ESA

The Economic Society of Australia

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Developing GenCost

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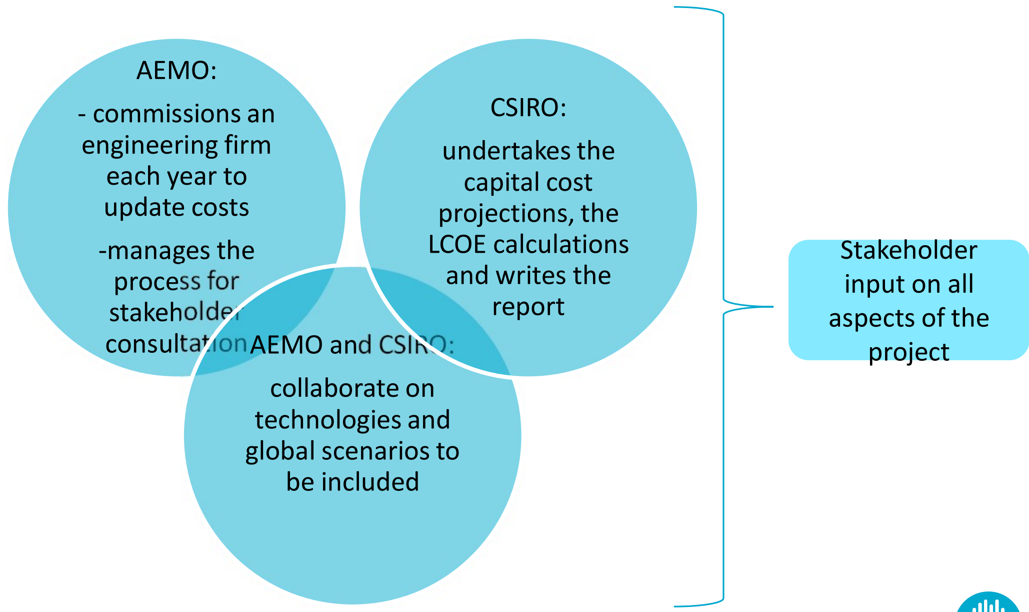
1

GenCost context – purpose and history

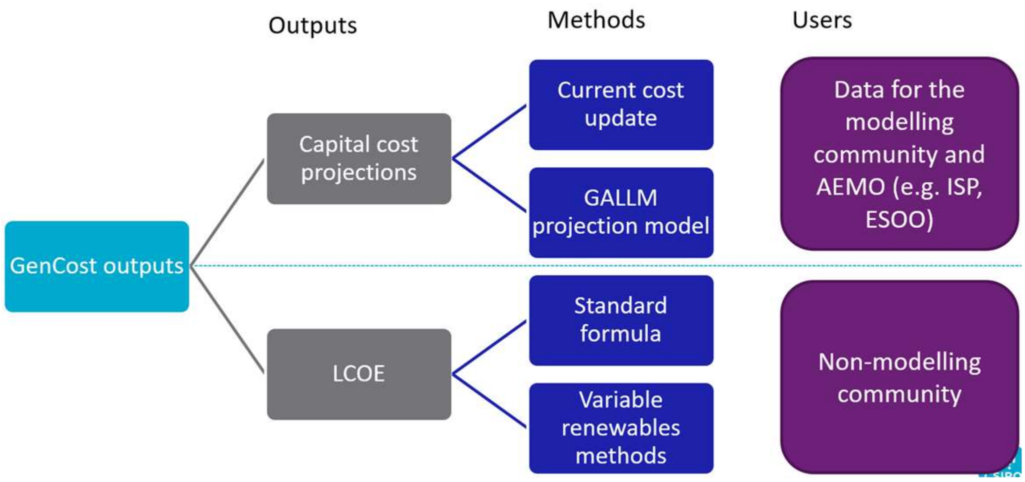
- Delivered since 2018 in partnership with AEMO.
- The purpose is to provide consistent annual update of current and projected electricity generation, storage and hydrogen technology costs.
- The purpose is not to be comprehensive, but rather repeatable, cost effective and targeted at the most important information

2

Roles



GenCost project outputs



Applying science and good practice

- We entered the cost projection field in 2011. The science standard was very low
- The industry has come to expect an open stakeholder process which improves the outcome no matter what the technical forecasting methodology
  - However, more recently, updates were not occurring frequently enough

5

Methods for projecting technology costs

- Consensus building
- Benchmarked
- Basis of views not transparent. Likely to include some bias in response selection

Expert surveys

- Simple, easy to follow
- Change is a function of time only – bottlenecks or stalled development not included
- Does not provide rationale for divergence from historical rates

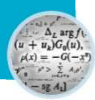
Historical rate extrapolation

- Strong basis in physical limits and science
- Provides deep guidance on cost and science challenges
- Costly. Typically delivered one technology at a time

Bottom-up engineering

- Transparent and strong basis for projections. But lacks science insights.
- Better able to project fast cost reductions of emerging technologies
- Computationally demanding

Learning by doing / simulation



6

CSIRO approaches

Expert surveys
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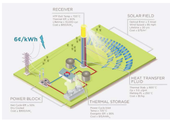
Established technologies e.g. gas turbines



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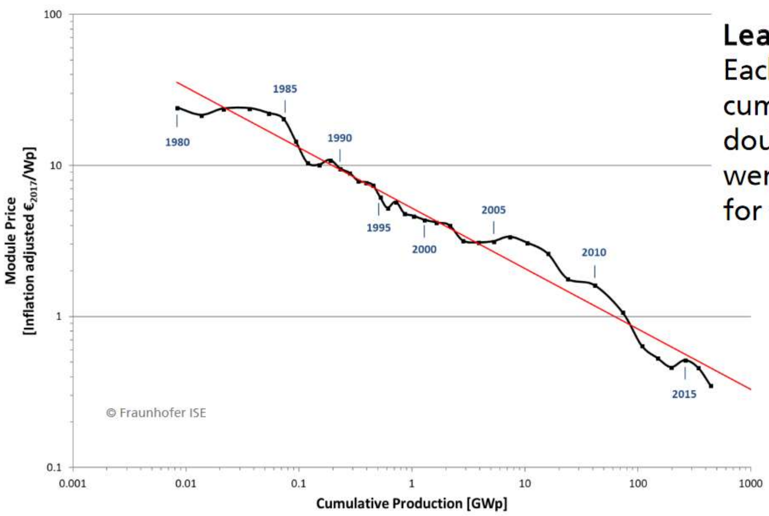
CSIRO Global and Local Learning Models

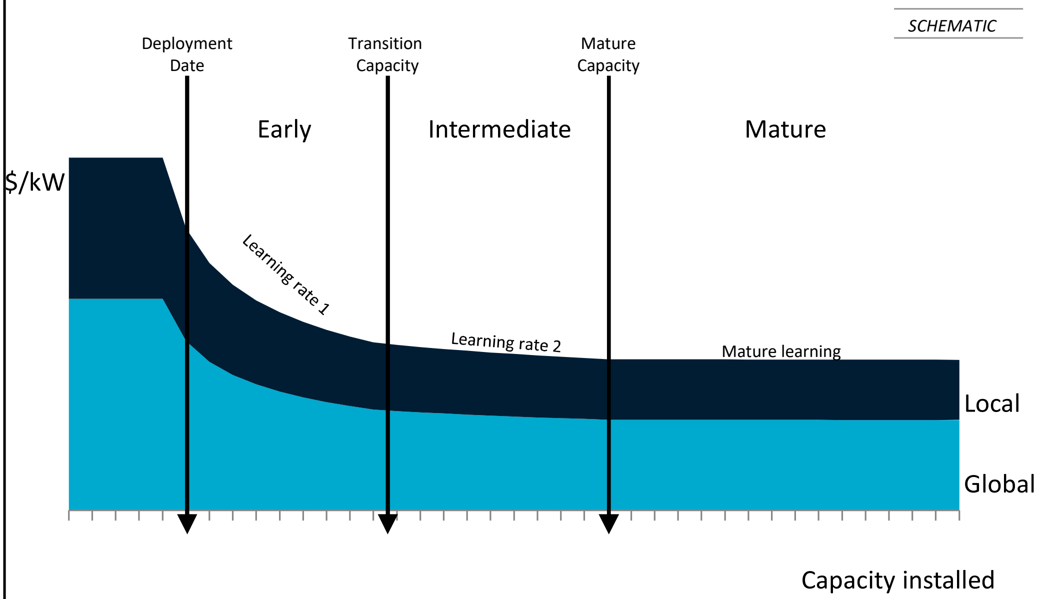
Concept of Technology Learning
- Example PV modules



Learning Rate:
Each time the cumulative production doubled, the price went down by 24 % for the last 37 years.

Source: Fraunhofer ISE

Definitions of Learning Curve Parameters



Capacity deployment based on global uptake model

1. The learning curve formula calculates costs for a future level of installed capacity. However, we want costs for a future *time*.

2. We need a projection of the future timing of installed capacity. *But that is dependent on future costs*

3. To consistently solve this problem, we embed the learning curves in a model of the global electricity market so that deployment and costs for all future time points are solved *simultaneously*

The solution - GALLME

- 13 region partial equilibrium electricity market model
- Solved as a cost minimising mixed integer linear program
- Global and local learning included
- Component and shared learning where appropriate
- Market forces represented by "penalty constraint"
- Two different learning rates for some technologies
- 34 technologies and 21 technology components

Limitations of the Learning Rate approach

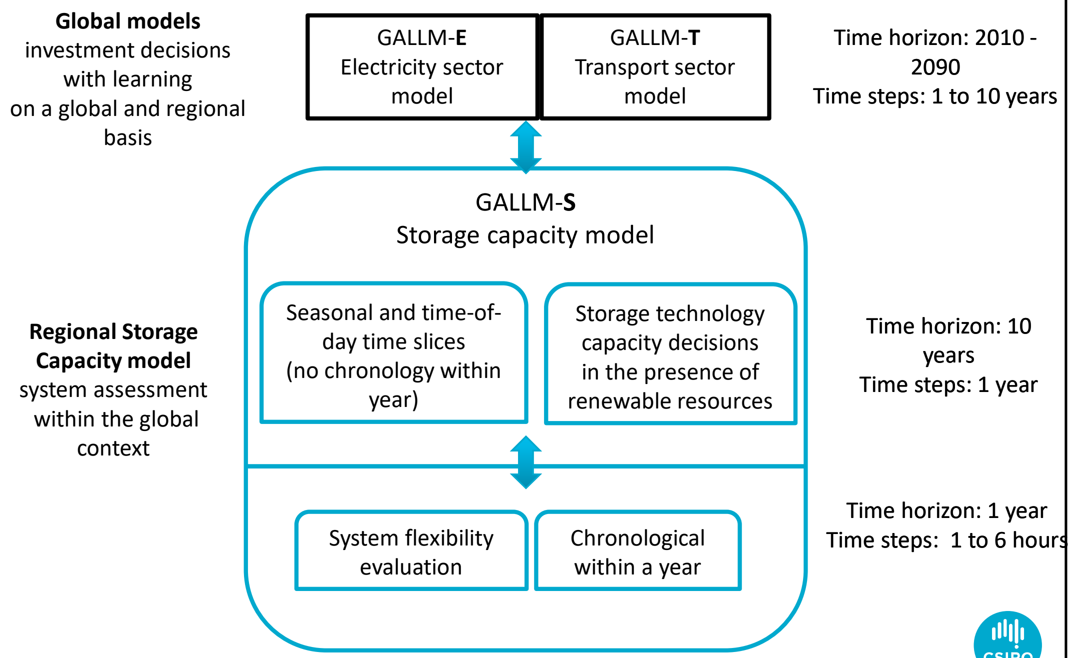
1. The learning curves do not explain from where the cost reductions will derive
2. Models such as GALLME find it difficult to cope with small variations between technologies – consequently they tend to deal with broader technology categories
3. They are complex and require access to fast computing facilities to solve in reasonable times.

There main advantage is a high degree of *transparency* – the learning rate and projected deployment determine the projected costs.

Key input assumptions

- Key technology starting costs and performance parameters (AEMO/Aurecon)
- Other technology starting costs and performance parameters (Reports, journal papers, IEA, IRENA, ARENA,CSIRO)
- Historical deployment (capacity) and learning rates (IEA, IRENA, CSIRO),
- Government policies (IEA and IPCC)
- Start date for zero installed technologies (AEMO)
- Fuel prices (IEA)
- Electricity and hydrogen demand (IEA)

Schematic Diagram of the Global And Local Learning Model (GALLM)

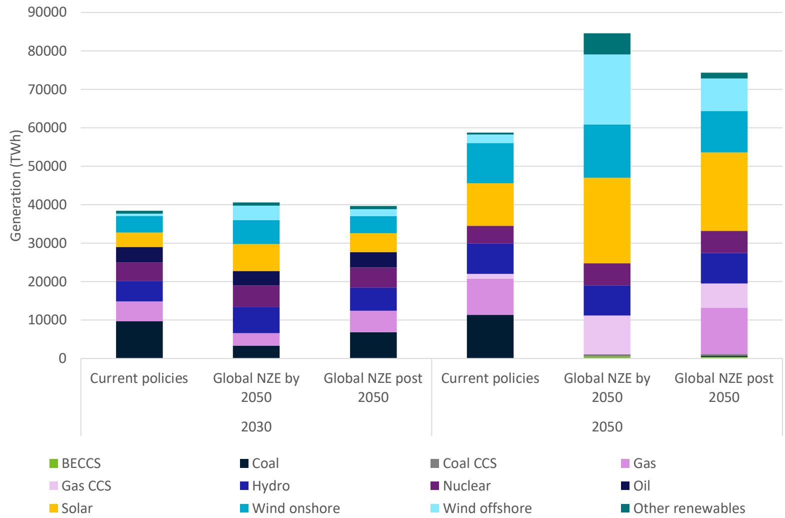


Capital cost projections

Scenarios

Key drivers	Global NZE by 2050	Global NZE post 2050	Current policies
IEA WEO scenario alignment	Net zero emission by 2050	Announced pledges scenario	Stated policies scenario
Climate policy	Consistent with 1.5°C world	Consistent with 1.7°C world	Consistent with 2.5°C world
Demand / Electrification	High	Medium-high	Medium
Learning rates	Stronger	Normal maturity path	Weaker

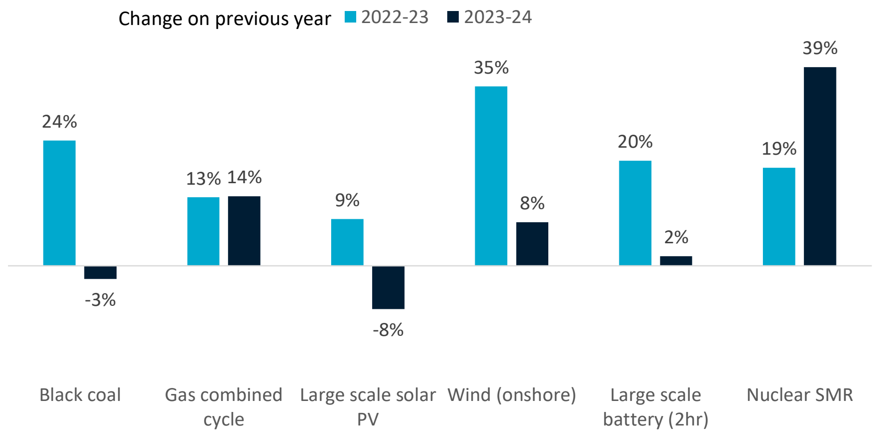
Projected global technology mix



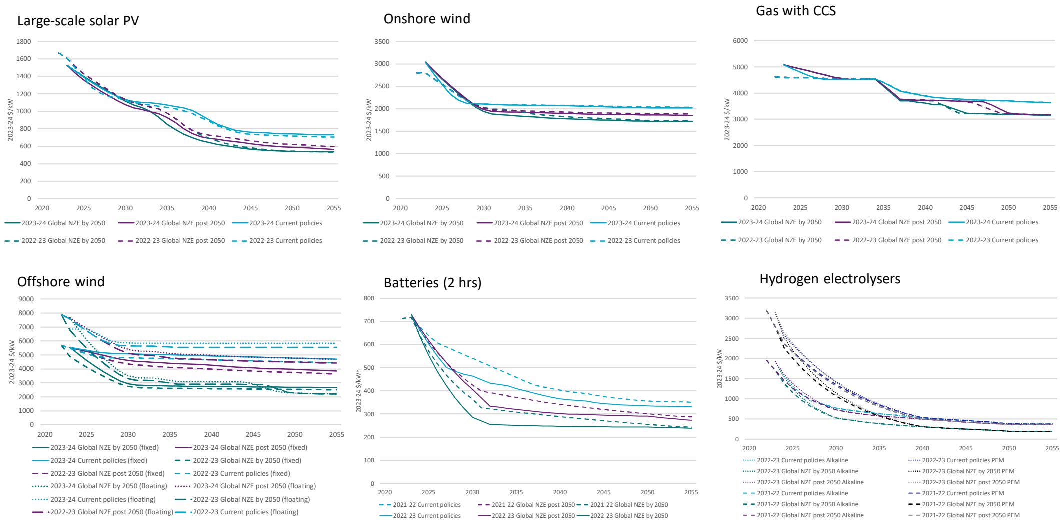
The global technology mix and capital cost reductions are simultaneously projected

Current cost updates

Inflationary pressures on capital costs are easing but pressure remains on gas, wind and nuclear SMR



Highlights



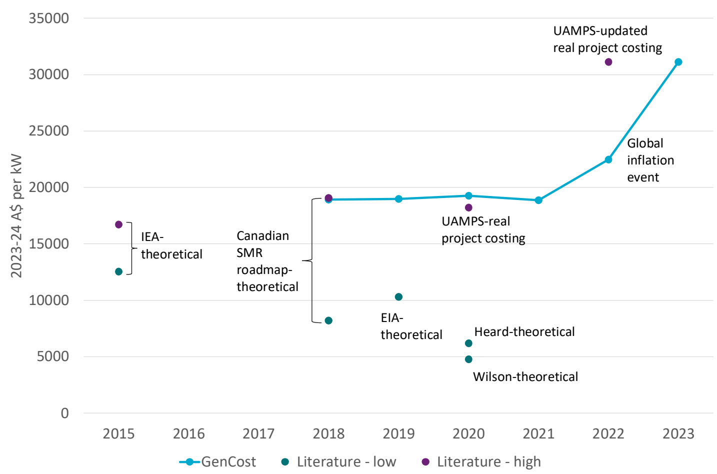
19

Nuclear SMR

- Nuclear small modular reactors (SMR) capital costs have been contentious.
- UAMP was the developer of a nuclear SMR project called the Carbon Free Power Project (CFPP) with a gross capacity of 462MW, to be fully operational by 2030.
- Project costs were estimated in 2020 to be A$18,200/kW. In late 2022 UAMPS updated their capital cost to A$31,100/kW citing the global inflationary pressures. The project was cancelled in November 2023.
- CFPP was the only SMR project in the US that had received design certification from the Nuclear Regulatory Commission.
- While there have been many vendor estimates provided for SMR. This is the only recent project where there were consequences for a published cost - the developers needed sufficient electricity pre-sold to cover the project costs.

20

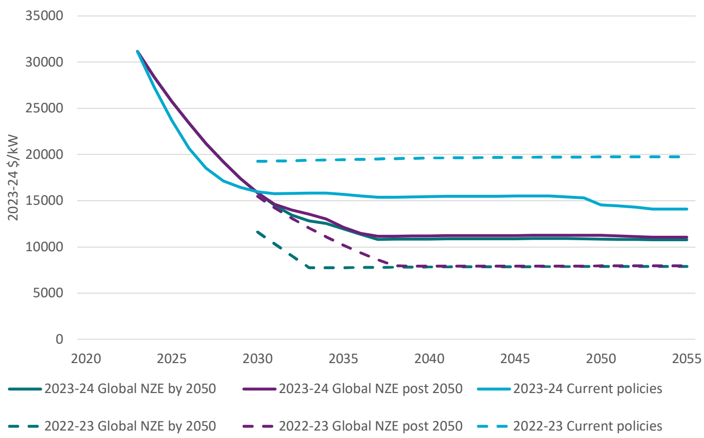
Nuclear SMR – history of estimates



Ask your question at www.Sli.do #GenCost

21

Nuclear SMR – projections



Like all technologies nuclear SMR gets back to normal by 2027 in *Current policies* and by 2030 in the Global NZE scenarios.

New builds drive costs reductions in the early 2030s in the Global NZE scenarios

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22

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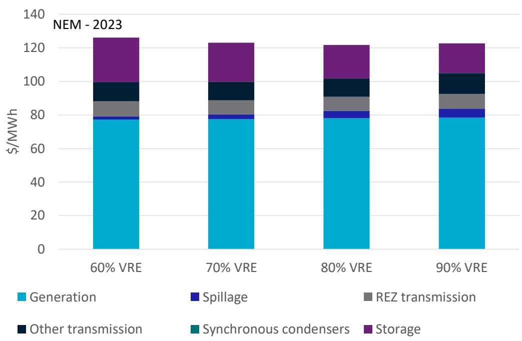
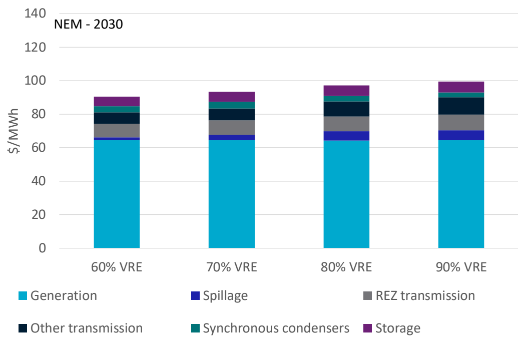
23

Results for 2023 and 2030

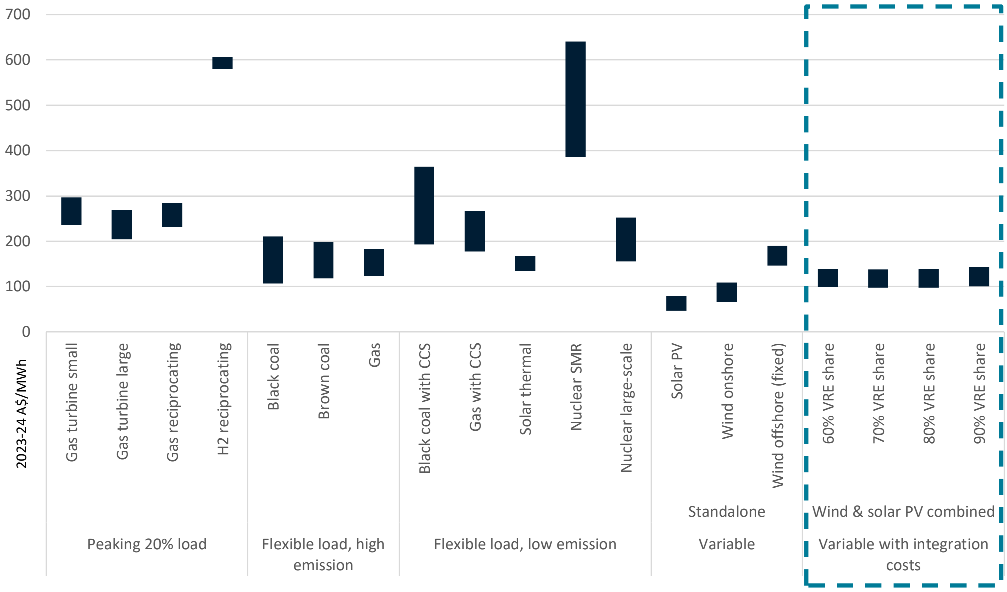




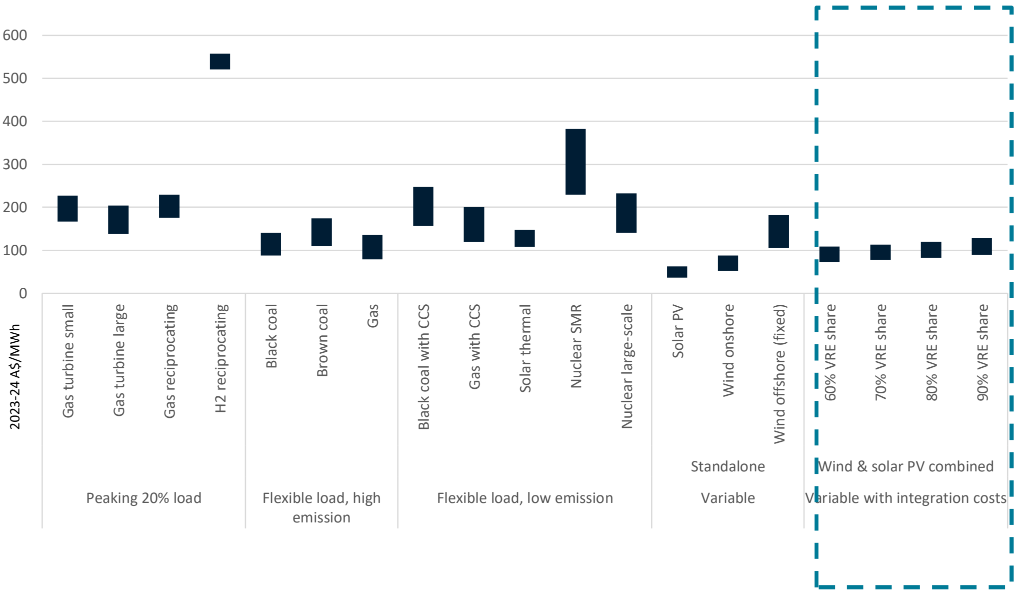
- Costs decrease in 2023 with higher VRE share as it has more generation to spread per MWh costs
- Half to three quarters (depending on the VRE share) of the higher costs in 2023 are due to investors having to pay 2023, instead of 2030, technology prices.
- The remainder is due to the cost of the pre-2030 committed projects which must be paid for in the 2023 analysis, but are considered existing capacity at no cost in 2030.
- Spillage costs included.
- All component costs come from a single worst weather year

24

Extended comparison results for 2023



Extended comparison results for 2030



Thank you

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Australia's National Science Agency