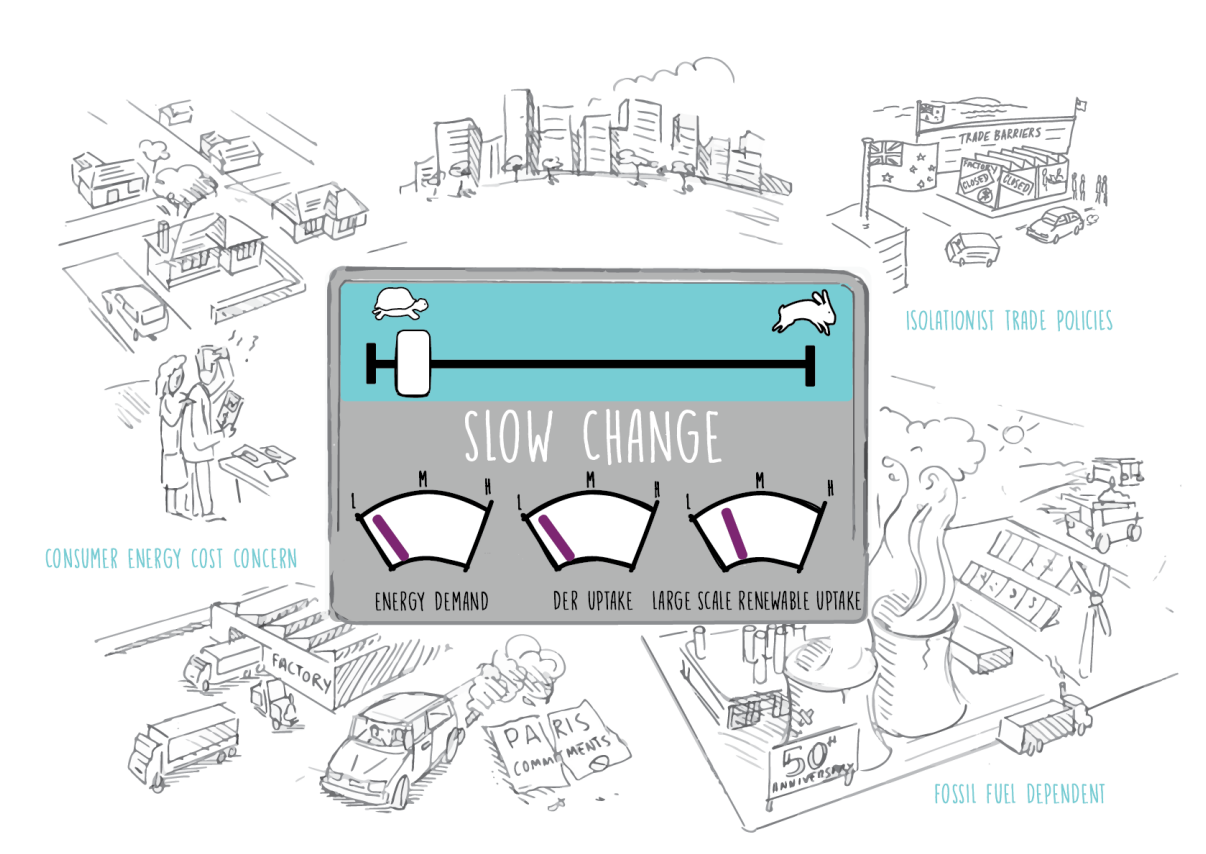
Central scenario

This scenario includes current federal and state energy policies



- Global economic growth is in line with 'central' estimates.
- Gradual improvement in technology – innovation and cost reductions in renewable and consumer technologies
- Adoption of EVs is slow as vehicle prices are slow to reduce, and vehicle model availability is limited in the short/medium term
- Moderate uptake of consumer DER, with consumers selecting DER to manage energy more affordability
- Economics, rather than policy, is driving industry change. Global commitments to climate change do not lead to strong increases in commitments to meet Paris Agreement goals (with countries not wishing to 'go it alone').
- Coal generation is being retired on schedule, rather than forced to close from policy measures. Energy sector change is evolutionary and gradual
- Climate change leads to higher temperatures and more extreme weather conditions, leading potentially to greater frequency of extreme or peakier demands

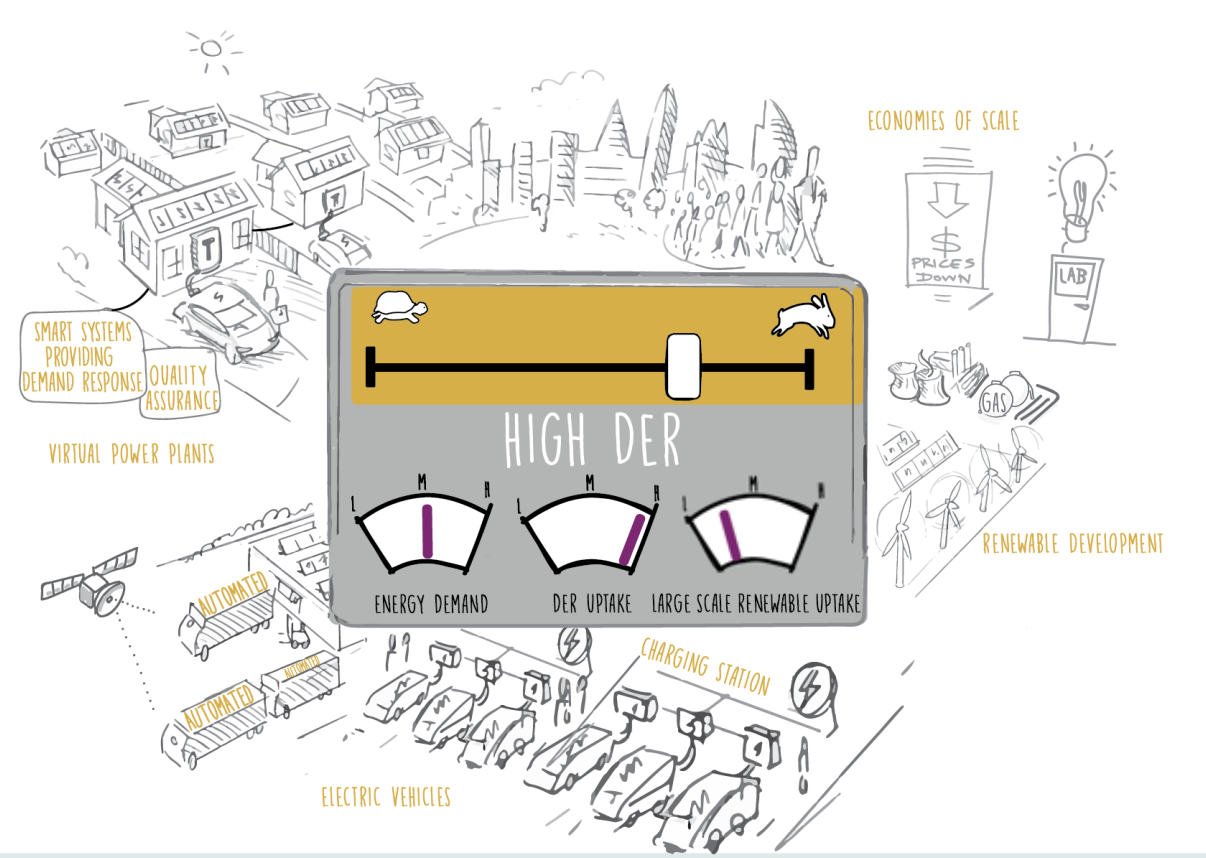
Slow Change



- Challenging global and local economic conditions lead to greater focus on domestic economic growth, with less international trade.
- International innovation is lower, leading to slower cost reductions of renewable energy / energy storage devices
- Weak economic conditions lead to higher project financing costs and closure of some industry
- Less capacity for and interest from consumers to control energy bills resulting in lower Distributed Energy Resources (DER) investment with no forthcoming policy support to compensate
- Adoption of electric vehicles (EVs) is limited as vehicle prices remain high and Australia does not strategically promote manufacturers to deliver models suitable for Australian conditions
- Generation technology transition is limited. Renewable investment slows. Thermal fleet is maintained at least to technical life based on positive economic case for continued operation. Limited political, commercial and social support for taking action on climate change.
- Climate change leads to higher temperatures and more extreme weather conditions, leading potentially to greater frequency of extreme or peakier demands

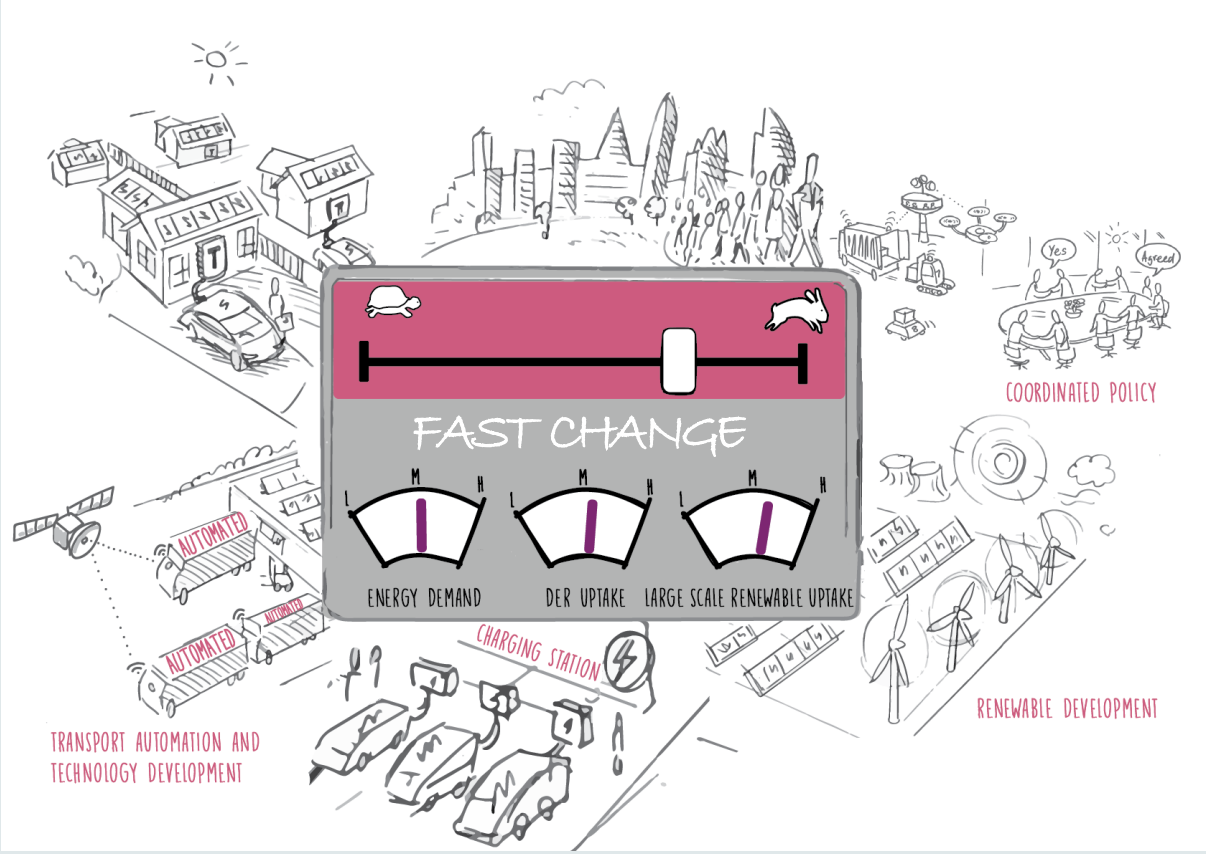
High DER

This scenario includes current federal and state energy policies



- Global economic growth and renewable generation policies are in line with 'central' estimates
- Emissions commitments in line with Central Scenario
- Highly digital society leads to strong innovation of easy to use, interactive and engaging consumer technologies. Consumers embrace broad technology innovations, driving significant industry change through DER uptake
- Society values a stronger role for community, self-sufficiency and sustainability. Consumers recognise the role they, rather than Government policy, must have in achieving energy transformation
- Economics of DER and a supportive policy environment underpin the pace of change
- Physical and technological infrastructure to support DER proliferates, especially with regards to EVs and virtual power plants (VPPs)
- Controllable home devices lead to a stronger role for at-home energy management to optimise own energy use and identify community energy aggregation opportunities

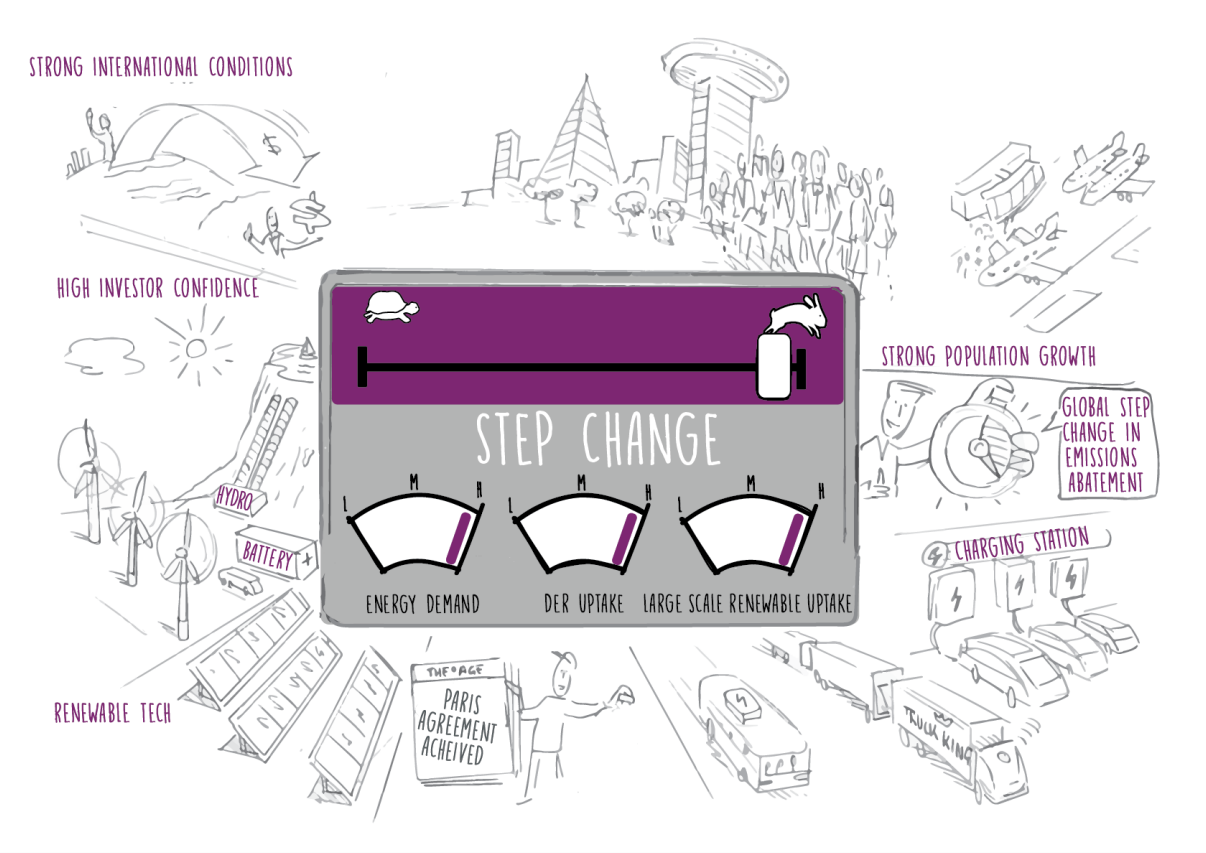
Fast change scenario



- **Global economic growth is in line with 'central' estimates** with significant increases in international commitments to decarbonise. [Despite this, global temperatures still rise just above 2 degrees by 2100]
- **Technology innovations** lead to cost reductions across large- and small-scale technologies in accordance with a decarbonising global economy
- **Moderate/High uptake of consumer DER**, as policy settings are even handed between large-scale and distributed technologies.
- **Fast adoption of EVs** as policy support catalyses infrastructure investments and supportive environment for consumers (model availability, new electricity tariffs)
- **Stronger focus on renewable generation** leads to some opportunities to withdraw coal ahead of technical life
- **Increased energy policy bipartisanship** towards national energy solutions in the longer term lead the market to deliver solutions at the large scale.

Step Change

This scenario represents strong climate action, with a step change in approach triggered by a major climate, political or social event.



- Strong population growth from increased quality and duration of life, and migration. Australia's resources, manufacturing and service industries all profit from this growth and a greater digital economy.
- Very strong international coordination of climate action, with rapid increases of climate commitments to avoid critical climate change
- Greater innovation in digital trends and consumer cost structures lead to stronger consumer energy management
- Technology innovation leads to lower solution costs for large and small scale technologies. Fast rate of development of renewable generation and higher economic growth enables increased DER investments
- Strong electric vehicle penetration and intelligent transport systems are widely adopted, and integrated into the electricity grid. Hydrogen-fuelled vehicles are also part of the mix.
- Strong bipartisanship towards clean energy solutions, with accelerated coal retirements both a function of economic rational behaviour and policy settings to decarbonise

Emission reduction and climate change

Spread of electricity sector decarbonisation objectives for each scenario

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Method

The emissions scenarios were developed using the following process:

1. Global emissions trajectories were established consistent with the scenario narratives.
2. The global trajectories were translated to Australian trajectories using methodologies broadly consistent with the Climate Change Authority[1] (considering global per-capita emissions).
3. The Australian trajectory was adjusted consistent with the scenario narrative to reflect the electricity sector's contribution (leading, parallel, lagging).
4. Assumes that demand from the electrification of other sectors (transport, gas) would be delivered through "zero-emissions" supply.
5. The trajectory was converted to a cumulative budget to allow optimised transition over time.

1. http://climatechangeauthority.gov.au/reviews/targets-and-progress-review-3 (Appendix C)

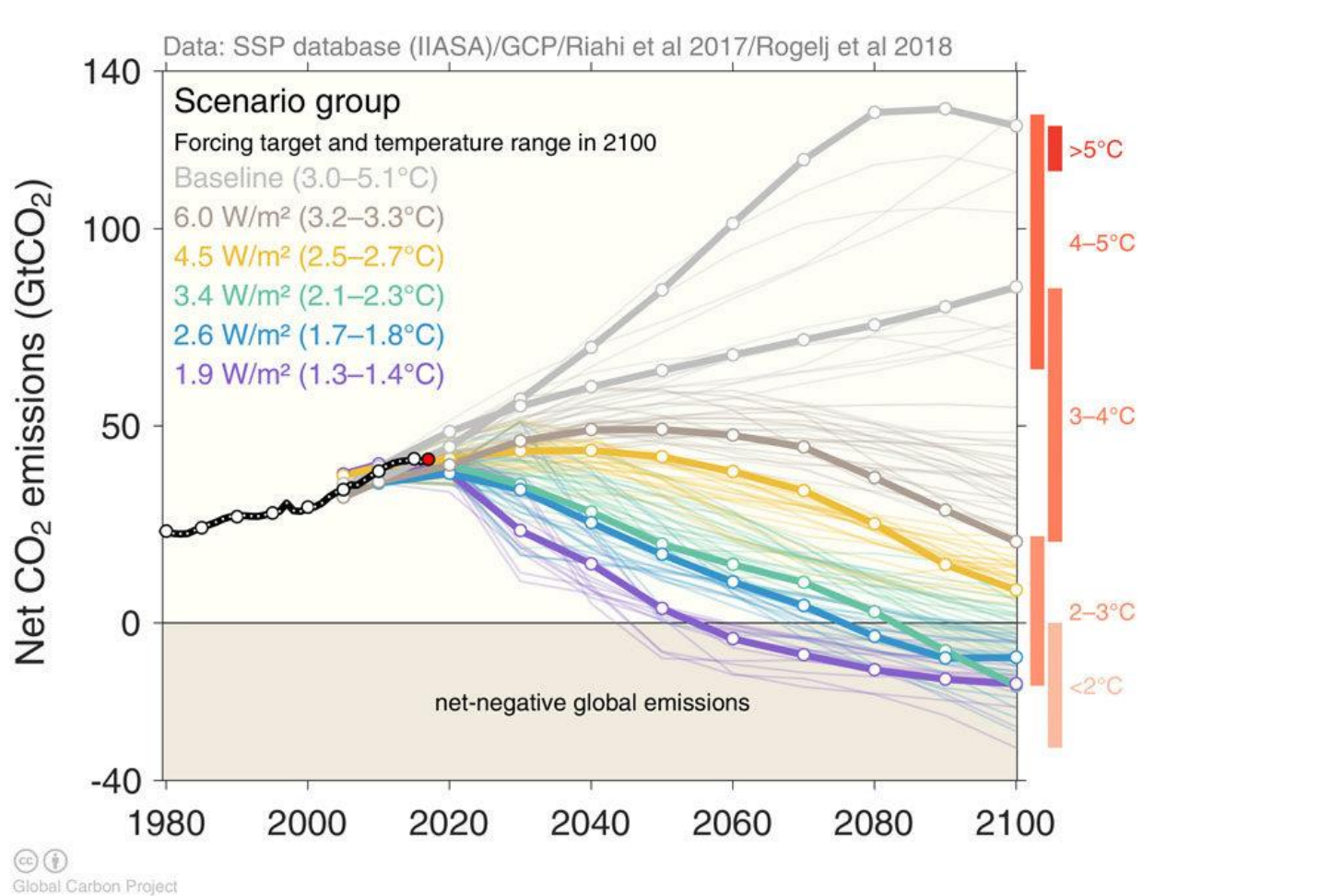
Context

- AEMO has relied on the analysis conducted by various sources to determine an appropriate application of decarbonisation to the NEM
- Australian trajectories align with a theme of global action.
- It is possible that global outcomes may occur with or without Australian alignment.

- The electricity sector is currently known to be a lower cost source of emissions reduction.
- The electrification of other sectors may reduce emissions outside this analysis.
- There may reach a point where emissions reductions are lower cost in other sectors.

The purpose is to develop a range of scenarios to inform the development of the NEM

Global Emissions Trajectories



- Scenarios with <2°C warming by 2100 require net-negative global emissions in the later half of the century.
- Current global emissions are consistent with RCP6.0 – 7.0.

Science Based Method

Actual emissions reduction trajectories will be confirmed via the modelling

Slow Change Scenario (RCP8.5)	2030	2050
Slowing global action, Australia lags, NEM parallel		
Global Emissions relative to 2005	168%	250%
Australian Emissions relative to 2005	TBC	72%
NEM Emissions relative to 2005	TBC	67%
Average temperature rise	>4.5°C by 2100	

Central Scenario (RCP7.0)	2030	2050
Current trajectory, Australia parallel, NEM parallel		
Global Emissions relative to 2005	143%	188%
Australian Emissions relative to 2005	N/A	
NEM Emissions relative to 2005	At least 26% reduction by 2030	
Average temperature rise	3.2-4.5°C by 2100	

Fast Change Scenario (RCP4.5)	2030	2050
Hastening action, Australia parallel, NEM leading		
Global Emissions relative to 2005	128%	124%
Australian Emissions relative to 2005	TBC	18%
NEM Emissions relative to 2005	TBC	10%
Average temperature rise	2.1-2.7°C by 2100	

Step Change Scenario (RCP2.6)	2030	2050
Action taken to keep under 2°C warming, Aus leads, NEM leading		
Global Emissions relative to 2005	100%	51%
Australian Emissions relative to 2005	TBC	-12%
NEM Emissions relative to 2005	TBC	5%
Average temperature rise	1.7-1.8°C by 2100	

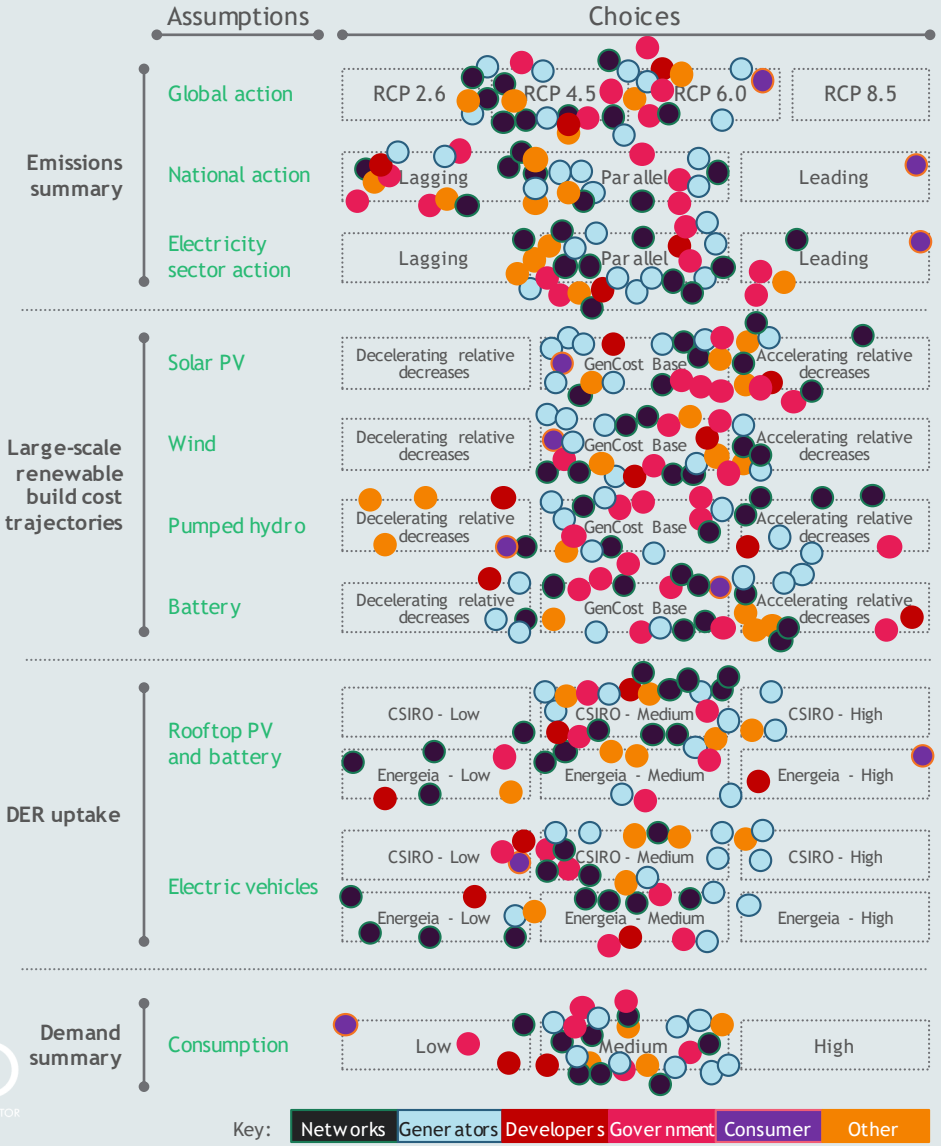
* High DER will reflect the conditions of the Central scenario, with higher DER uptake.

Other key inputs that shape the scenarios

For 2019 Forecasting

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Participant sentiment towards Central assumption choices

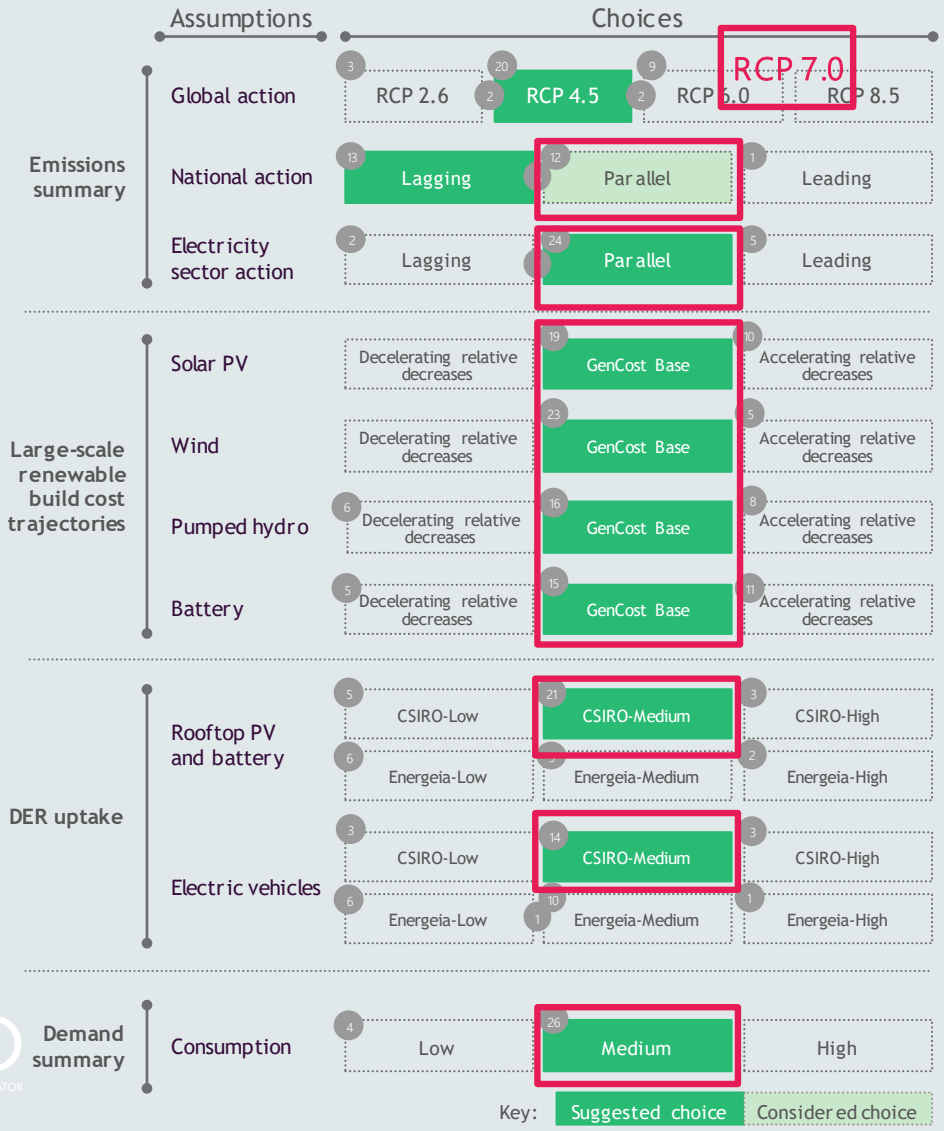


Additional participant comments

- Emissions summary:
  - Some emissions targets and policies should be assumed
  - Consider ability for gas to operate as a transactional fuel

- Large-scale renewable build cost trajectories:
  - Important to consider changes in plant life, especially plant life extension and factors that will act a barrier to exit such as site remediation and redundancy costs

Consolidated view of assumption choices



Commentary on key decisions

- Emissions summary, global action
  - While stakeholder feedback suggested RCP4.5 as the preferred pathway, consideration of current estimates regarding the effectiveness of current policies globally to meet long term emissions abatement outcomes has led to RCP7.0.

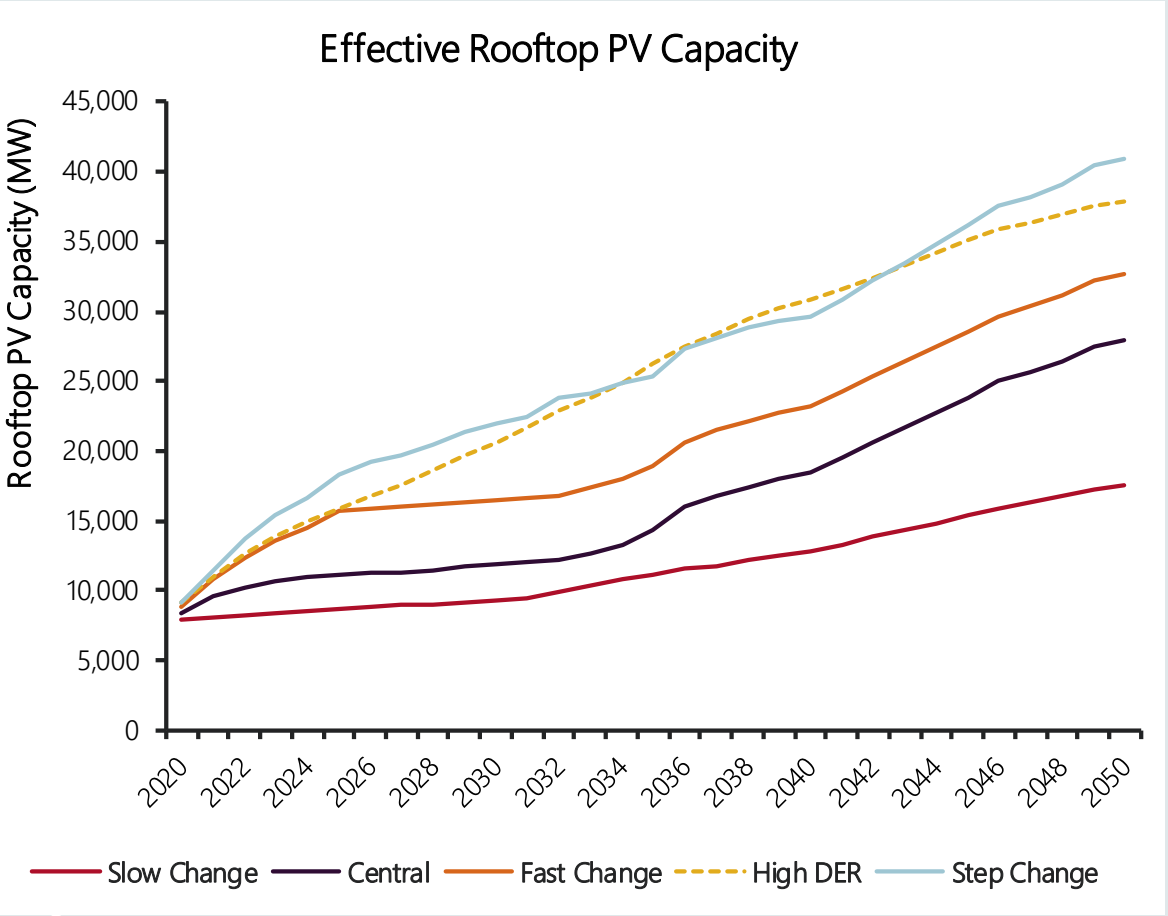
- Emissions summary, national action
  - Electricity sector is lagging as economic decisions rather than emissions reduction objectives influence investment action on coordinated investments towards renewable energy and earlier action towards coal closures.

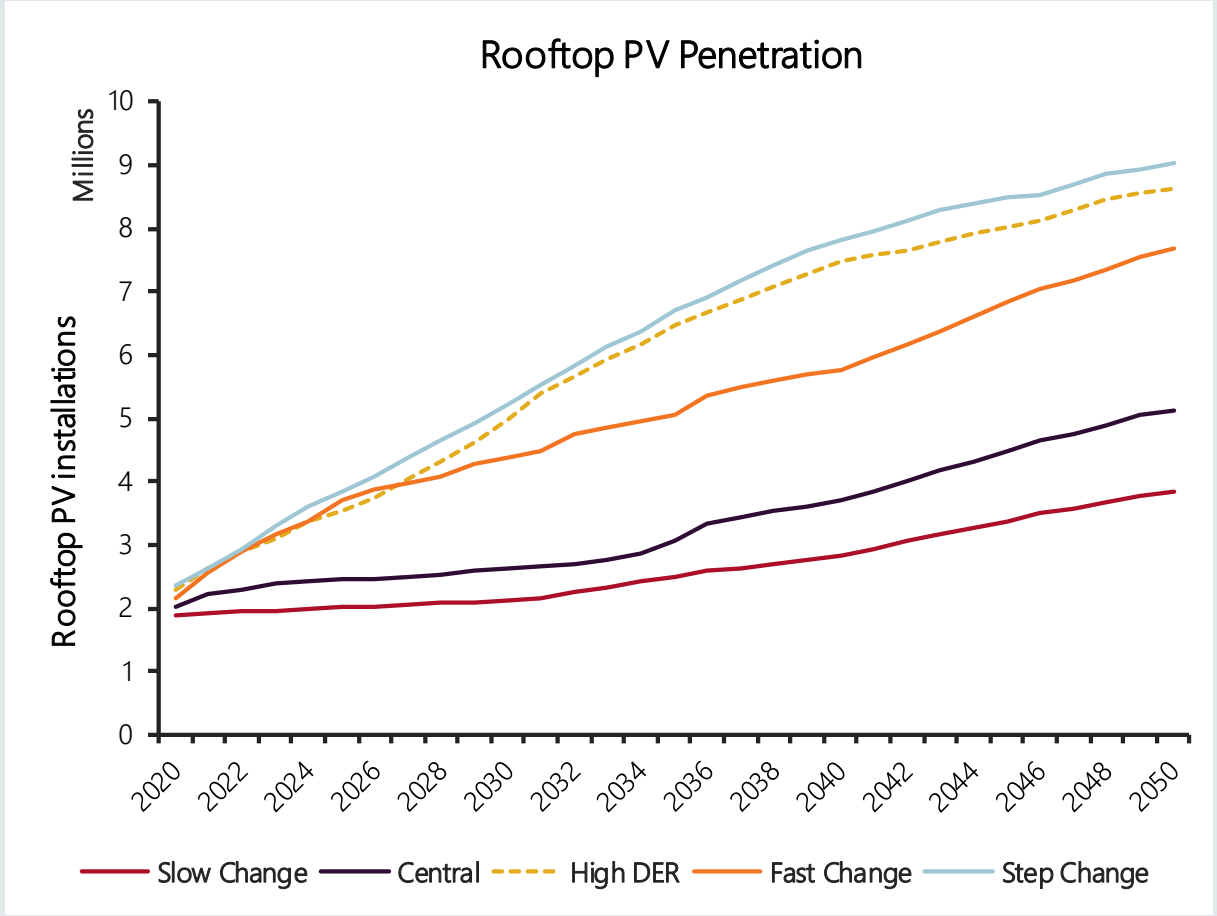
Distributed Energy Resources

For 2019 Forecasting

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

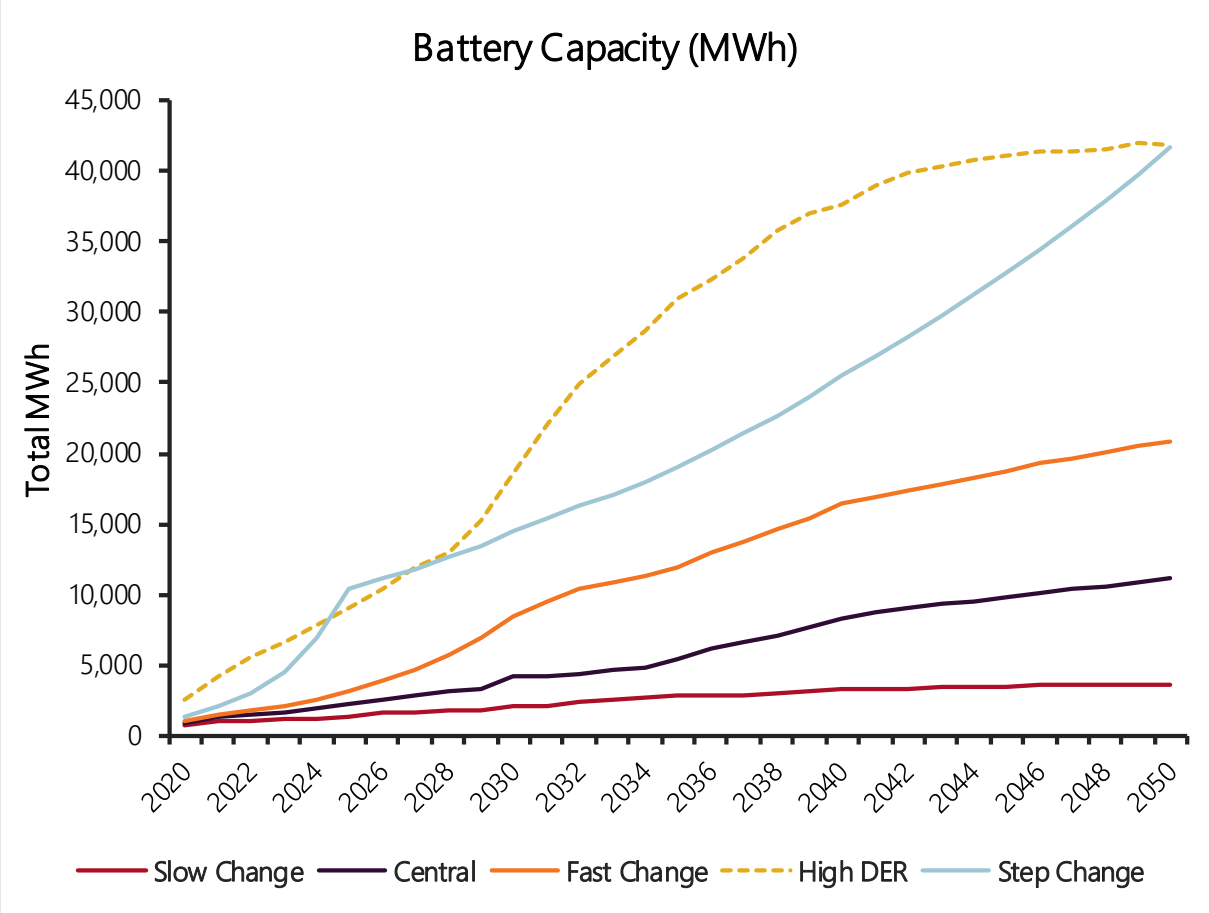
DER trajectories: Rooftop PV

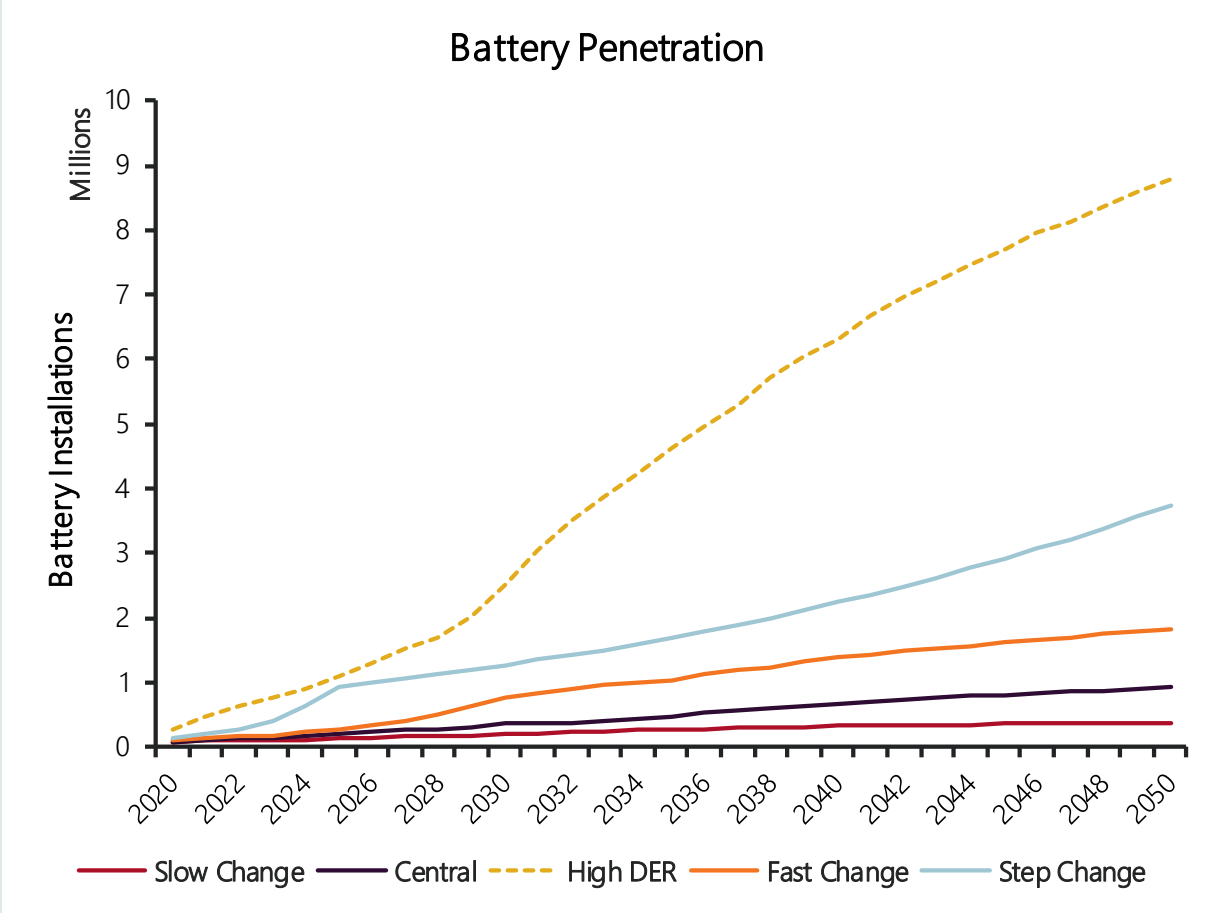




Total eligible households in NEM regions by 2050 is approximately 11-13 million

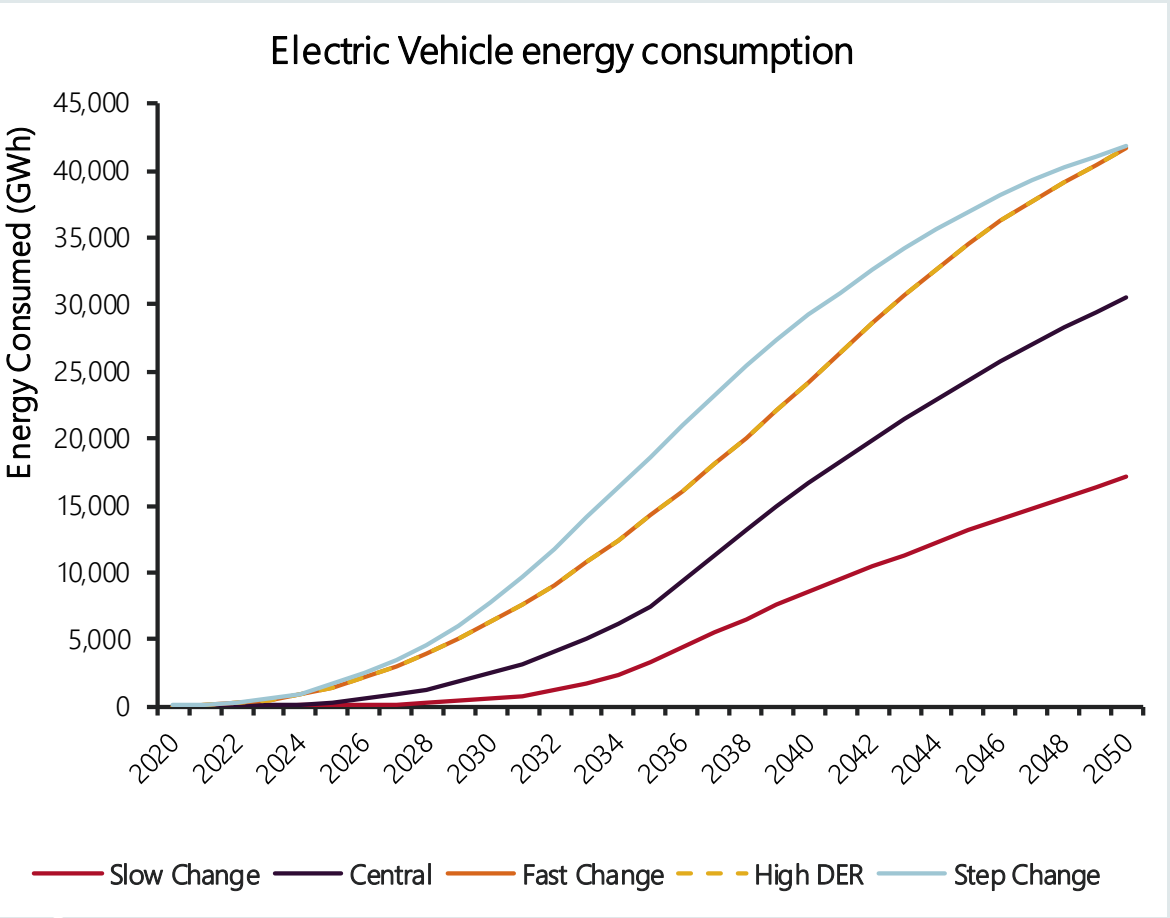
DER trajectories: Embedded battery systems

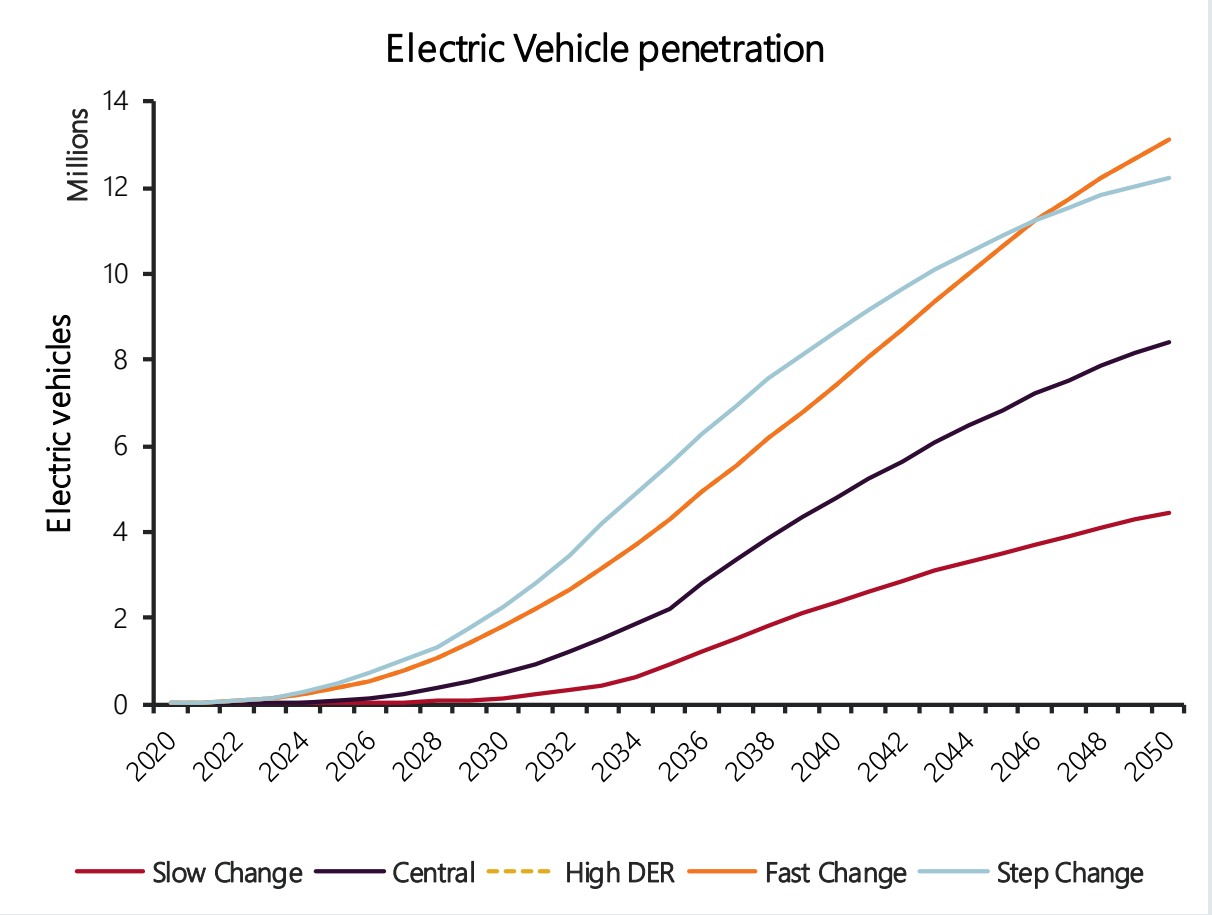




Total eligible households in NEM regions by 2050 is approximately 11-13 million

EV trajectories





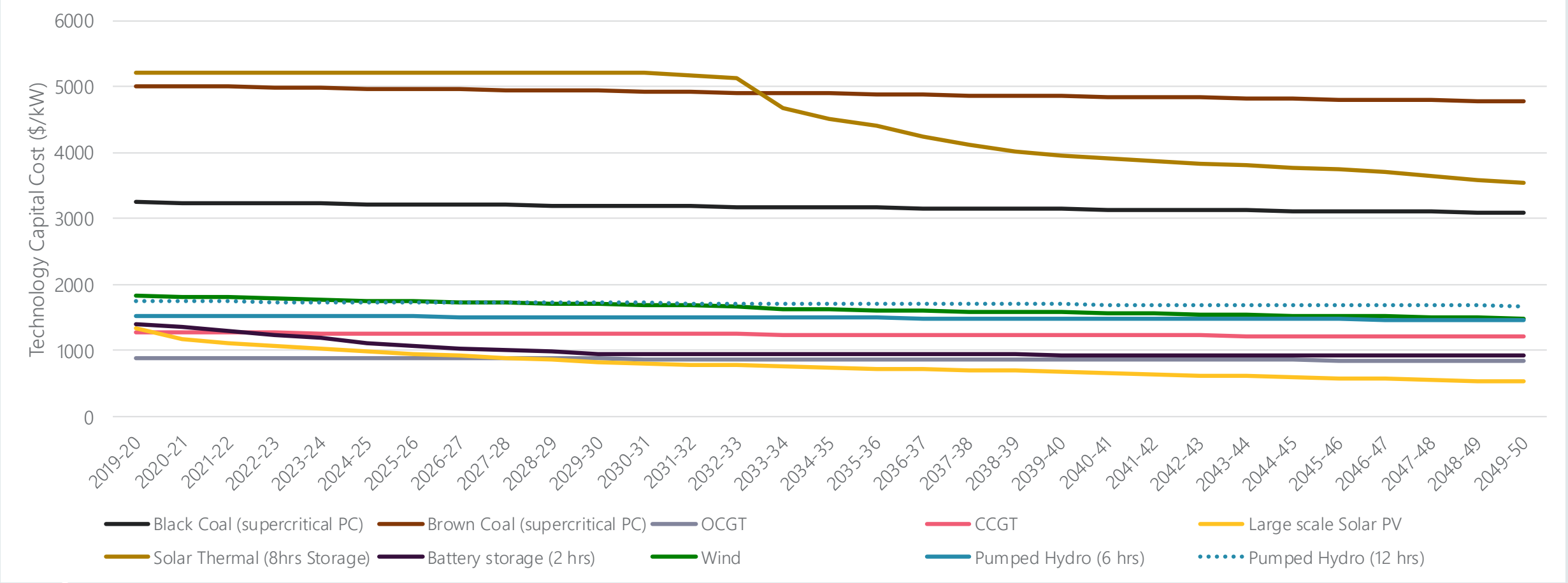
EV fleet share between approximately 20% to 60% of vehicles by 2050

Generation technologies and their costs

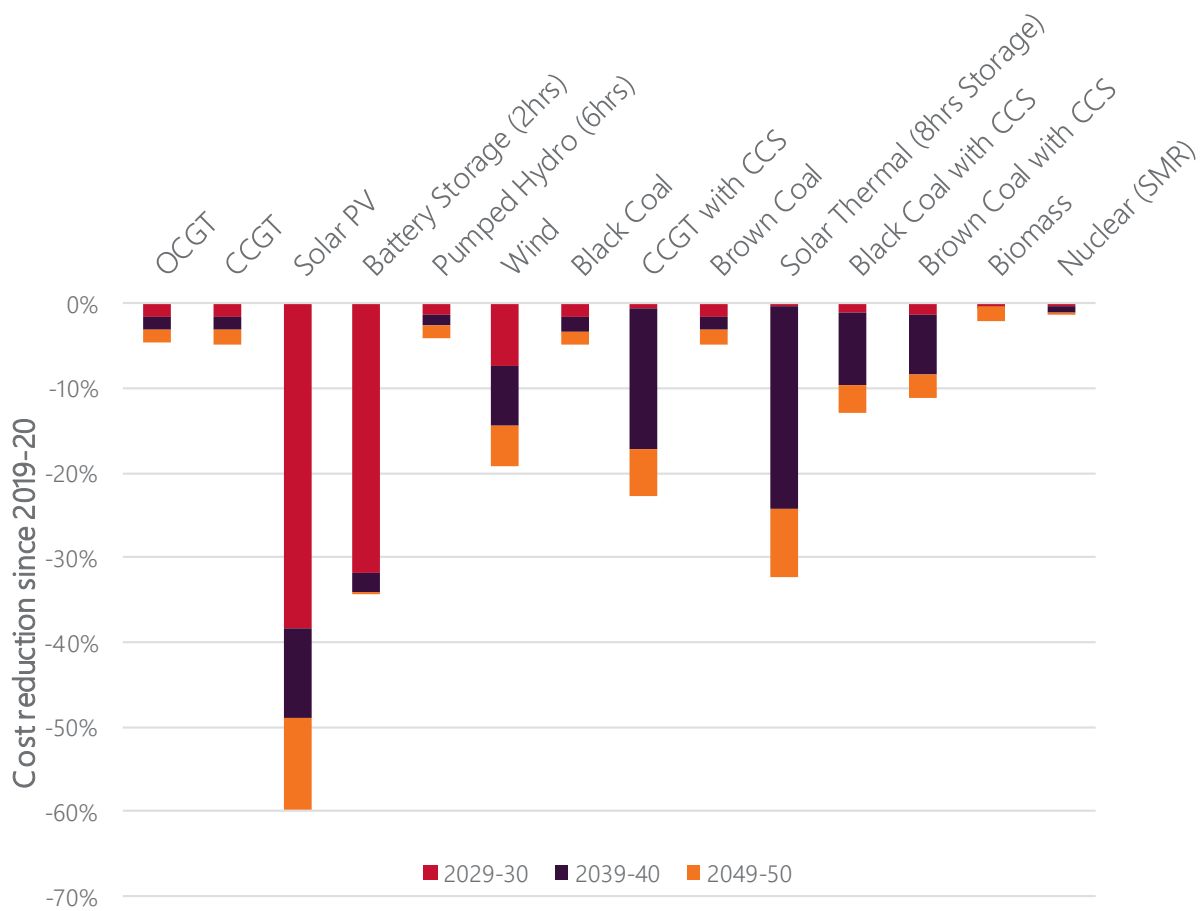
For 2019-20 ISP

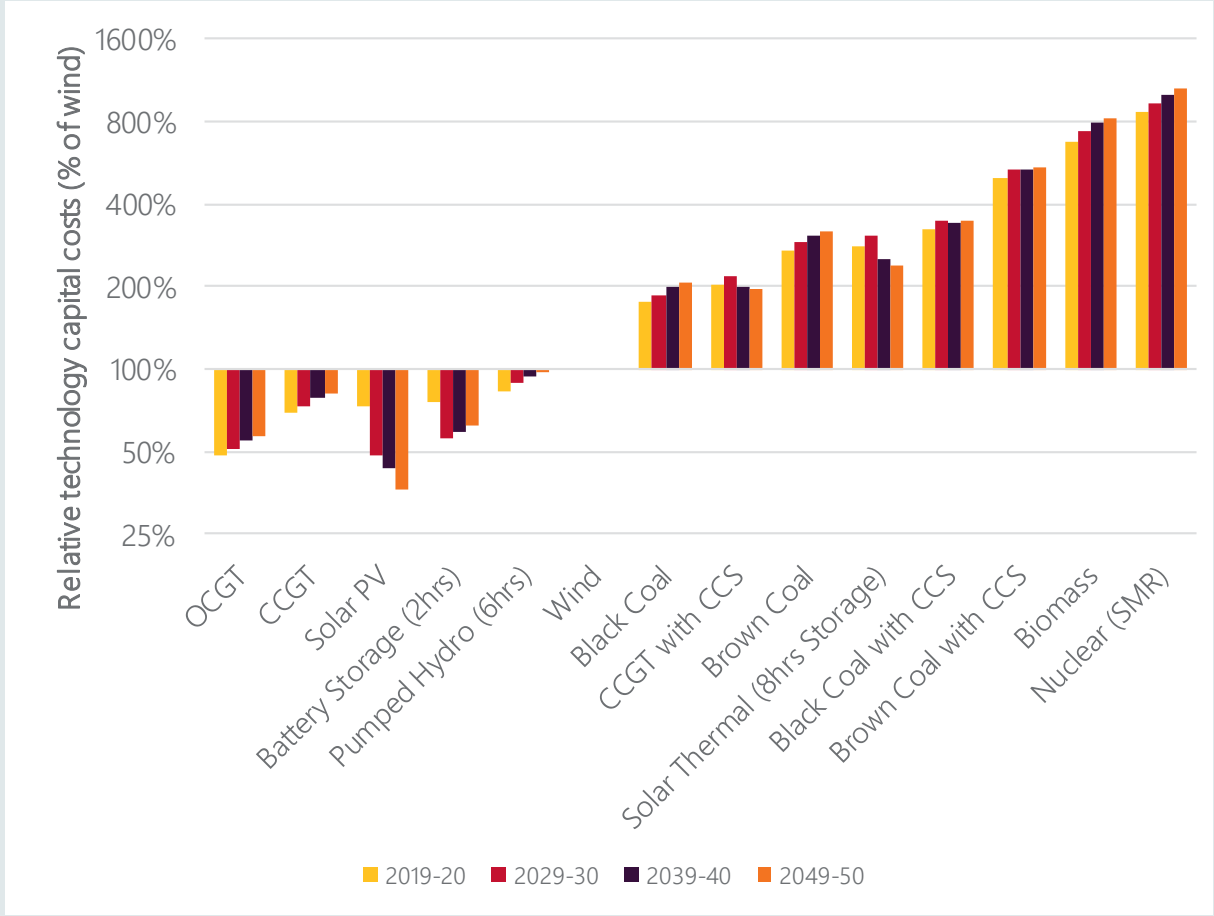
AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Key technology costs in Central scenario

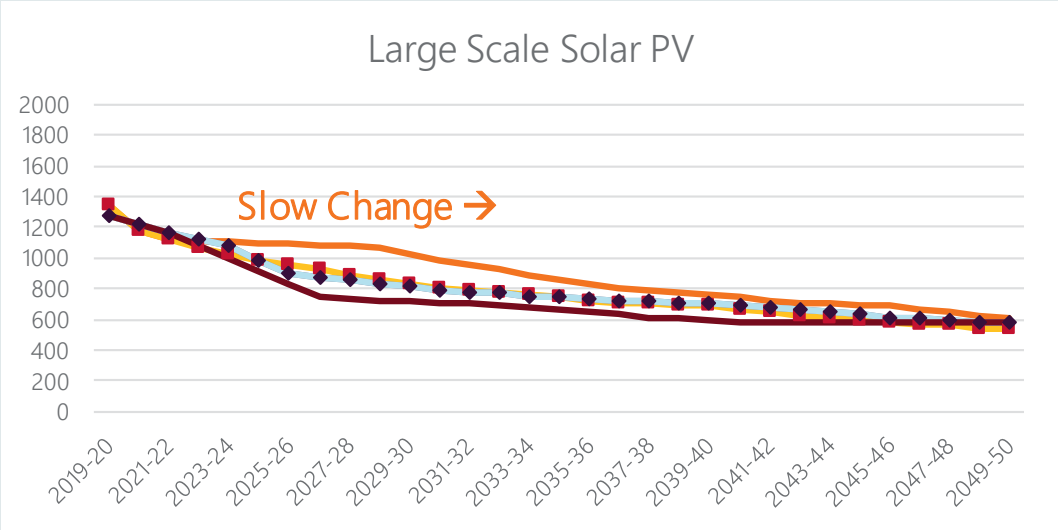


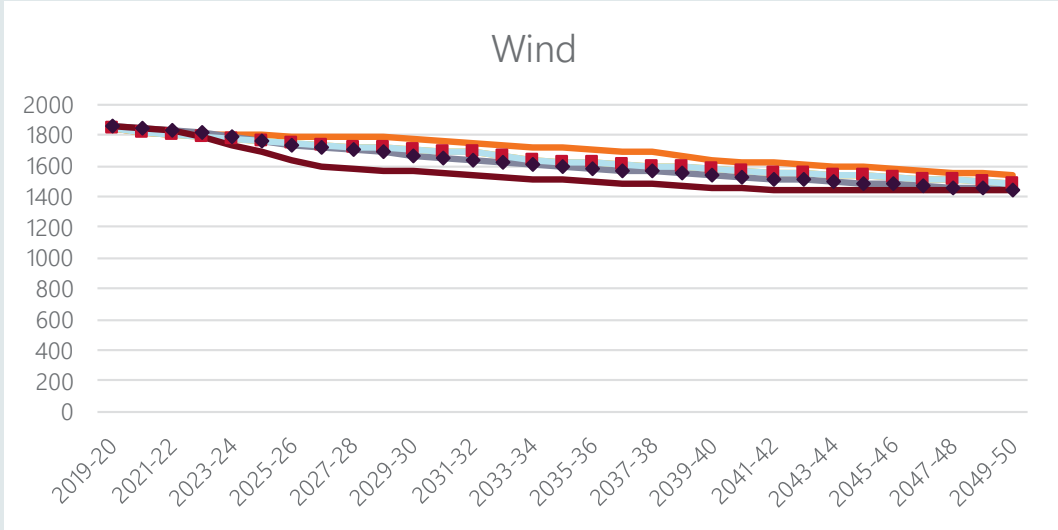
Relative cost reductions in the Central Case

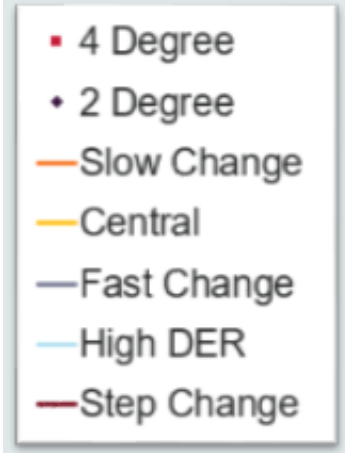


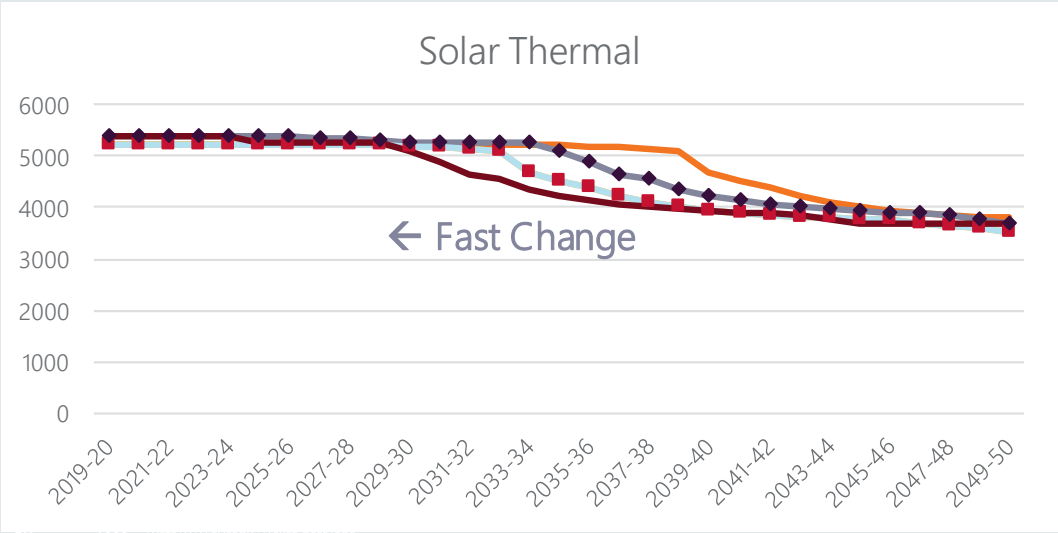


Relative technology cost changes across scenarios









Baseline cost scenarios:

- Mix of 4 degree and 2 degree CSIRO GenCost baselines

Scenario dispersion:

- Delayed technology cost reductions: Slow Change
- Hastened technology cost reductions::
  - Fast Change
  - Step Change

Key technologies affected:

- Wind
- Solar PV
- Solar Thermal


AEMO
AUSTRALIAN ENERGY MARKET OPERATOR