Modelling of Australia's National Energy Guarantee

Ambition is key

White Paper

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Bloomberg New Energy Finance

Executive Summary

The Turnbull Government's National Energy Guarantee could deliver reliable, low-emissions electricity supply for Australia's National Electricity Market. But the outlook for renewable energy depends squarely on the ambition of the emission reduction target. The government's -28% by 2030 target could decimate large-scale wind and solar construction, whilst Labor's -45% (2 degree pathway) would continue the current boom.

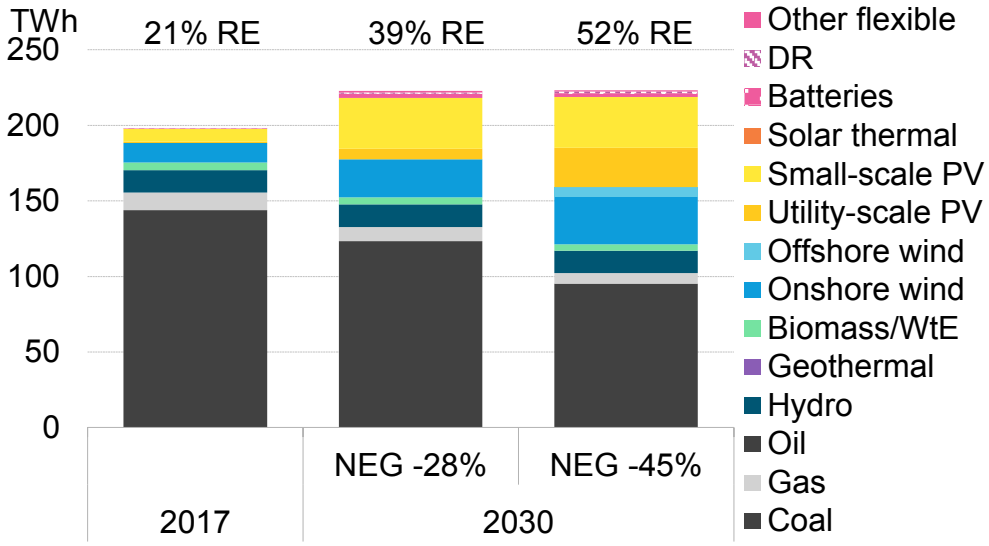
- The government's current 28% below 2005 levels by 2030 CO2 target would slow the current pace of renewable installations and emissions reduction in the National Electricity Market (NEM) and requires little effort to achieve. Existing policies should deliver a 23% reduction by 2020, and small-scale PV uptake should do most of the heavy lifting thereafter, bringing renewable generation to 39%. But only 1.5GW of new large-scale renewables will be required from 2021-30 to meet this Emissions Guarantee target.
- A 45% reduction on 2005 levels by 2030 by contrast would require 17.3GW of large-scale renewables in the next decade and lift renewable generation to 52%. This would continue the current pace of emissions reductions from existing policies in the NEM.
- The Reliability Guarantee is unlikely to give windfall gains to coal, if it is designed to ensure there is enough dispatchable capacity only. Around 6GW of coal is forecast to close and be replaced by 5GW of gas in either scenario, with our assumed policy configuration. However the Reliability Guarantee will likely prevent further coal closures under a deeper emissions reduction target, ensuring the system remains stable whilst reducing emissions and coal burn.

1.5GW Large-scale renewable additions under a -28% by 2030 target

17.3GW Large-scale renewable additions under a -45% by 2030 target

6GW Coal closure in either scenario

National Energy Market (NEM) generation mix



Source: Bloomberg New Energy Finance Note: RE = renewable energy generation

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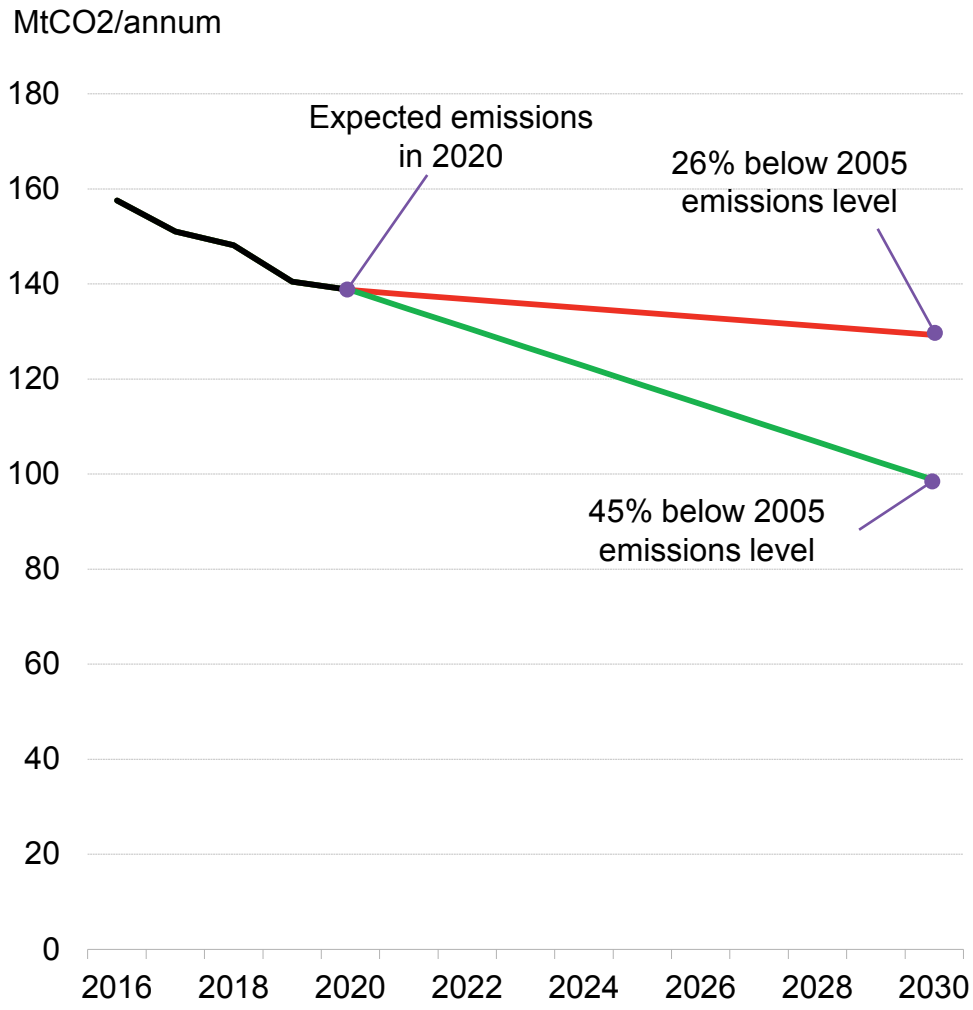
Introduction

The Australian government unveiled a new policy concept for the National Electricity Market (NEM) on October 17, 2017. The proposal, dubbed the National Energy Guarantee (NEG), would obligate electricity retailers to secure enough dispatchable and low-emissions generation to meet the country's energy goals.

The plan is currently only at the conceptual stage, and the newly formed Energy Security Board is producing modeling for the Council of Australian Governments to show the potential impact of the NEG on the NEM. In this note, we produce our own independent modelling of the NEM based on our understanding of the major objectives of the NEG, and compare the results against the Australian projections from the New Energy Outlook 2017, which serves as our base case. The modelling forecasts the evolution capacity and energy generation in the NEM with an enforced reliability and emissions constraint.

Two emissions reduction scenarios are modelled. The least ambitious scenario (28% emissions reduction from 2005 levels) is modelled based on Australia's international emissions reduction commitments. The most ambitious scenario (45% emissions reduction from 2005 levels) is modelled based on a 2 degree pathway, which is the opposition Australian Labor Party's policy platform.

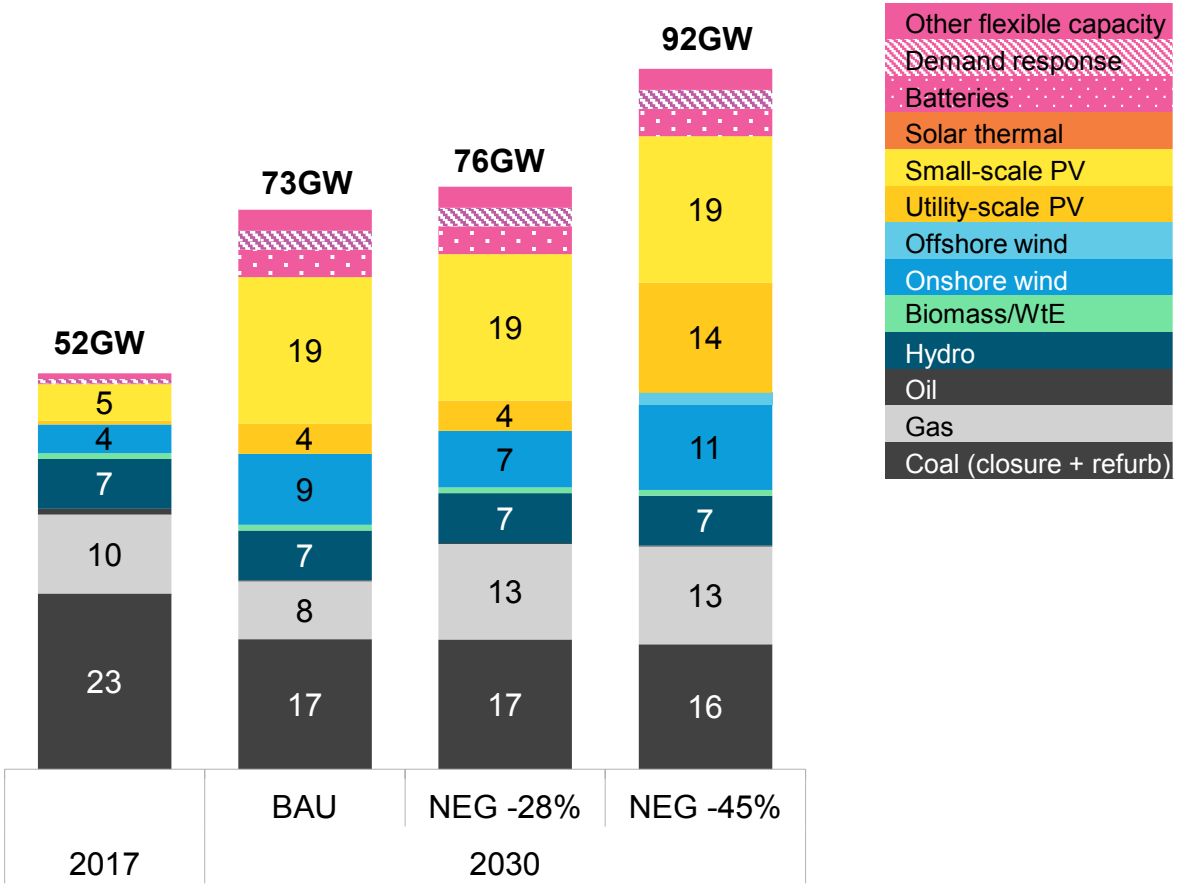
Two modelled emissions reduction scenarios



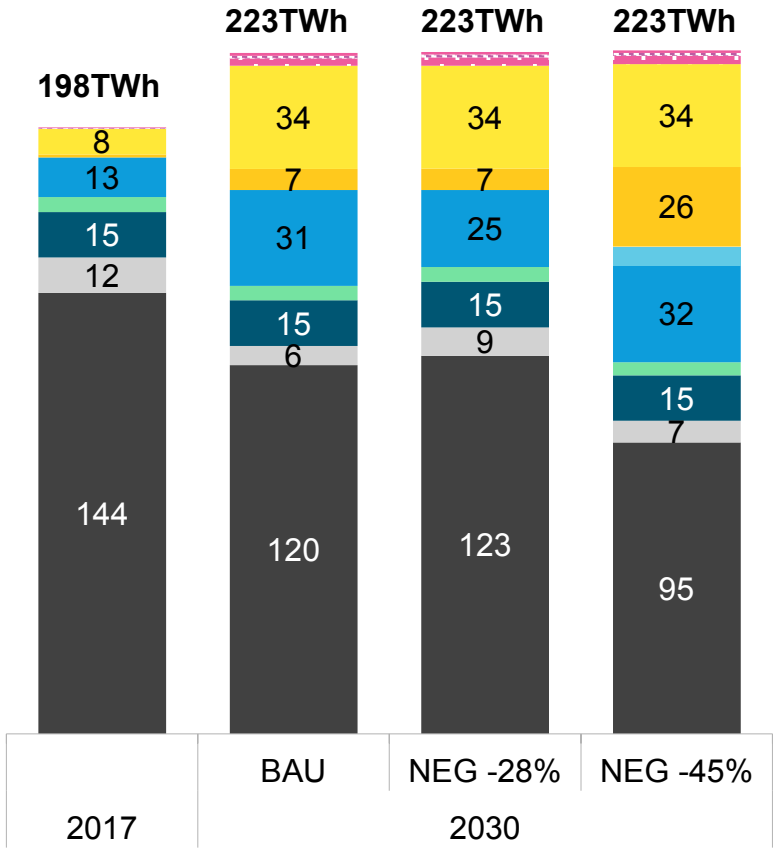
Source: Bloomberg New Energy Finance

Modelling results at a glance

Capacity



Generation



Source: Bloomberg New Energy Finance Note: BAU projections are based on the Australian projections from the New Energy Outlook 2017

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The National Energy Guarantee

Reliability Guarantee

Reliability Guarantee

By 2019 electricity retailers will have to own or contract enough capacity to meet a percentage of their forecast peak load

Concept

- Will obligate electricity retailers and large consumers to make arrangements with approved dispatchable resources, to cover a predetermined percentage of their peak load
- Entities can use futures contracts, PPAs or direct ownership to demonstrate compliance
- Targets will be set on a state-by-state level (taking into account existing generation, demand forecasts and interconnection within the region)
- The Australian Energy Market Commission (AEMC) and the Australian Energy Market Operator (AEMO) will determine:
  - Eligible generation technologies
  - Minimum levels of dispatchable generation in each state
  - The forecasts for peak demand
- The reliability guarantee may only come into force when dispatchable capacity falls below a determined threshold

What we don't know

- What technologies will be categorized as 'dispatchable'
- What type of contracts will be accepted as part of the guarantee
- Whether contracts will be based on rated capacity (MW) or generation (MWh)
- Whether synchronous generation will be specifically required
- How much of each retailers peak demand forecast will need to be covered
- Whether retailers will be able to utilize 'behind-the-meter' capacity

For more details see: Battle Over? Australia's National Energy Guarantee (web | terminal)

Modelling approach – Reliability Guarantee

Key assumptions

To approximate the effect of a reliability guarantee we assume:

- A 10% reserve capacity margin has to be maintained across the NEM. Each generation technology is assigned a reliable capacity value, based on data from the Australian Energy Market Operator. To be conservative, variable renewable generators (wind and PV) are assigned a reliable capacity value of zero, but in practice they can supply a small portion of generation reliably
- Each state must also have sufficient local capacity to meet peak
- Generator dispatch is unaffected by the reliability guarantee (which only affects build and retirements), and occurs on a purely economic basis
- No constraints are applied to the amount of fuel type of generation in the market
- Behind-the-meter assets and demand response contribute to reliable capacity
- The government's proposed 2GW Snowy 2.0 pumped hydro project is commissioned in 2025

Reliable capacity value of generation types

Technology	Reliable capacity (%)
Coal	95
Gas	100
Oil	95
Batteries (including behind-the-meter)	75
Demand response	97
Biomass/WtE	95
Hydro	97
Solar	0
Wind	0

Source: Bloomberg New Energy Finance

Emissions Guarantee

Emissions Guarantee

By 2020 electricity retailers will have to own or contract enough low emissions generation to be below an emissions target

Concept

- Retailers must ensure the average emissions intensity of their electricity procurement falls within a prescribed limit
- Limits will be set by Parliament, in line with Australia's national emissions reduction targets (i.e. 26-28% reduction on 2005 level emissions by 2030)
- Emissions intensity of a retailer includes:
  - Their own generation
  - Generation procured through contracts
  - The average intensity of un-contracted generation in the NEM for any spot market purchases
- Australian Carbon Credit Units (ACCUs) and 'international units' may be used to meet a 'small' proportion of a retailers emissions obligation.
- Banking and borrowing across compliance periods is also expected to be allowed, as will transfers between parties
- Renewables built to meet state-based targets will be counted towards the national emission reduction goal.

For more details see: Battle Over? Australia's National Energy Guarantee (web | terminal)

What we don't know

- How the year-to-year profile to achieve emissions intensity targets will be set
- Whether emissions intensity targets will be locked into the rule change (via COAG) or subject to Federal Government discretion
- How existing state-based differences in emissions intensities will be taken into consideration and allowed for
- Whether tradable instruments will be established to allow the easy transfer of low emissions generation between retailers
- Whether retailers will be able to utilize 'behind-the-meter' capacity

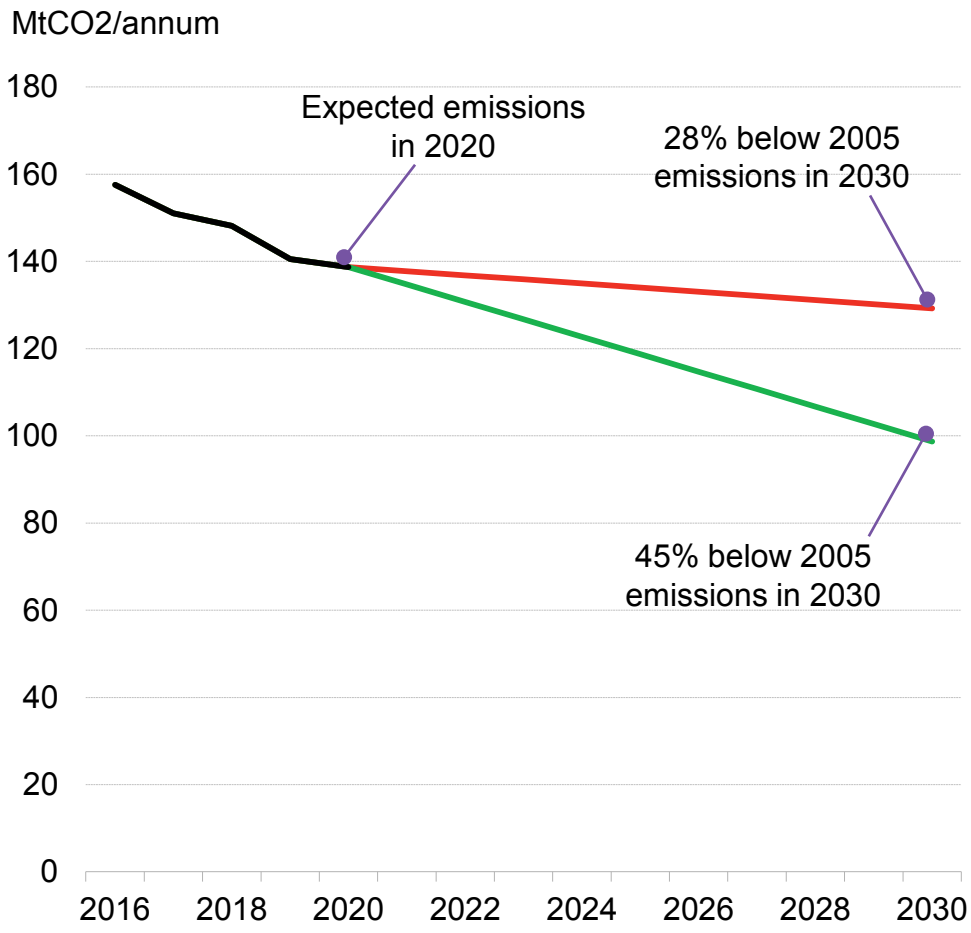
Modelling approach – Emissions Guarantee

Key assumptions

To approximate the effect of an emissions guarantee we assume:

- An annual emissions cap for the NEM is set by a linear trajectory from projected 2020 emissions to the 2030 goal.
- To meet the emissions cap, the model first tries to optimize dispatch for emissions, by introducing a shadow carbon price up to the level of fuel switching between black and brown coal generation.
- If this is insufficient, the model builds the most economic low emissions generator.
- The use of carbon offsets, and potential for banking and borrowing across compliance periods is not modelled (as emissions targets must be met annually).
- The potential impact of state-based renewable energy targets after 2020 (e.g. Victoria) are not incorporated into this analysis.
- Emissions targets apply to the NEM as a whole, and not individual states.
- Behind-the-meter generation lowers overall NEM emissions.

National Electricity Market emissions pathways



Source: Bloomberg New Energy Finance

-28% scenario

Key results of -28% scenario

- **Capacity build:** 26GW of new capacity built from 2021-30 (1.5GW of wind, negligible large-scale PV, 12GW small-scale PV, 3GW of behind-the-meter storage and 4.9GW gas). This is less renewables and more gas than in our NEO2017 base case, due to the impact of our assumed reliability guarantee. Gas is built in 2022 and 2027 to meet reserve capacity margins, replace much of the capacity of retiring coal and to meet peak demand on a state level. Gas build could be lower if demand response is effectively utilized, battery storage is built instead, or firm factors for renewables are recognized.
- **Retirements:** 6.0GW of coal is retired and 0.6GW is life-extended. This is a similar outcome to our NEO2017 result, suggesting that the reliability guarantee has little impact on coal's role in the power system. However it is possible that in reality more coal could be life-extended instead of building new gas, depending on the condition of individual assets.
- **Generation:** 39% of generation is from renewables in 2030, which is slightly less than the 41% in our NEO2017 base case. Almost all of the growth in gross electricity demand is met by increasing small-scale PV generation. The output of retiring coal plants is replaced by a combination of new wind and gas, as well as an increase in output from the remaining coal generators. Average gas generation is higher than in our NEO2017 base case, due to the combined impact of the reliability and emissions guarantees.
- **Emissions:** The -28% target is met mainly via abatement from small-scale PV and energy efficiency. NEM emissions will likely be 23% below 2005 levels in 2020, so little large-scale renewable build is needed to meet the target.

Comparison of modelling scenario results for the National Electricity Market, 2021-30

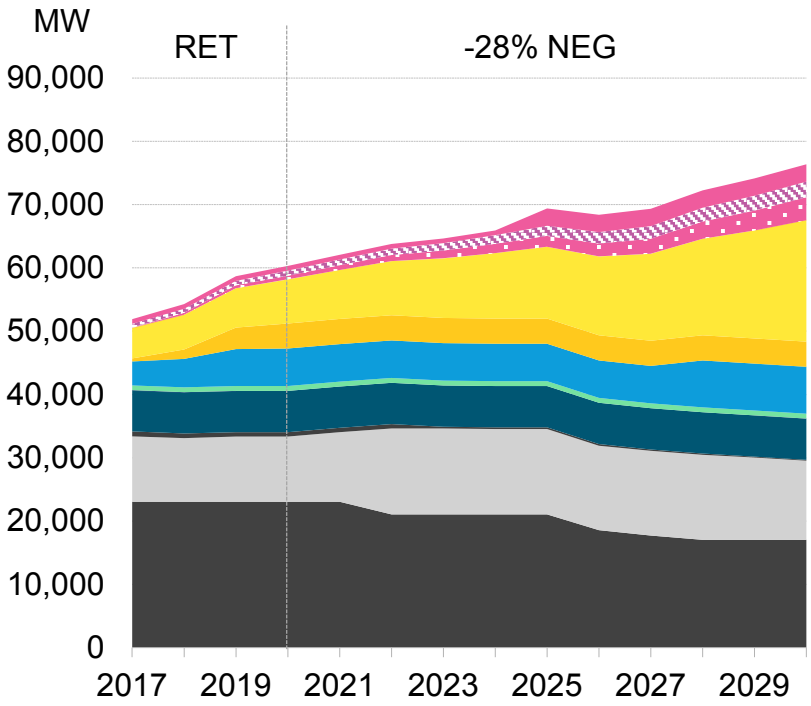
Scenario	Large-scale renewables build (GW)	Gas build (GW)	Coal closures (GW)	Renewable penetration (%)	Average gas generation (TWh/p.a.)	Average black coal generation (TWh/p.a.)	Average brown coal generation (TWh/p.a.)
NEO 2017 base case	3.4	0	6.0	41%	13.1	88.4	37.2
NEG -28%	**1.5**	**4.9**	**6.0**	**39%**	**15.0**	**87.6**	**37.2**

Source: Bloomberg New Energy Finance

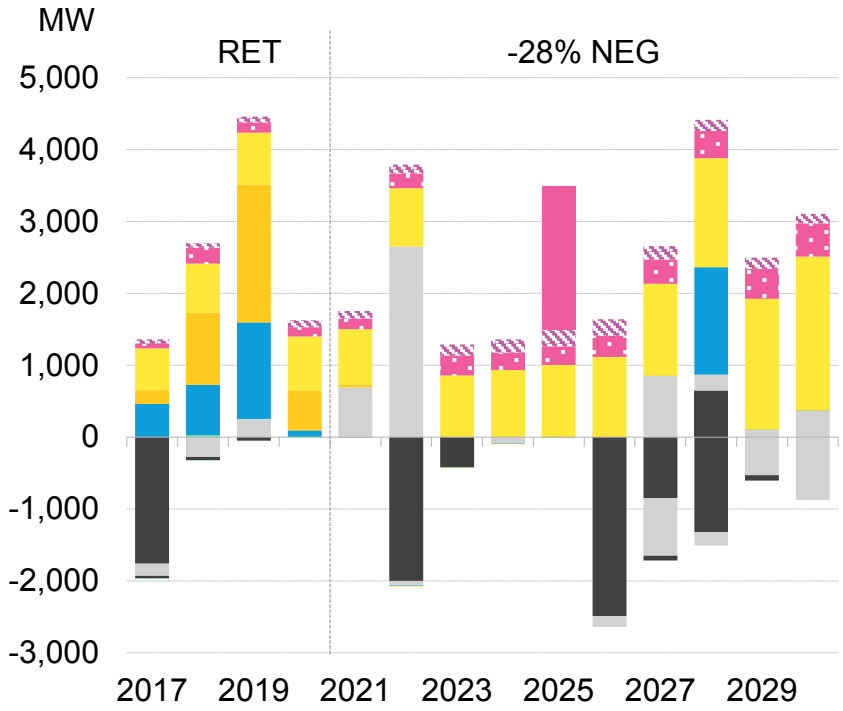
-28% scenario

Capacity mix

Cumulative installed capacity



Gross capacity additions & retirements



- Small-scale PV grows continuously, driven by consumer economics, with gradual uptake of end-user batteries
- Coal capacity declines due to end-of-life retirements, requiring new gas to meet our assumed reliability guarantee

Source: Bloomberg New Energy Finance

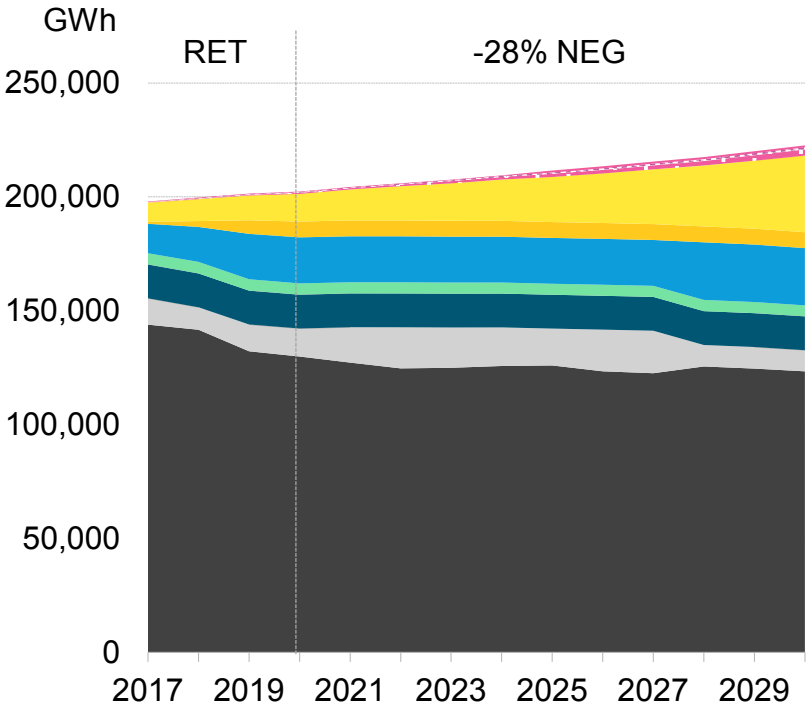
- Only 1.5GW of large-scale renewables are built post-2020 to meet the emissions guarantee, due to strong uptake of small-scale PV and the weak emissions target.
- Gas and pumped hydro (Snowy 2.0) replace exiting coal capacity in the mid 2020s

Source: Bloomberg New Energy Finance

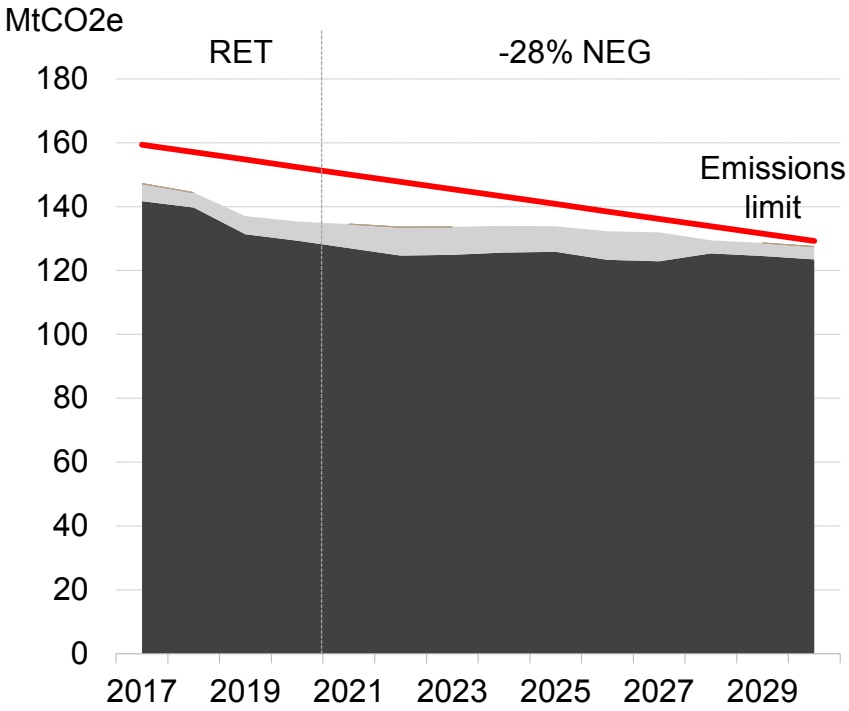
-28% scenario

Generation and emissions

Electricity generation, by technology



Emissions



- Renewable energy supplies 39% of generation in 2030, due mainly to the continued growth of small-scale PV
- Coal and gas generation remain roughly flat

Source: Bloomberg New Energy Finance

- NEM emissions are generally well below the -28% emissions guarantee limit, as the RET already achieves a 23% reduction on 2005 levels by 2020.
- The emissions guarantee should only begin to bind in 2028, requiring investment in renewable energy

Source: Bloomberg New Energy Finance

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-45% scenario (2°C)

Key results of -45% scenario

- **Capacity build**: 41GW of new capacity built from 2021-30 (6.8GW of wind, 10GW of large-scale PV, 12GW small-scale PV, 3GW of behind-the-meter storage and 5.2GW gas). Substantially more renewables are built to meet the stronger emissions target compared to other scenarios, but a similar amount of gas is needed to meet the reliability guarantee.
- **Retirements**: 6.6GW coal retired with no capacity life extended. This is only 600MW less than in the other scenarios (despite the emissions guarantee reducing the utilization rate) as the reliability guarantee requires coal to stay in the system to meet the capacity margin. In practice, this may require payments and entail some costs.
- **Generation**: 52% of generation is from renewables in 2030. Renewable generation increases steadily, reducing the output of brown and black coal generators. However from 2027 renewable curtailment begins to arise due to its high penetration and the inflexibility of the existing coal fleet, with 9TWh curtailed in 2030. Gas generates a similar amount to other scenarios, to balance renewables and meet regional needs where gas is the dominant fuel.
- **Emissions**: The -45% target is met with the continuous construction of large-scale renewable generation. Notably, this target continues the average annual rate of emissions reduction achieved by the existing RET from 2017-20 (3.3%/year).

Comparison of modelling scenario results for the National Electricity Market, 2021-30

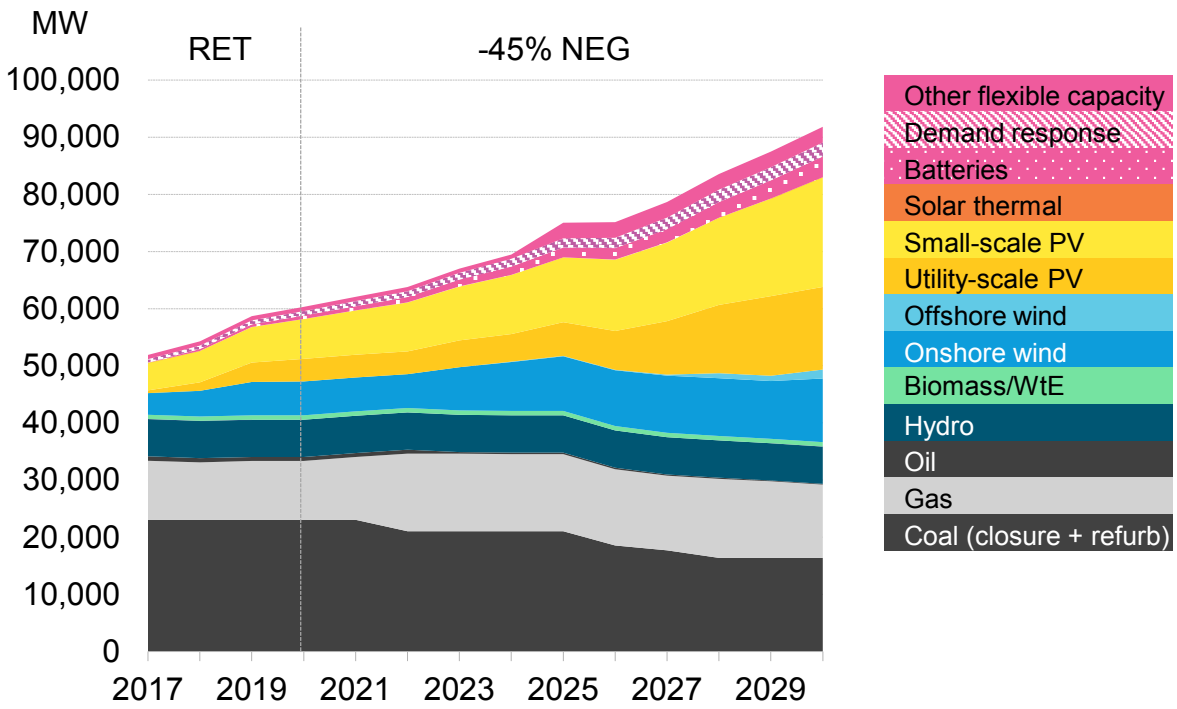
Scenario	Large-scale renewables build (GW)	Gas build (GW)	Coal closures (GW)	Renewable penetration (%)	Average gas generation (TWh/p.a.)	Average black coal generation (TWh/p.a.)	Average brown coal generation (TWh/p.a.)
NEO 2017 base case	3.4	0	6.0	41%	13.1	88.4	37.2
NEG -28%	1.5	4.9	6.0	39%	15.0	87.6	37.2
NEG -45%	**17.3**	**5.2**	**6.6**	**52%**	**14.6**	**76.2**	**33.4**

Source: Bloomberg New Energy Finance

-45% scenario (2°C)

Capacity mix

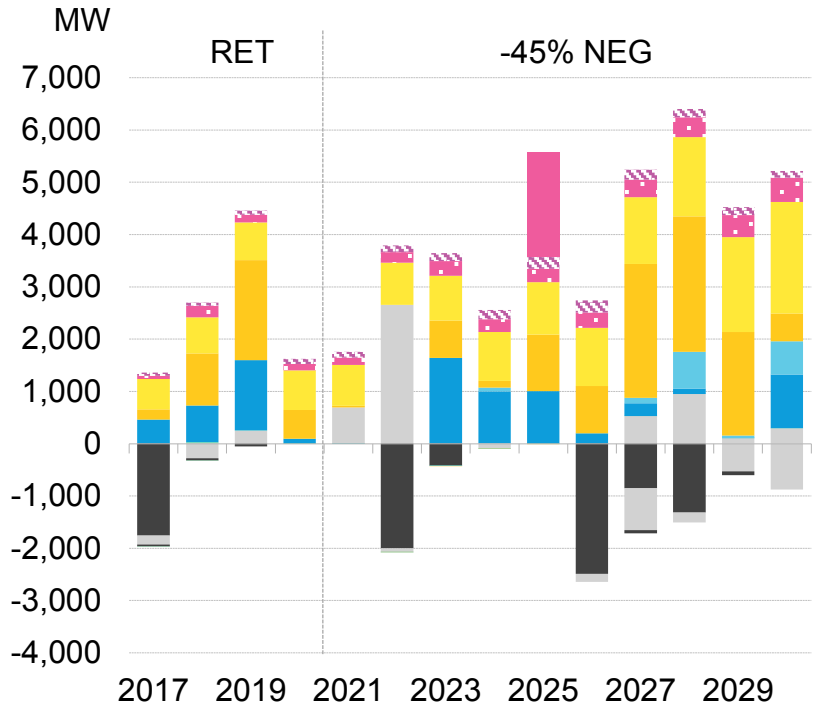
Cumulative installed capacity



- Small-scale PV grows continuously, driven by consumer economics, with gradual uptake of end-user batteries
- Coal capacity declines due to end-of-life retirements, requiring new gas to meet the reliability guarantee

Source: Bloomberg New Energy Finance

Gross capacity additions & retirements



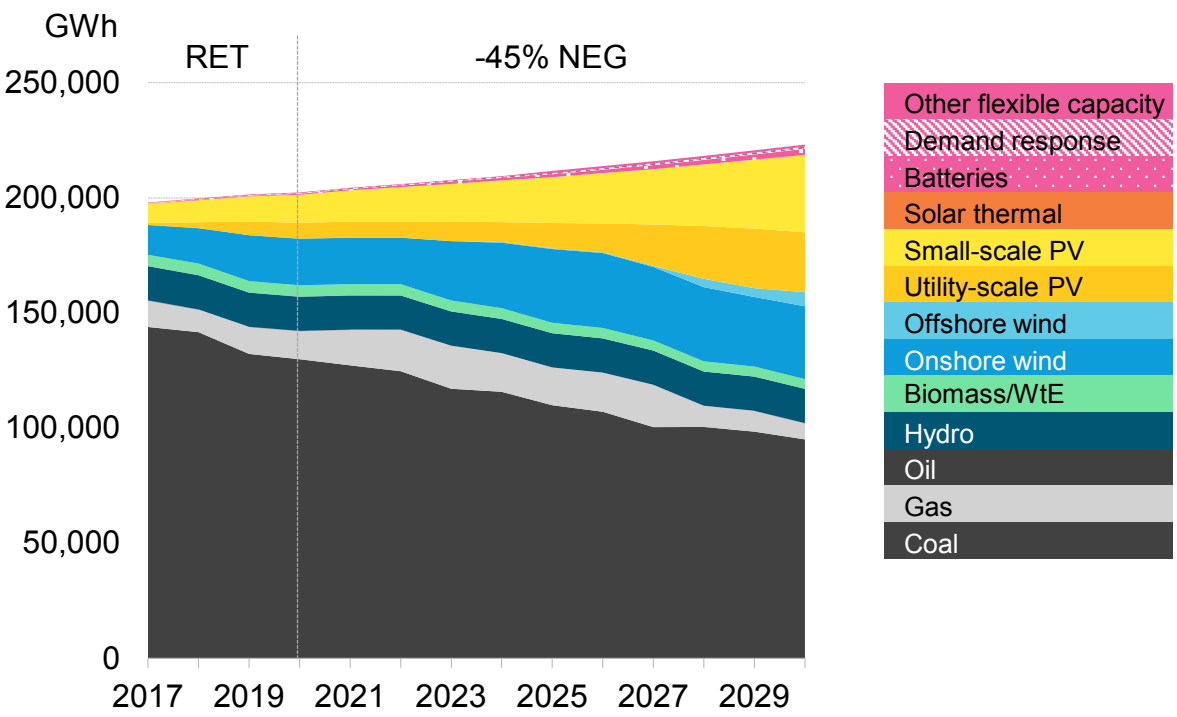
- Around 17.3GW of large-scale renewable capacity is built from 2021-30 to meet the -45% emissions guarantee
- Large-scale renewables, gas and pumped hydro (Snowy 2.0) replace exiting coal capacity in the mid 2020s

Source: Bloomberg New Energy Finance

-45% scenario (2°C)

Generation and emissions

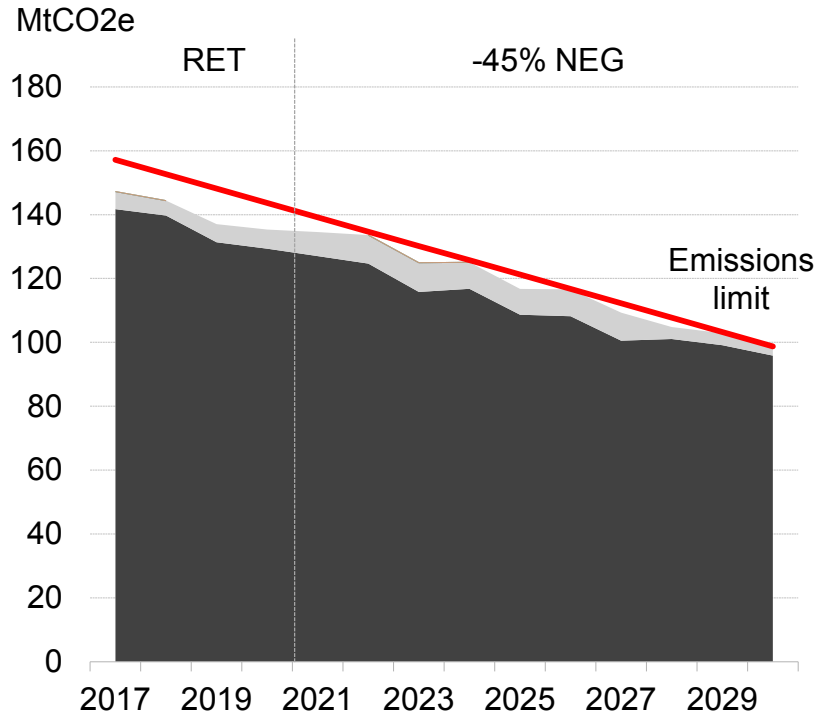
Electricity generation, by technology



- Renewable energy supplies 52% of generation in 2030. Due to this high penetration, and inflexibility of the coal fleet, 9TWh of renewable generation is curtailed in 2030.
- Coal generation steadily declines due to its high emissions, whilst gas retains its role of balancing

Source: Bloomberg New Energy Finance

Emissions



- The emissions guarantee begins to bind in 2023, requiring ongoing investment in renewable energy to meet the continuously declining limit

Source: Bloomberg New Energy Finance

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Key modelling assumptions

Parameter	Assumption	Reference
Total demand	197.3TWh in 2017, rising to 217TWh in 2030 AEMO 2017 native demand (plus) AEMO Small-scale PV generation (plus) BNEF EV demand	2H 2017 Australia Power Market Outlook (web | terminal)
Small-scale PV and storage uptake	4.8GW PV, 0.1GWh storage in 2017, rising to 19.2GW PV, 3.6GWh storage in 2030 BNEF 2017 small-scale PV and storage forecast. Assumes NEG has no impact on uptake in either scenario.	Australia behind-the-meter PV and storage forecast (web | terminal)
Demand response	0.5GW in 2017, rising to 2.5GW by 2030.	
Levelized cost of electricity (2017 A$)	Wind: A$64-104/MWh in 2017, declining to A$46-69/MWh in 2030 Large-scale PV: A$84-124/MWh in 2017, declining to A$42-62/MWh in 2030 Gas (CCGT): A$79-86/MWh in 2017, declining to A$81-87/MWh in 2030 Refurbished coal: A$59-72MWh in 2017, declining to A$55-63/MWh in 2030	1H 2017 APAC LCOE Update (web | terminal)
Pumped hydro	Assume completion of 2GW Snowy 2.0 project in 2025	2H 2017 Australia Power Market Outlook (web | terminal)
Expected 2020 emissions (baseline)	138.72 MtCO2 – Based on emissions reductions through BNEF LRET build and small-scale PV build	New Energy Outlook 2017: Asia Pacific (web | terminal)
LRET build	LRET is met by 2021	2Q 2017 Australia REC Market Outlook (web | terminal)
Fuel prices (2017 A$)	BNEF New Energy Outlook fuel price assumptions: Coal: A$63/t in 2017 flat at A$63/t out to 2030 Gas: A$8.8/GJ in 2017 falling to A$7.3/GJ in 2030	New Energy Outlook 2017: Data Viewer (web | terminal)

Source: Bloomberg New Energy Finance

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