2025 **Transmission Network** Forum

State of the Network

Paul Simshauser
Powerlink Queensland

Powerlink acknowledges the Traditional Owners and their custodianship of the lands and waters of Queensland and in particular the lands on which we operate.

We pay our respect to their Ancestors, Elders and knowledge holders and recognise their deep history and ongoing connection to Country.

Agenda

1 Investment – *market led*

2 Industry cost dynamics

3 Coal plant and economic gravity

4 Power system planning

5 On gas turbines

6 The trilemma

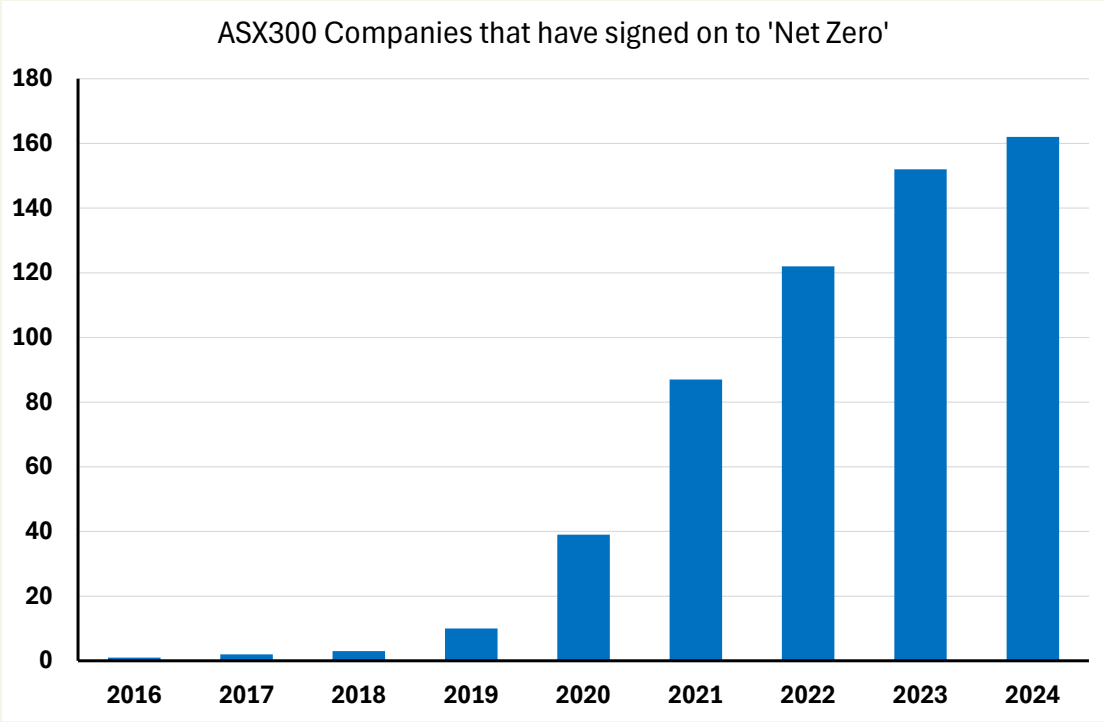
NEM renewables… *largely* market led

Investment commitments in renewables (RE) largely market led from 2019…

- Government policy & RE subsidies drove investment from 1998-2018 in the NEM
- 20% RET *initiated* a supercycle when the policy finally settled (c.2015)

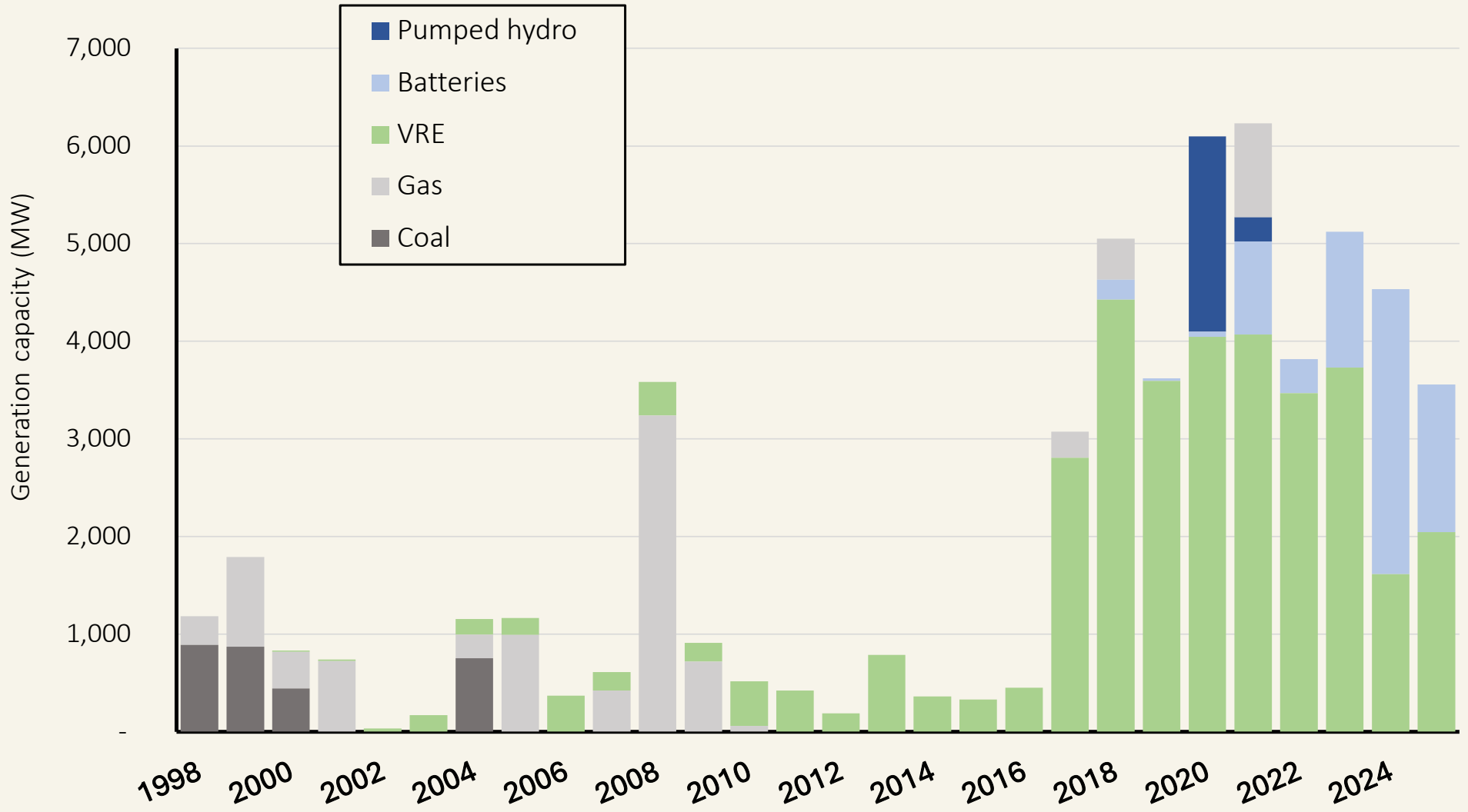
- Capital markets and entry economics took over (2019 -)
- Capacity Investment Scheme effects hard to isolate
  (CIS Announcement is not the same as Investment Commitment)
- Boardroom Investment Commitments in RE and firming:
  - 1998 to 2025 = $98 billion, 275 projects, 40,200 MW
  - 1998 to 2018 = $32 billion, 125 projects, 11,300 MW

- Plus, *kitchen table* Investment Commitments (rooftop PV)
  - $10 billion, 14,400 MW (2019-2025)
- Total (2019-2025) ~43,000 MW



Sources: Simshauser & Gilmore (2022), Climate change policy discontinuity & Australia's 2016-2021 renewable investment supercycle. ASX300 Chart - Macquarie Research.

NEM investment commitments 1998-2025 – New capacity



2017-2025
- 224 projects
- 37.2GW
- $84.3 billion

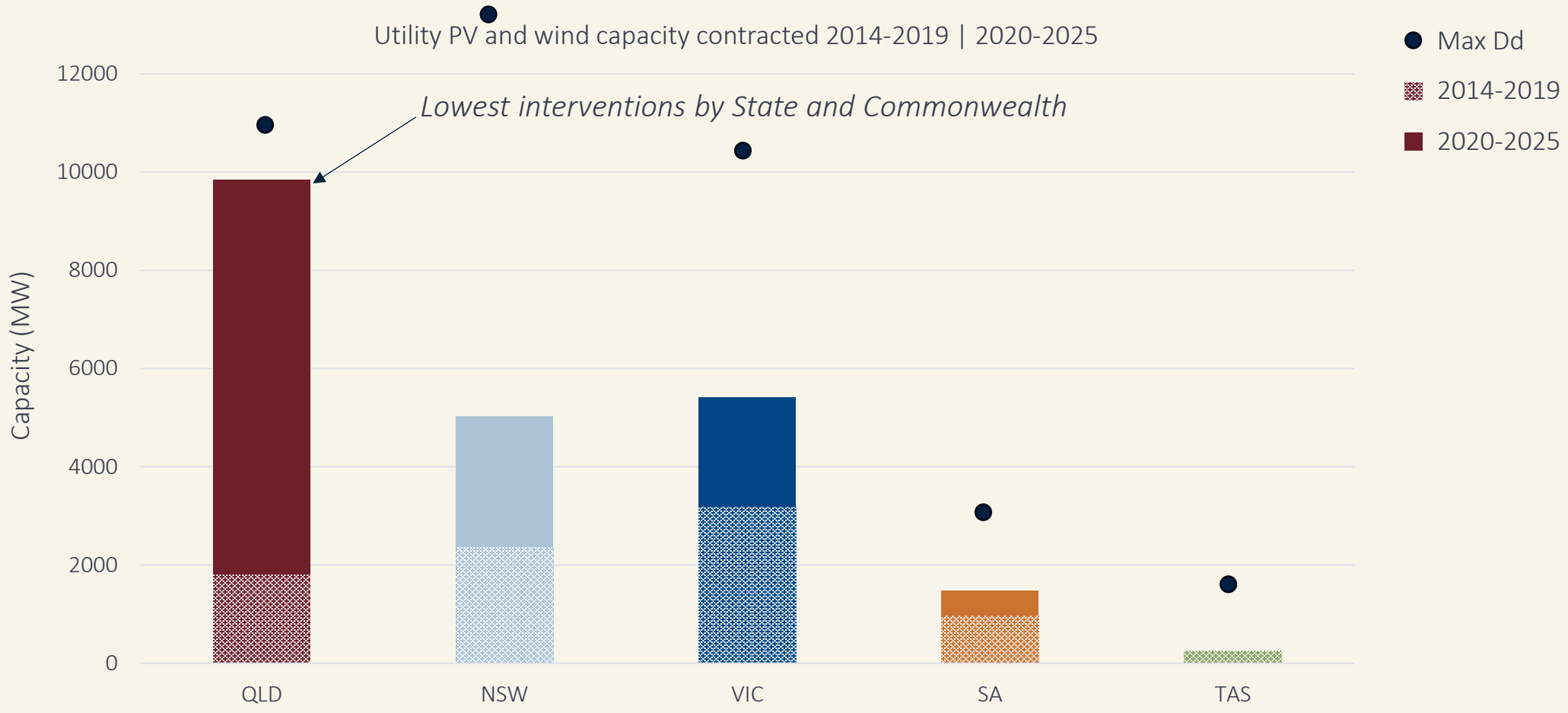
Wind
- 51 projects
- 10.6GW
- $27.8 billion

Solar
- 118 projects
- 15.2GW
- $27.6 bn

Batteries
- 48 projects
- 7.4GW
- $10.7 bn

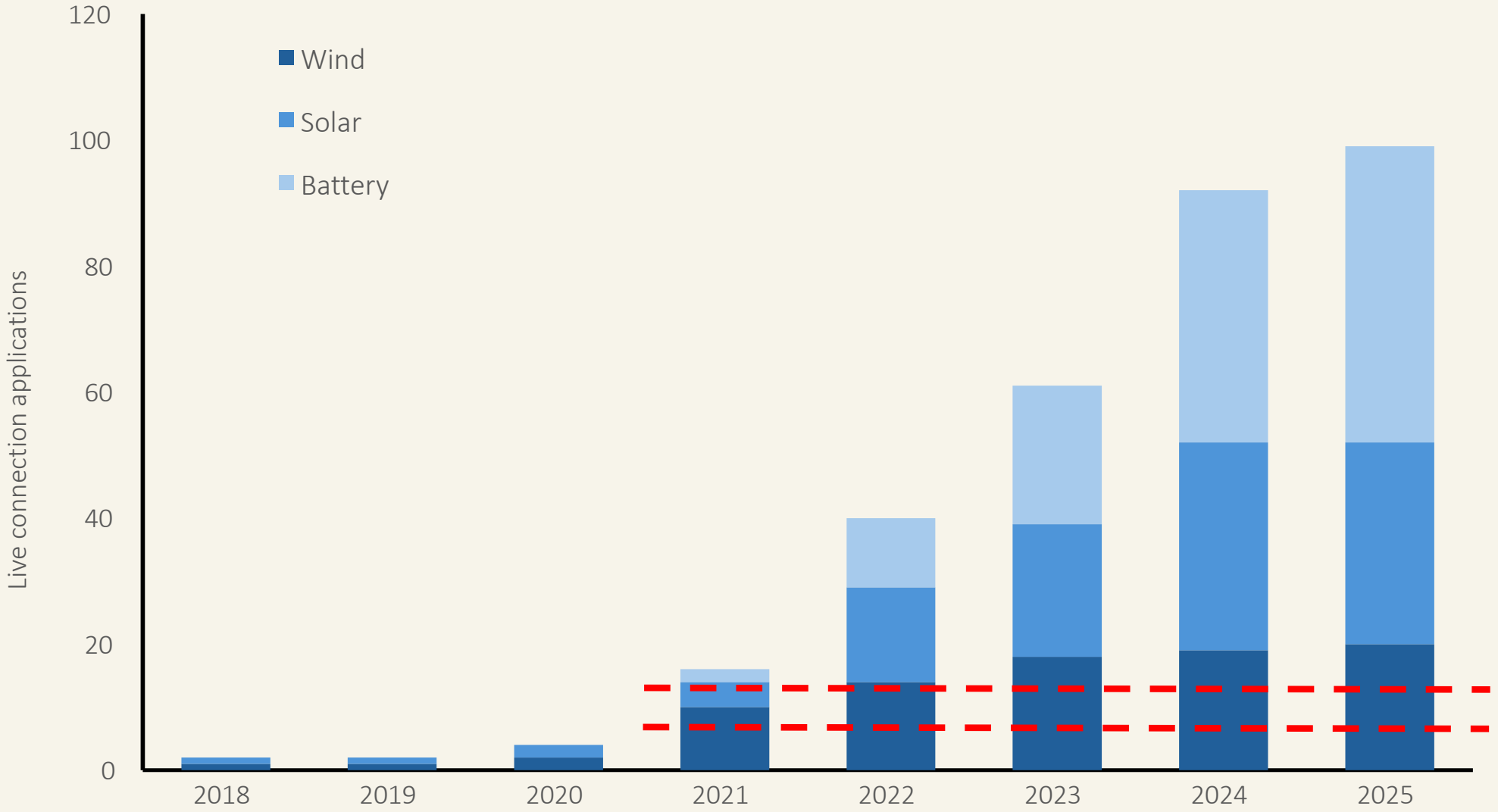
Source: Simshauser & Gilmore (2022), Climate change policy discontinuity & Australia's 2016-2021 renewable investment supercycle. Energy Policy, Vol.160

RE commitments (2014-2025) by NEM region



Source: Rystad Energy Research and Analysis

Queensland connection applications



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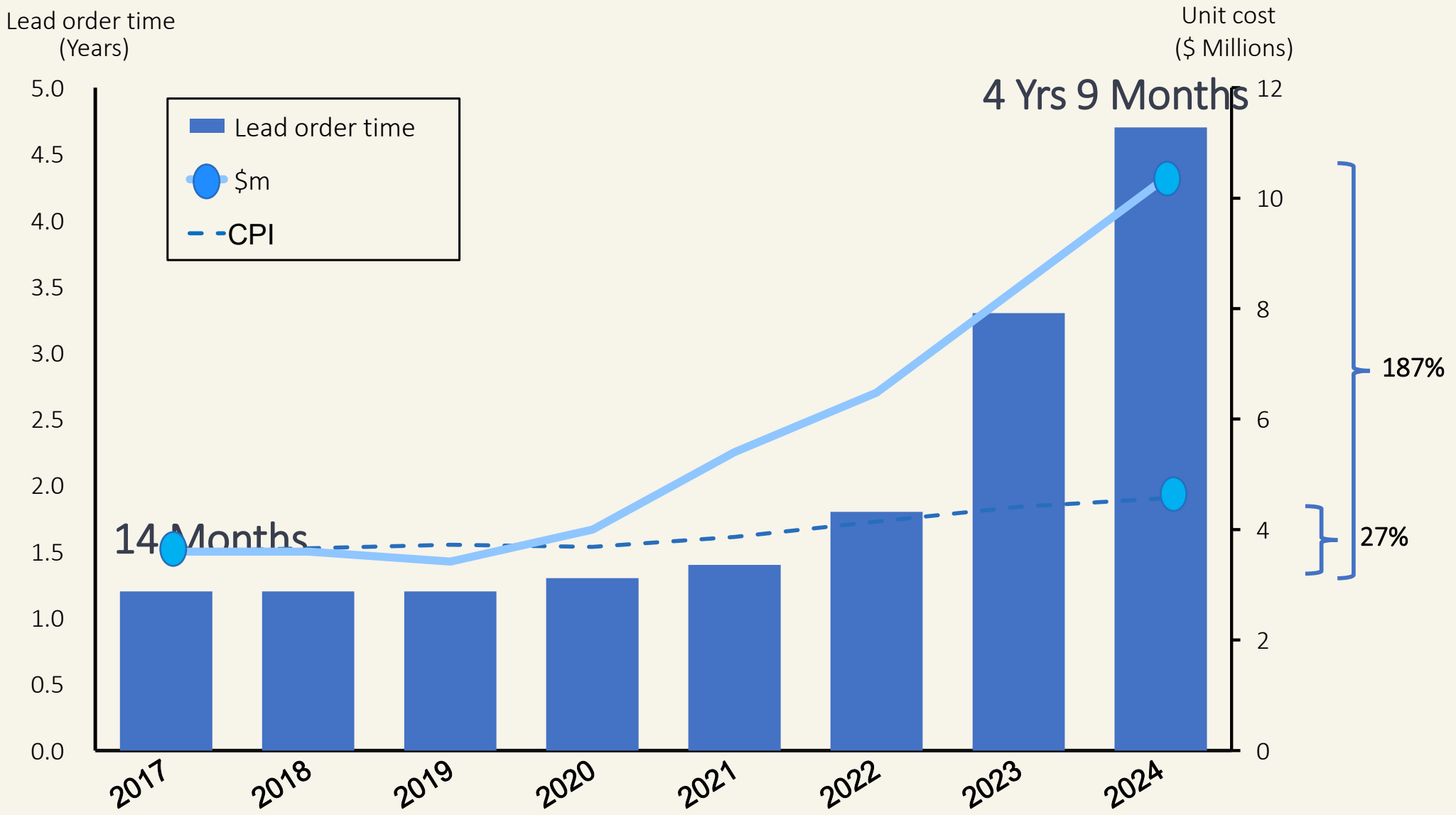
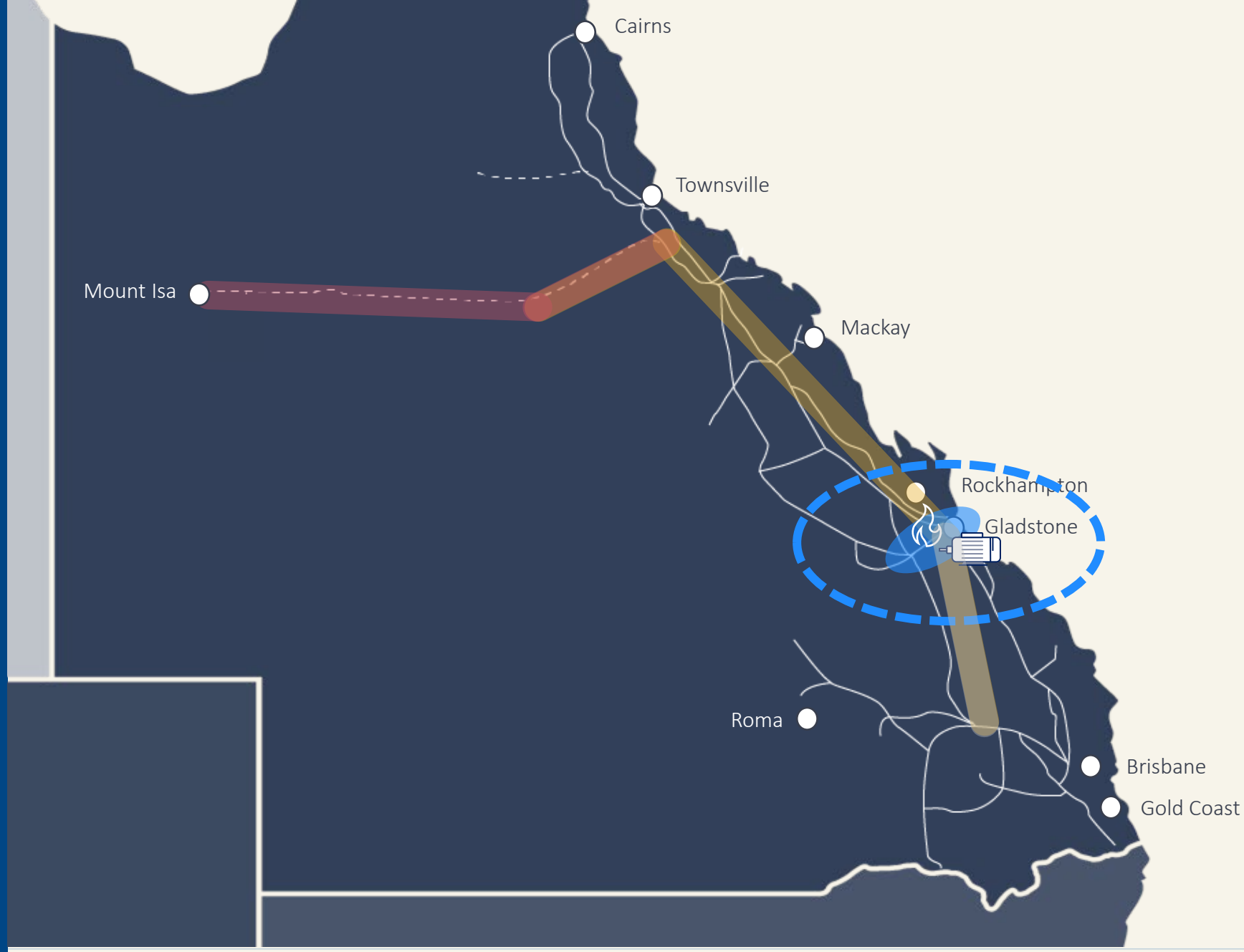
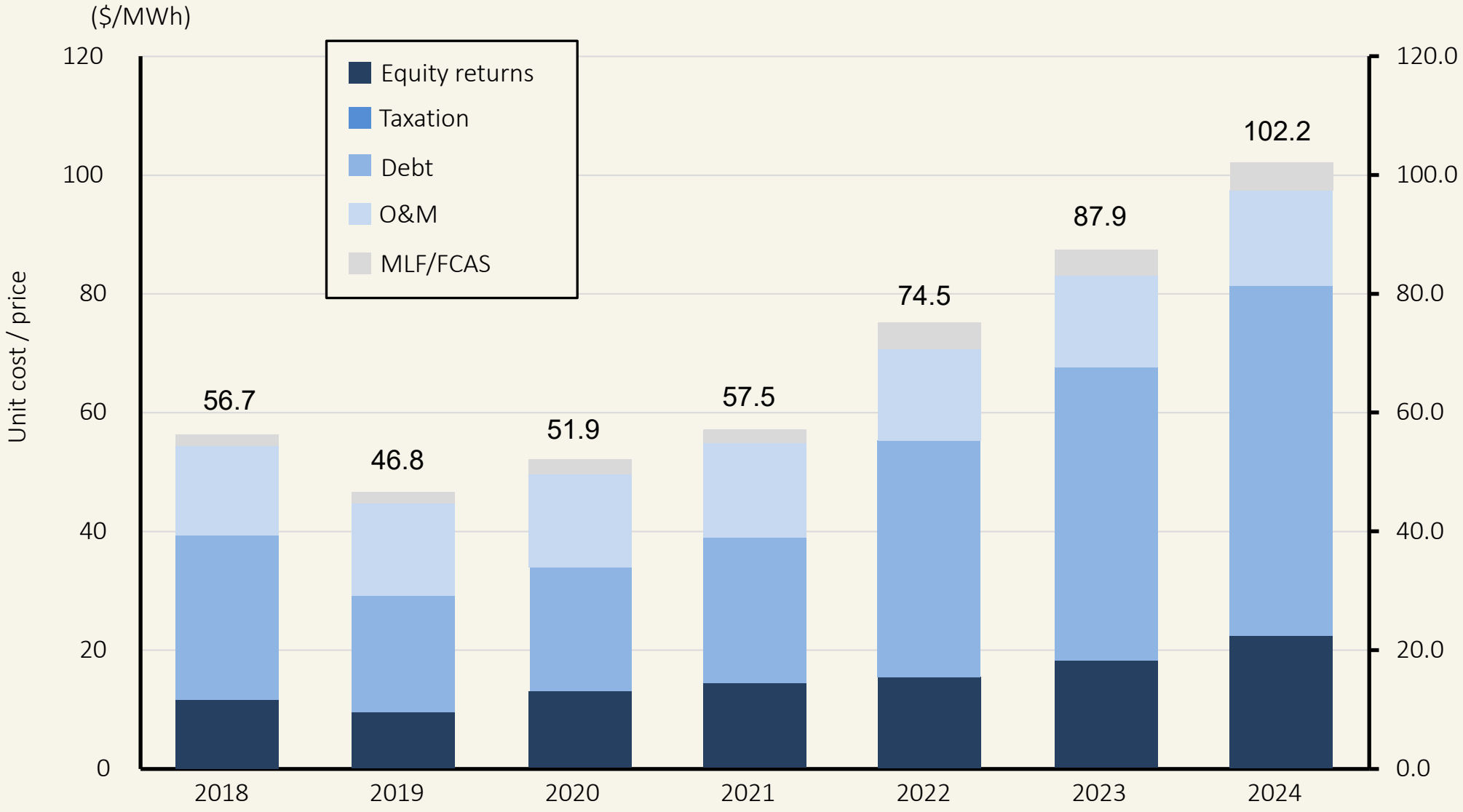
275kV transformers – time and cost



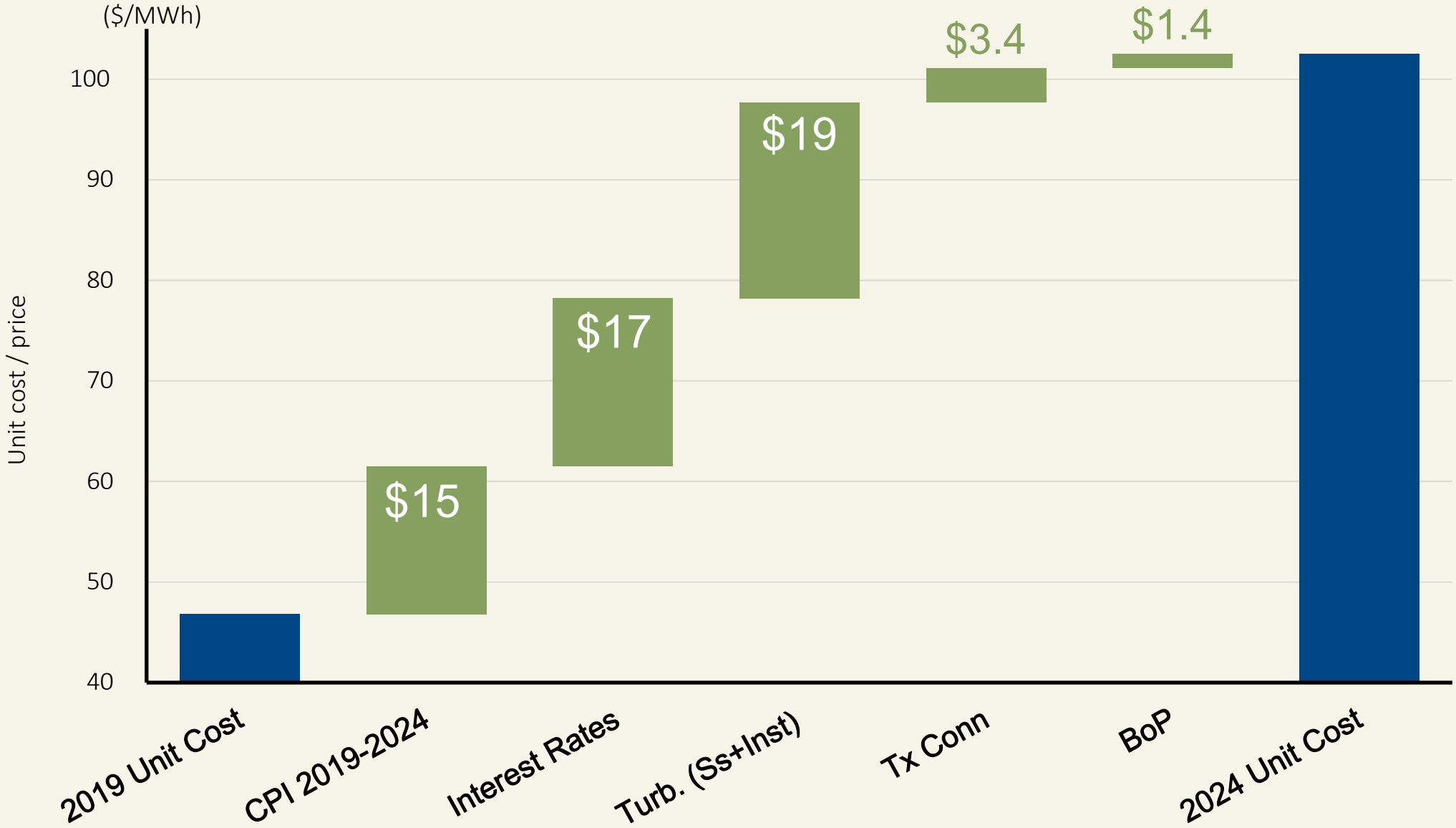
2025 Network Plan



Unit cost of wind (unconstrained)

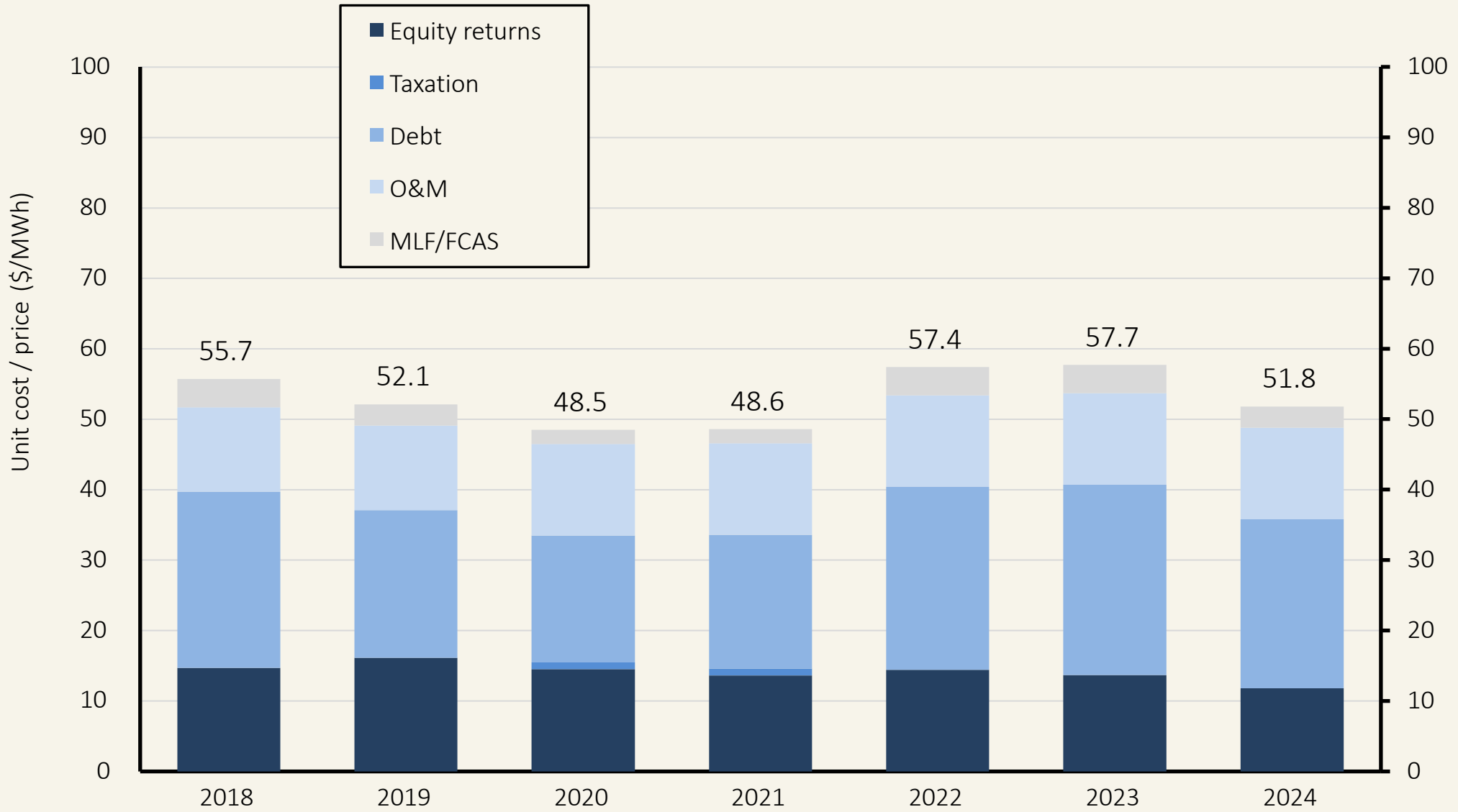


Changes in the unit cost of wind



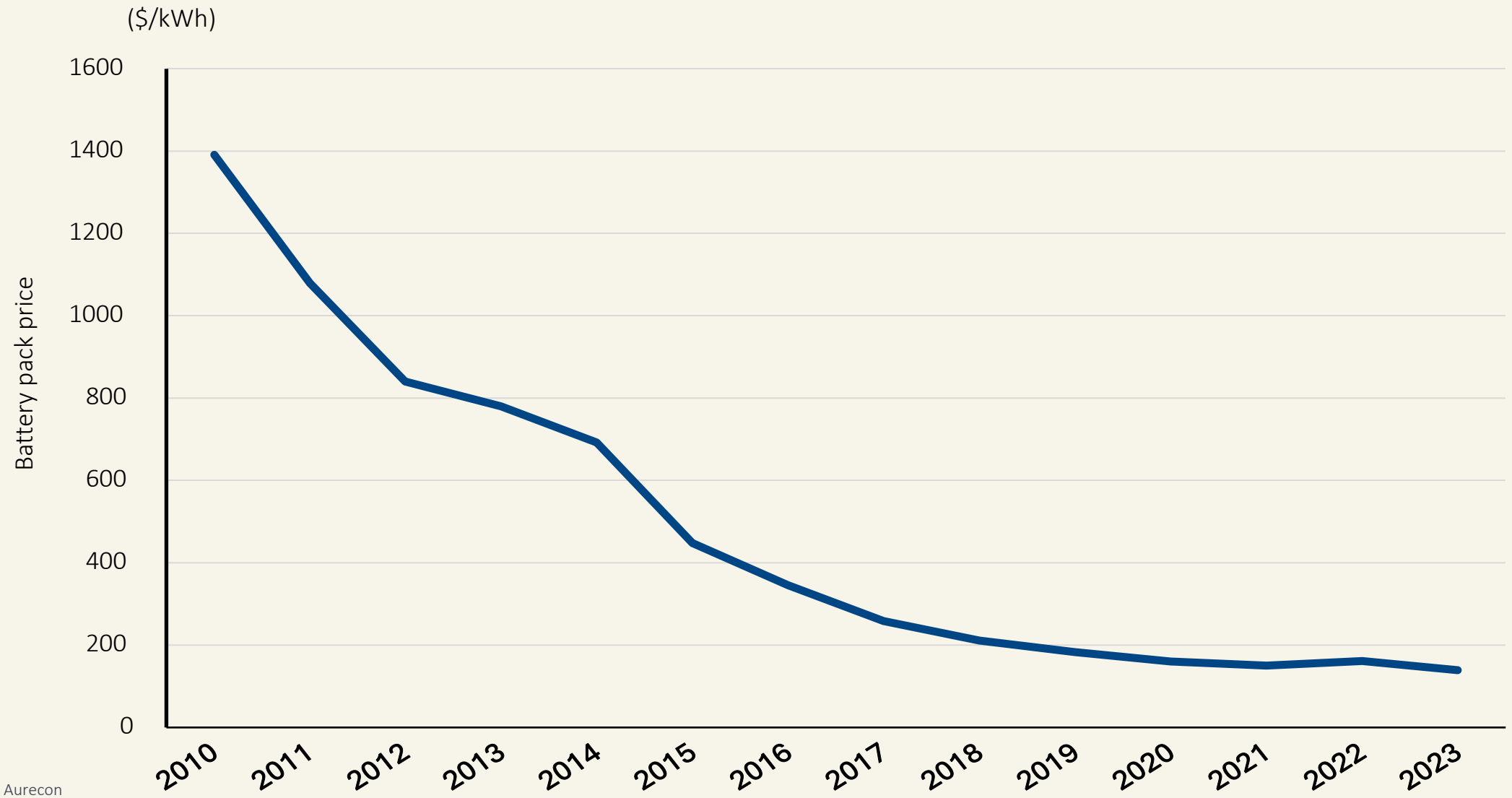
Sources: Aurecon, Simshauser, Rai & Gleeson (2025).

Unit cost of solar (unconstrained)



Sources: Aurecon, Simshauser, Rai & Gleeson (2025).

Lithium-ion battery pack prices ($/kWh)



Source: Aurecon

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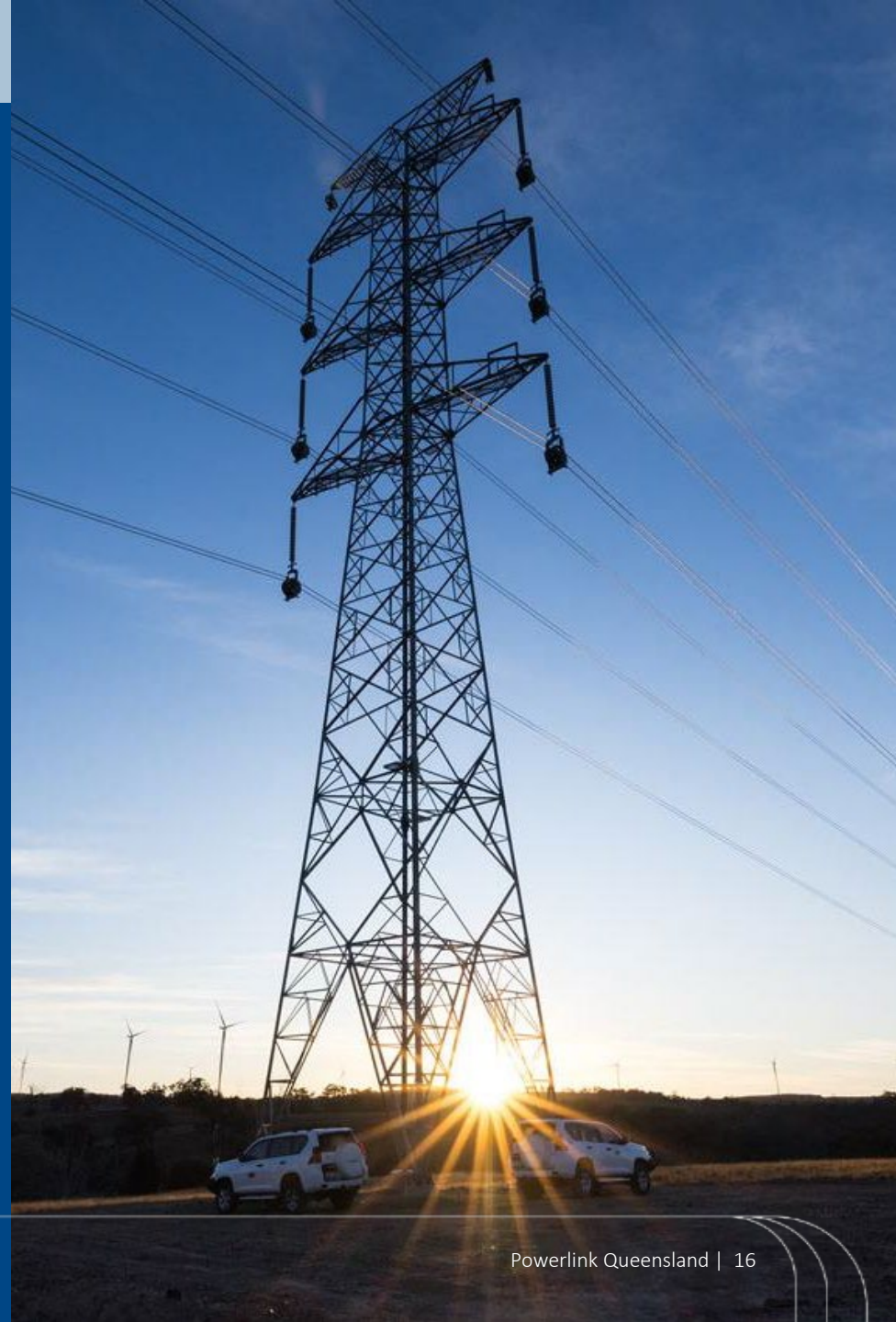
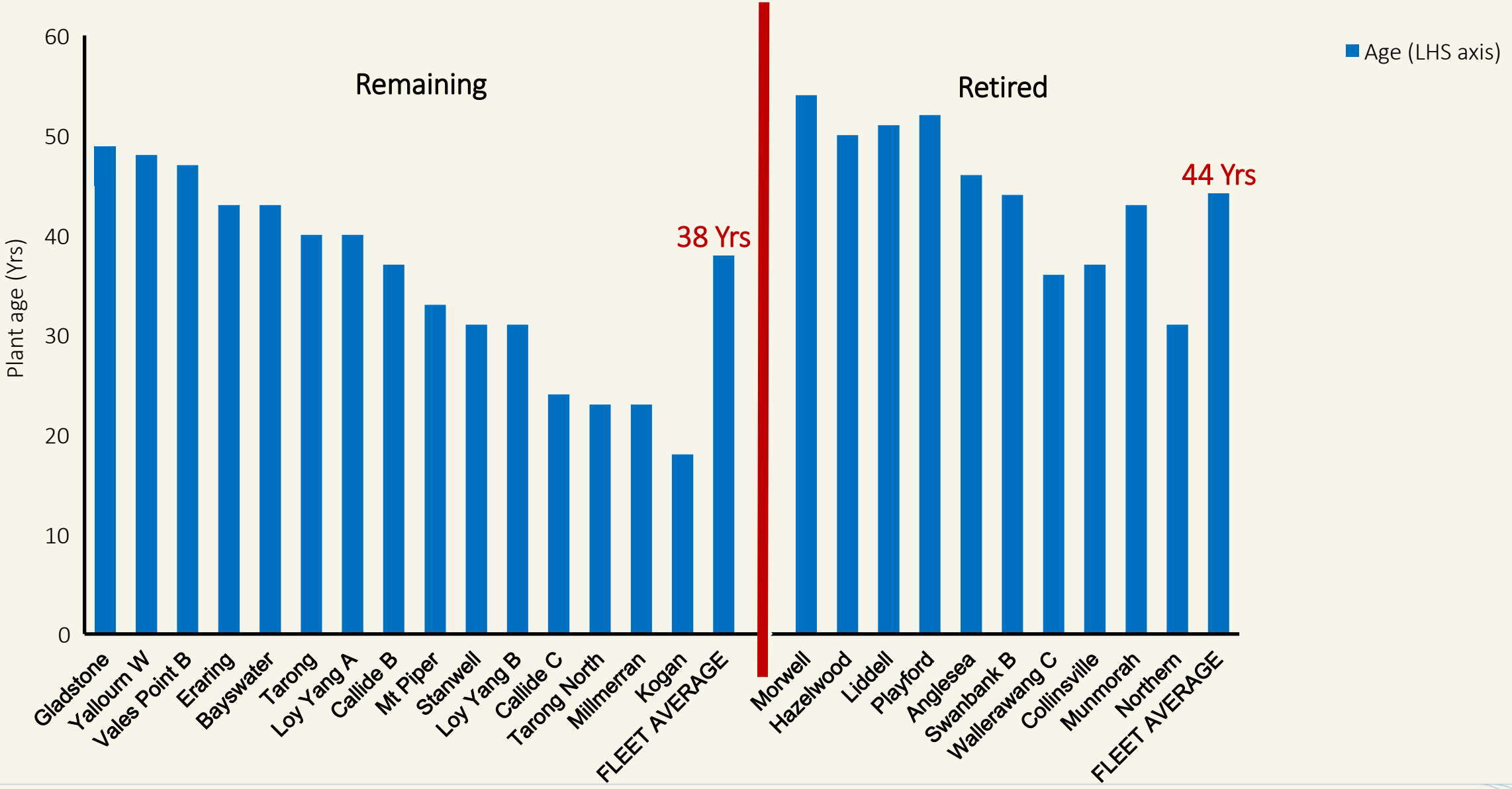
Our legacy coal fleet is important for price stability, reliability and system services.

Across the NEM, coal plant retirements are being delayed. There are ‘speed limits’ to life extensions:

- Not all coal plant is low cost
- Plant age and plant outage rates are correlated

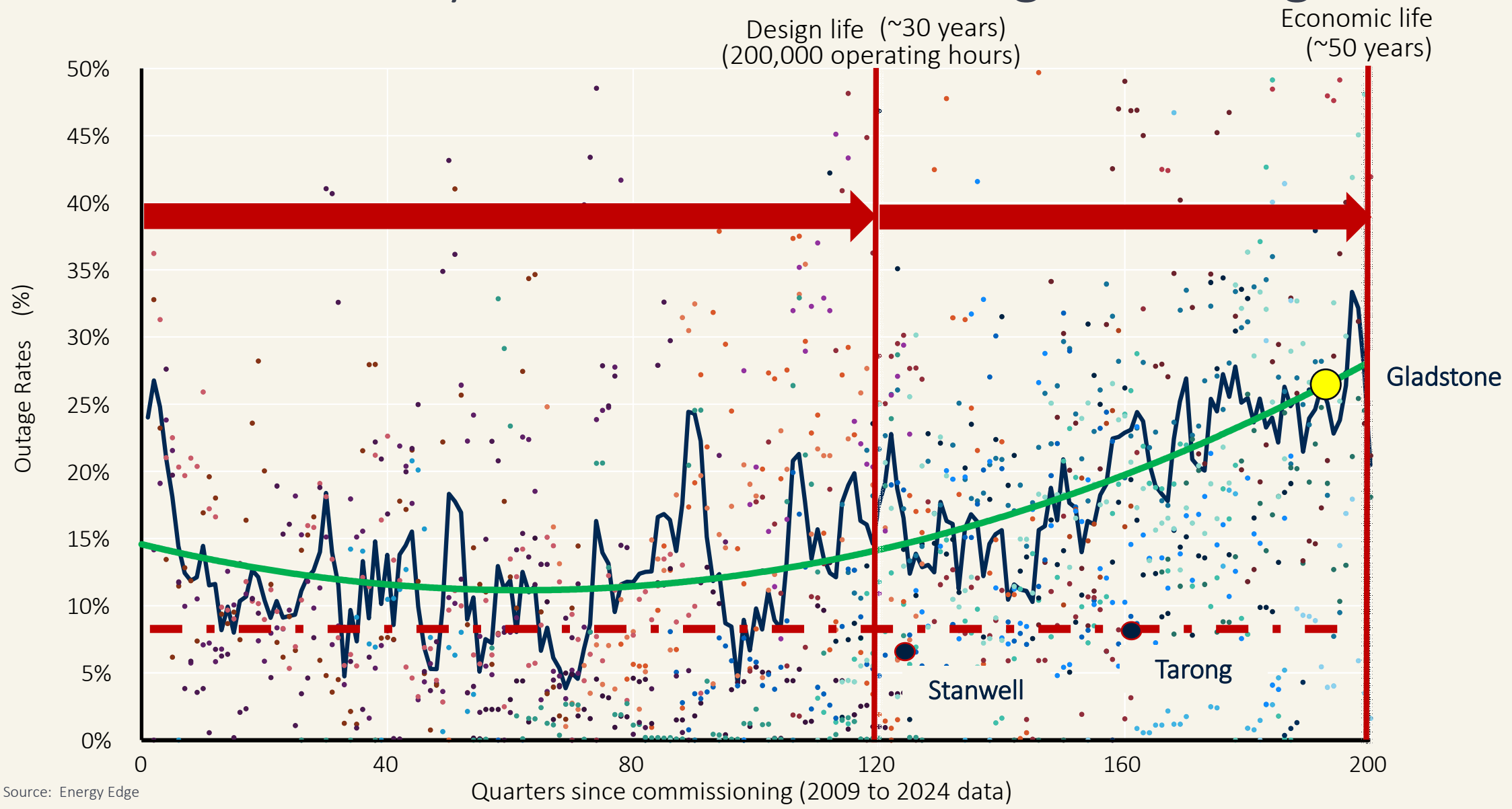


National Electricity Market coal fleet – Remaining vs Retired



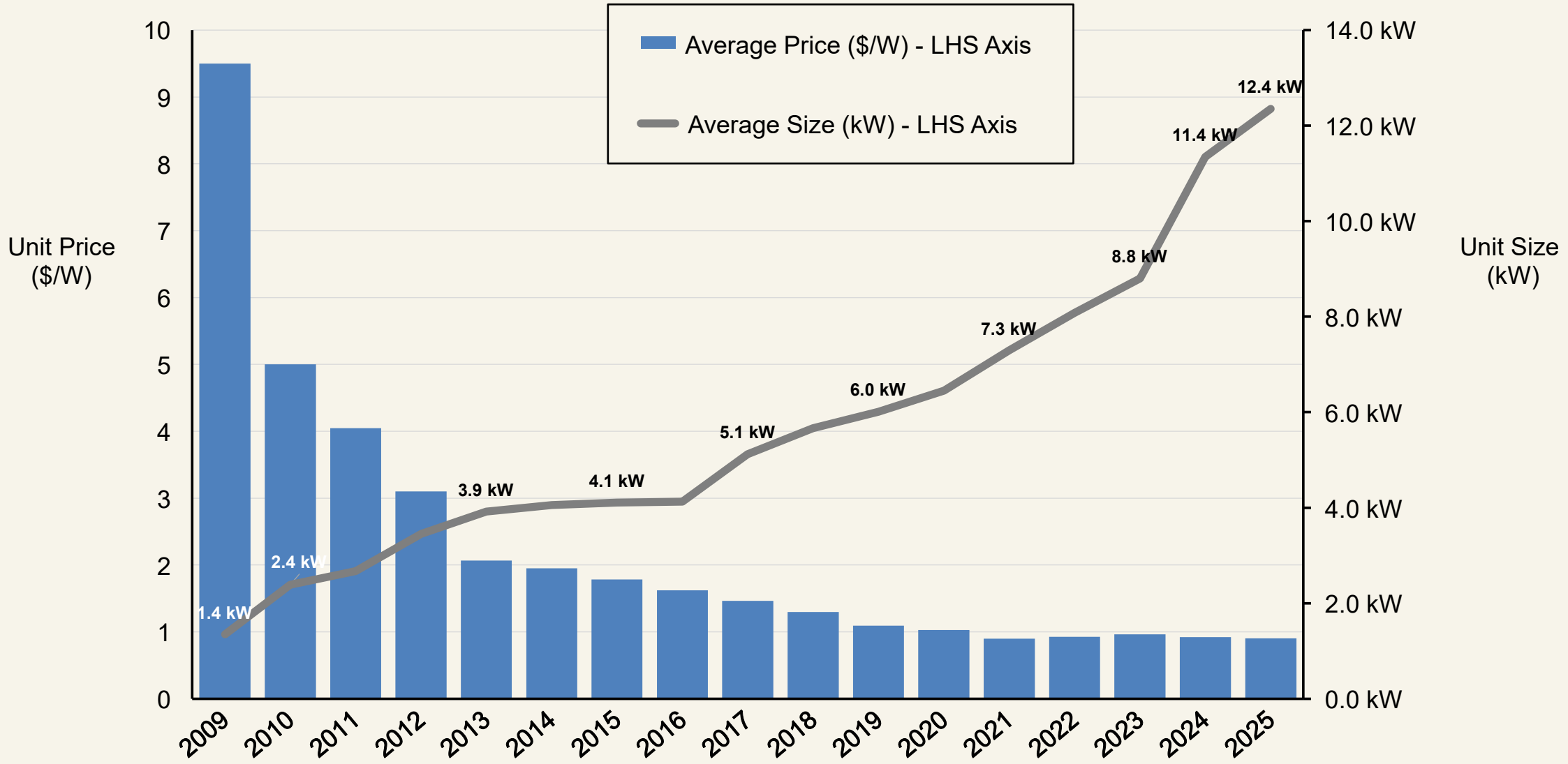
Source: Simshauser & Gilmore (2023), "The Counterfactual Scenario: are renewables cheaper?", CAEEPR Working Paper, Griffith University.

National Electricity Market Coal Fleet: Age vs Outage Rates



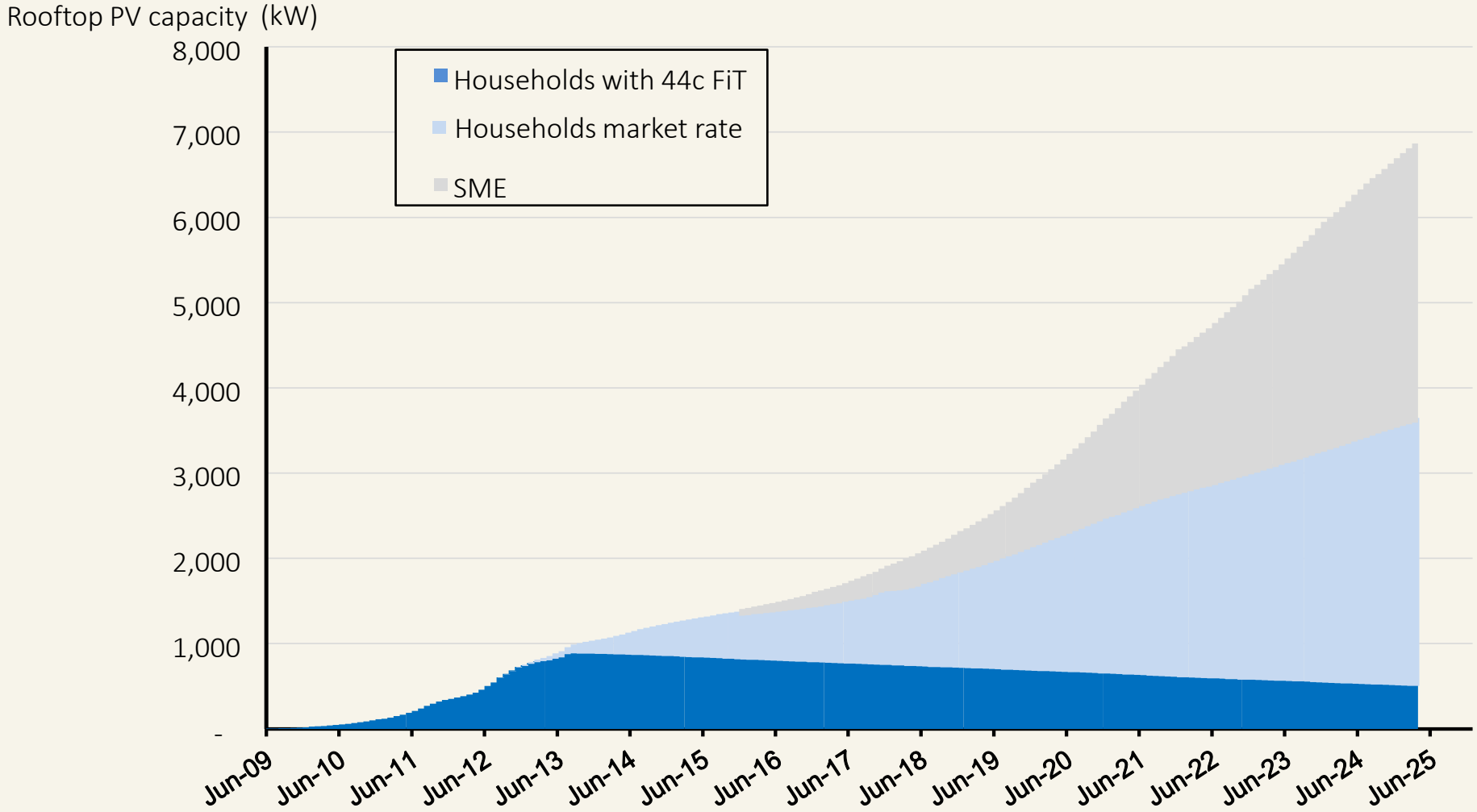
Source: Energy Edge

Rooftop solar: cheaper and larger



Source: Simshauser, Nelson & Gilmore (2023), "The Sunshine State: causes and effects of mass rooftop solar PV take-up rates in Queensland", Book Chapter.

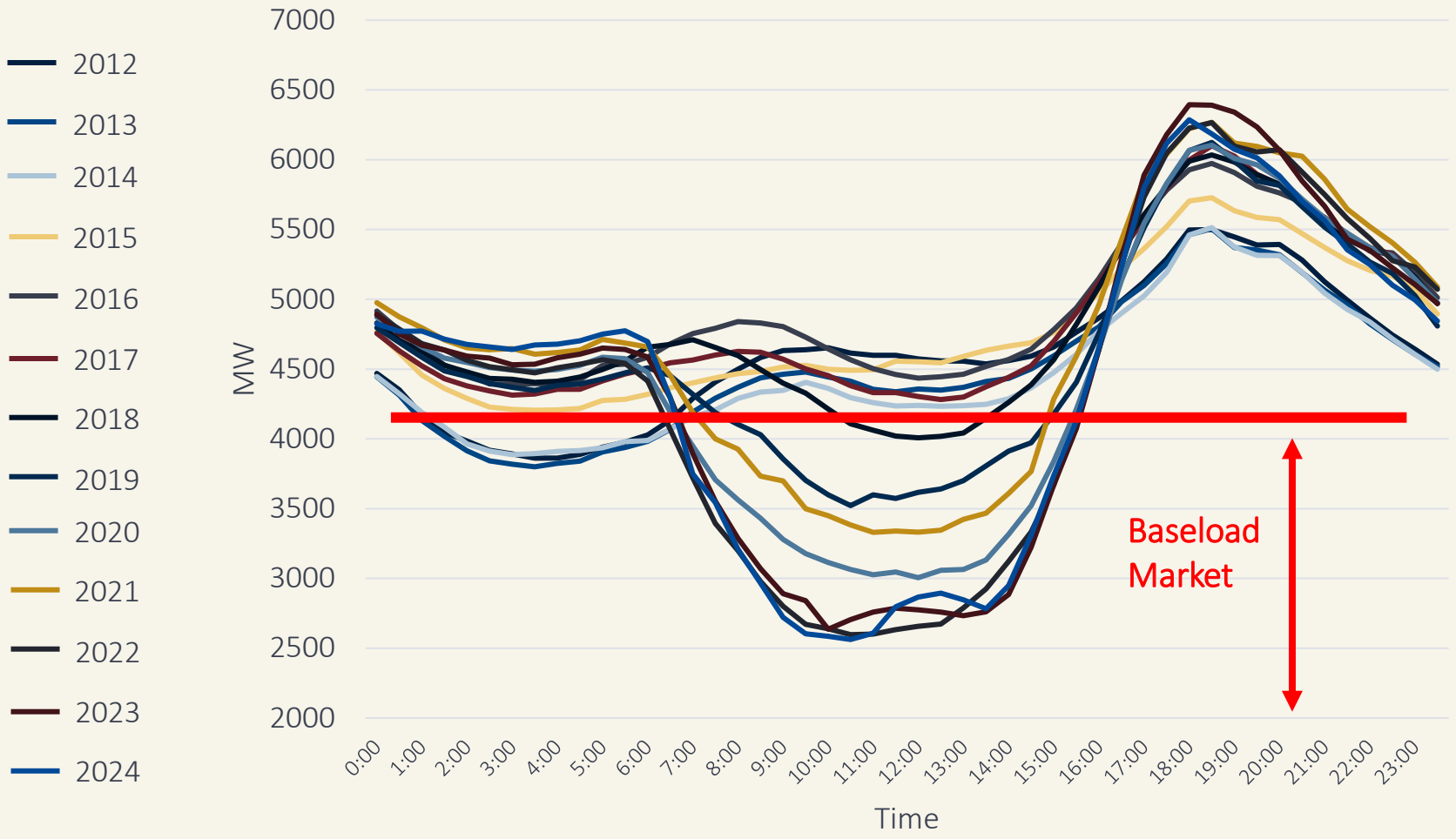
Queensland rooftop take-up rate – 53.7%
(highest take-up rate in the world)



Source: Simshauser, Nelson & Gilmore (2023), "The Sunshine State: causes and effects of mass rooftop solar PV take-up rates in Queensland", Book Chapter.

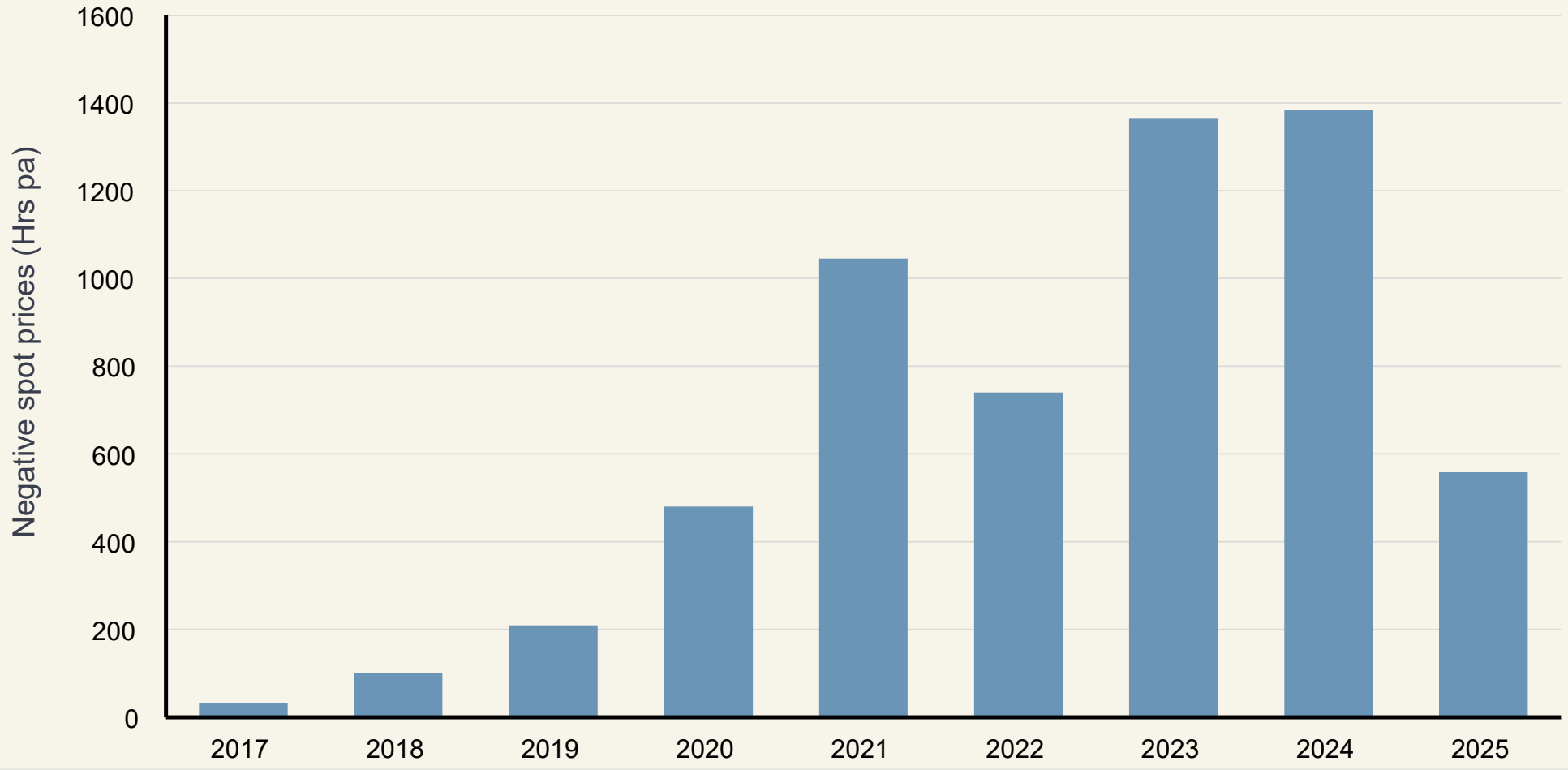
The baseload market is contracting

Coal plants need to run continuously between their minimum stable load and maximum rated capacity.

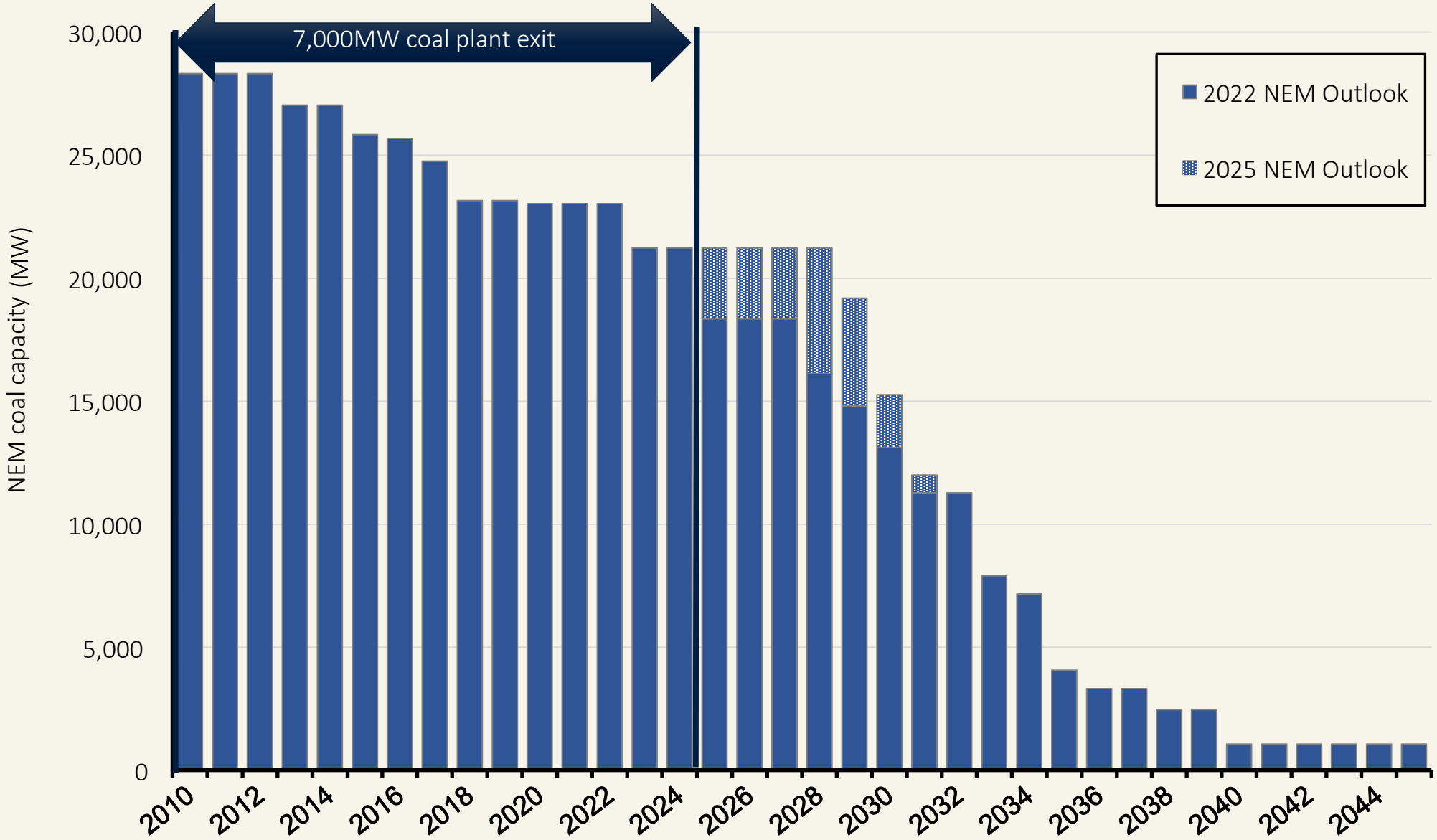


Rooftop PV is sending closure signals - requires flexibility

Negative spot prices: average hours pa (Qld, NSW, Vic)



NEM coal plant – remaining capacity (MW)



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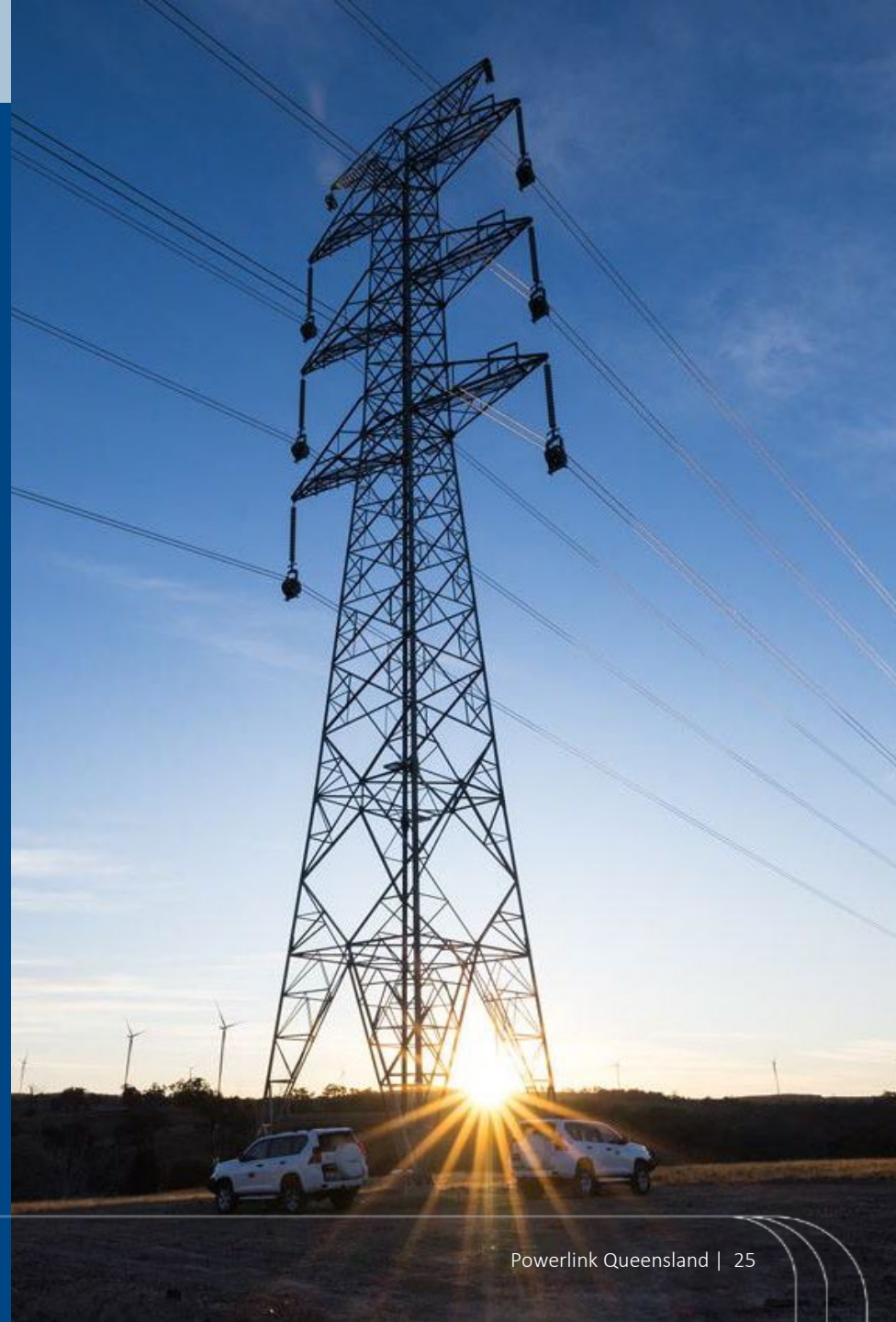
4 Power system planning – *the counterfactual scenario*

5 On gas turbines

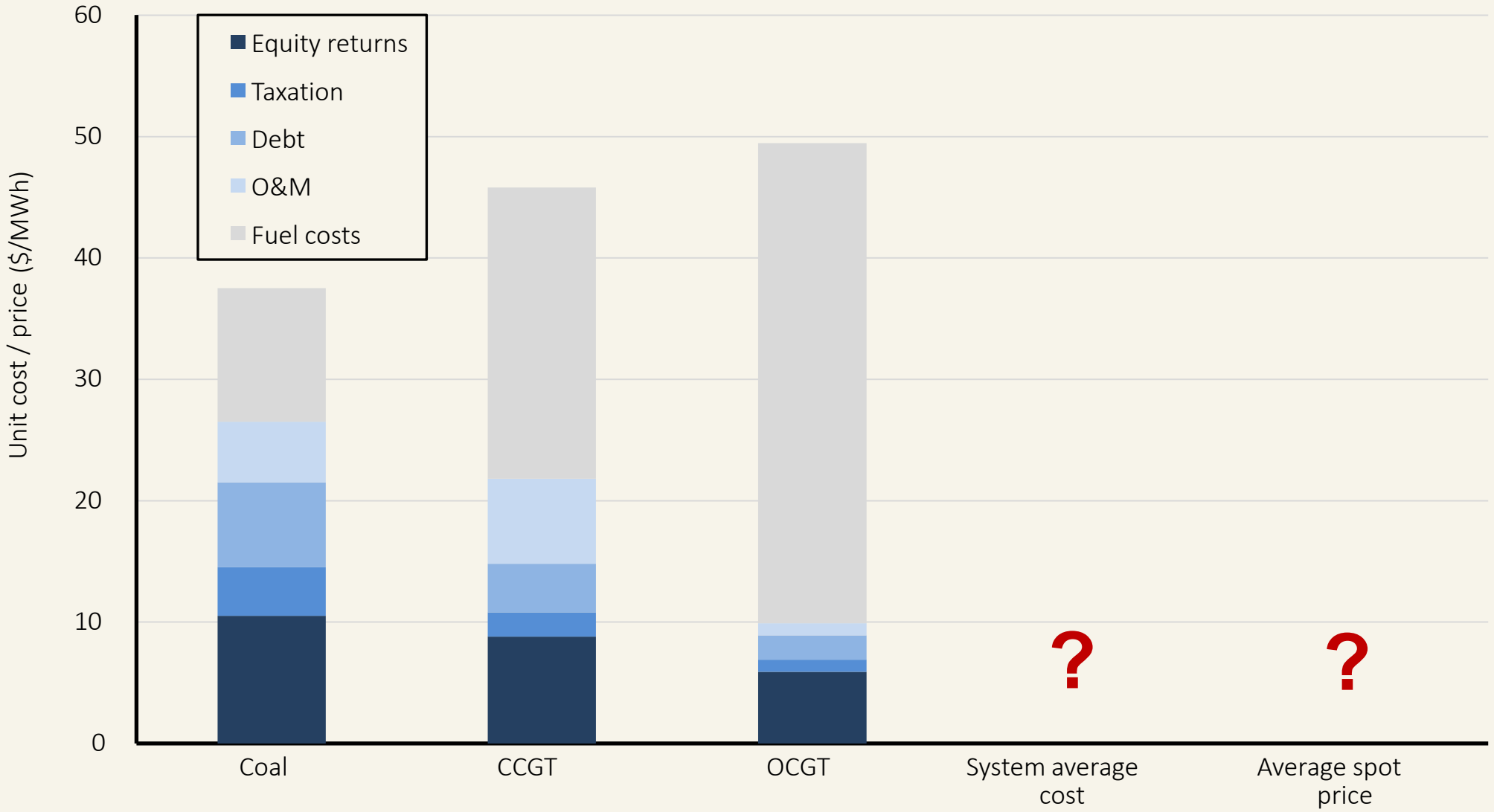
6 The trilemma

Given the NEM's current cost dynamics, power system planning requires *'everything in balance'*.

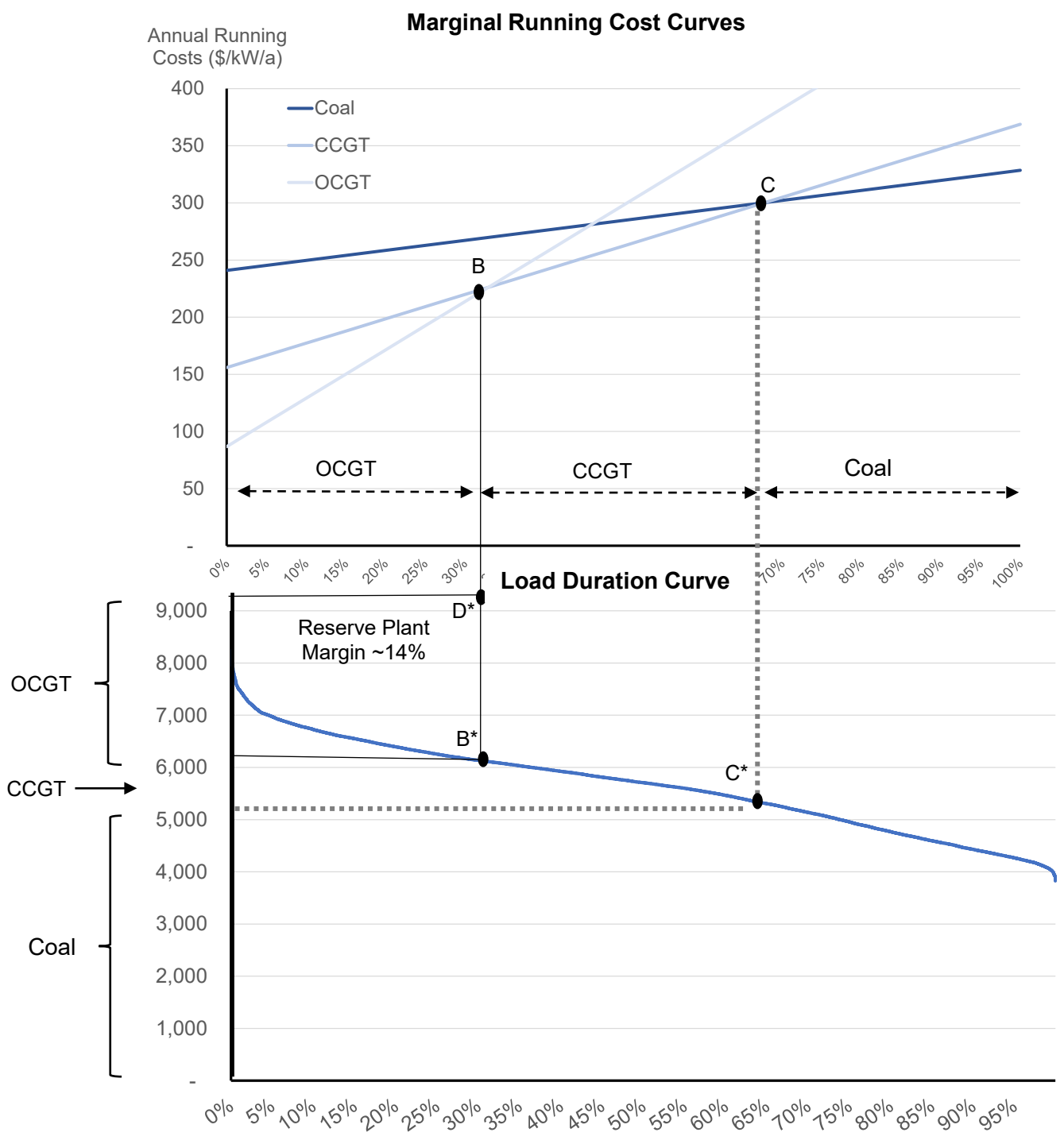
- Marginal coal plant are exposed to export coal prices and realities of aged-based reliability
- Lowest cost replacement *at pace* requires
  - RE (i.e. wind and solar); and
  - dispatchable fleet (GTs, batteries and pumped hydros).

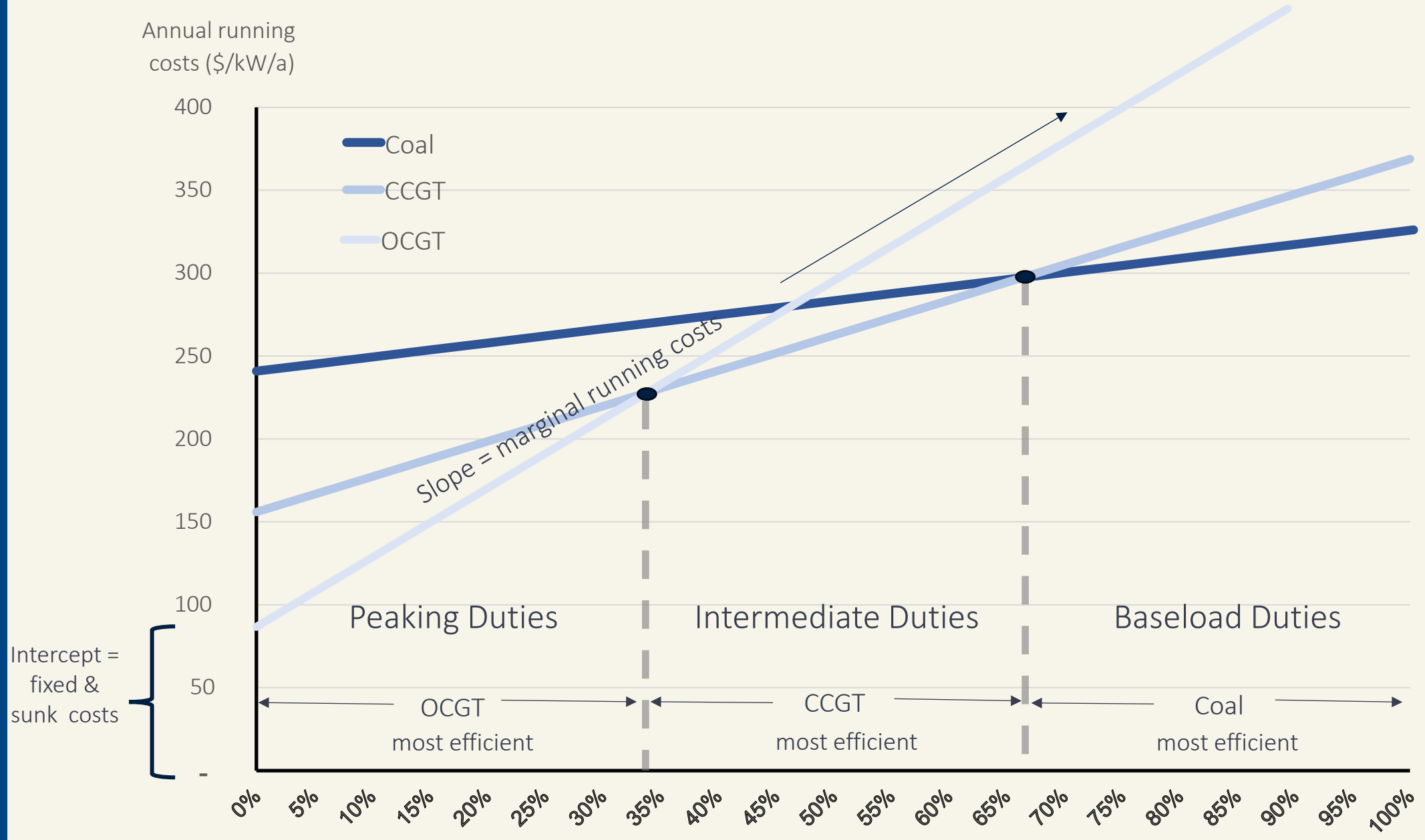


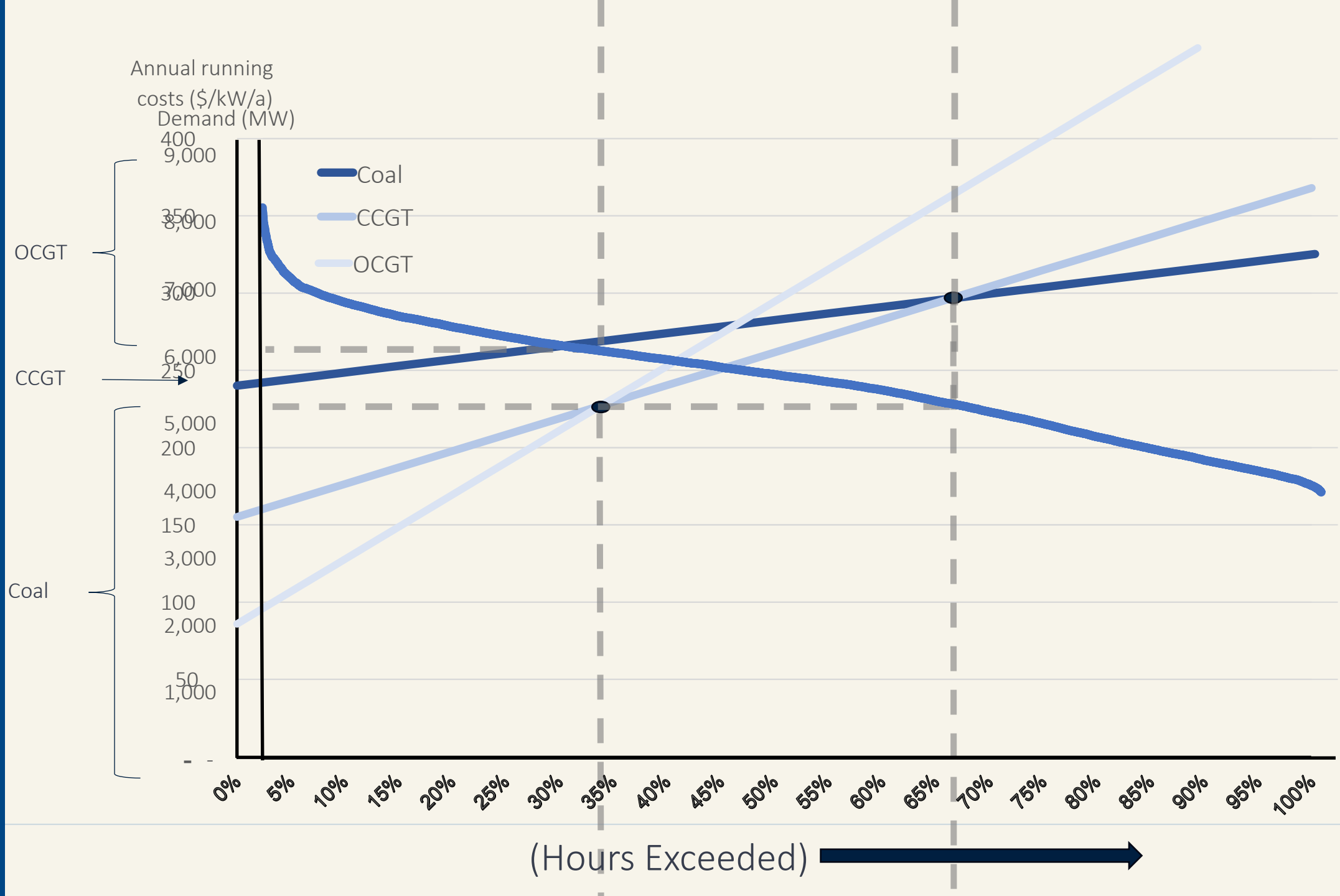
Power system planning in 2005

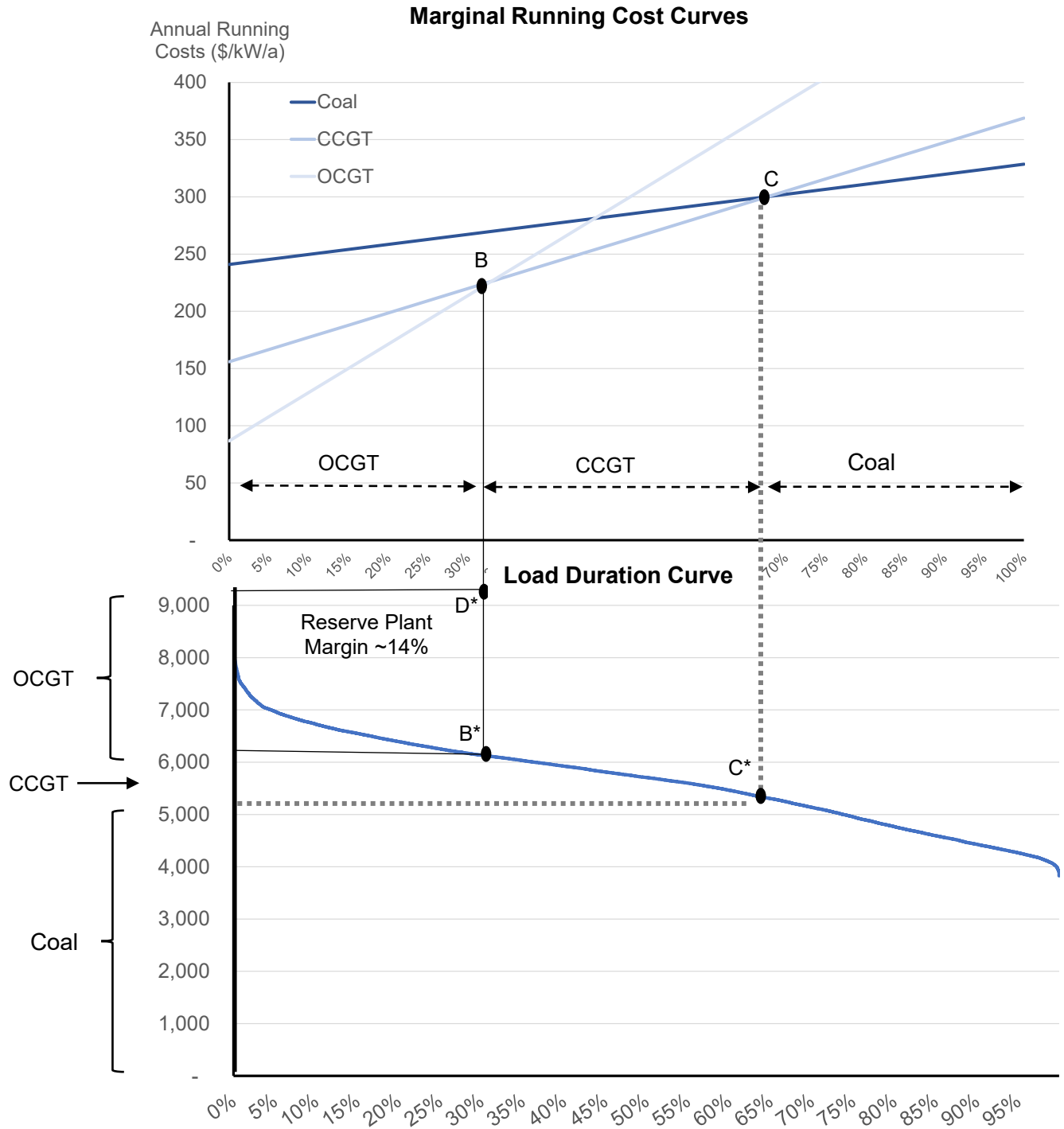


Source: Simshauser & Gilmore (2023), "The Counterfactual Scenario: are renewables cheaper?", CAEEPR Working Paper, Griffith University.


Marginal Running Cost Curves
Annual Running Costs ($/kW/a)
400
350
300
250
200
150
100
50
-
Coal
CCGT
OCGT
B
C
OCGT
CCGT
Coal
0%
5%
10%
15%
20%
25%
30%
75%
80%
85%
90%
95%
100%
Load Duration Curve
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
D*
Reserve Plant Margin ~14%
B*
C*
OCGT
CCGT
Coal
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
50%
55%
60%
65%
70%
75%
80%
85%
90%
95%


Annual running costs ($/kW/a)
400
350
300
250
200
150
100
50
-
Coal
CCGT
OCGT
Slope = marginal running costs
Peaking Duties
Intermediate Duties
Baseload Duties
Intercept = fixed & sunk costs
OCGT most efficient
CCGT most efficient
Coal most efficient
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
50%
55%
60%
65%
70%
75%
80%
85%
90%
95%
100%
Annual Run Time (Hours Exceeded)


Annual running costs ($/kW/a)
Demand (MW)
400
350
300
250
200
150
100
50
-
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
Coal
CCGT
OCGT
OCGT
CCGT
Coal
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
50%
55%
60%
65%
70%
75%
80%
85%
90%
95%
100%
(Hours Exceeded)


Marginal Running Cost Curves
Annual Running Costs ($/kW/a)
400
350
300
250
200
150
100
50
-
Coal
CCGT
OCGT
B
C
OCGT
CCGT
Coal
0%
5%
10%
15%
20%
25%
30%
70%
75%
80%
85%
90%
95%
100%
Load Duration Curve
D*
Reserve Plant Margin ~14%
B*
C*
OCGT
CCGT
Coal
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
0%
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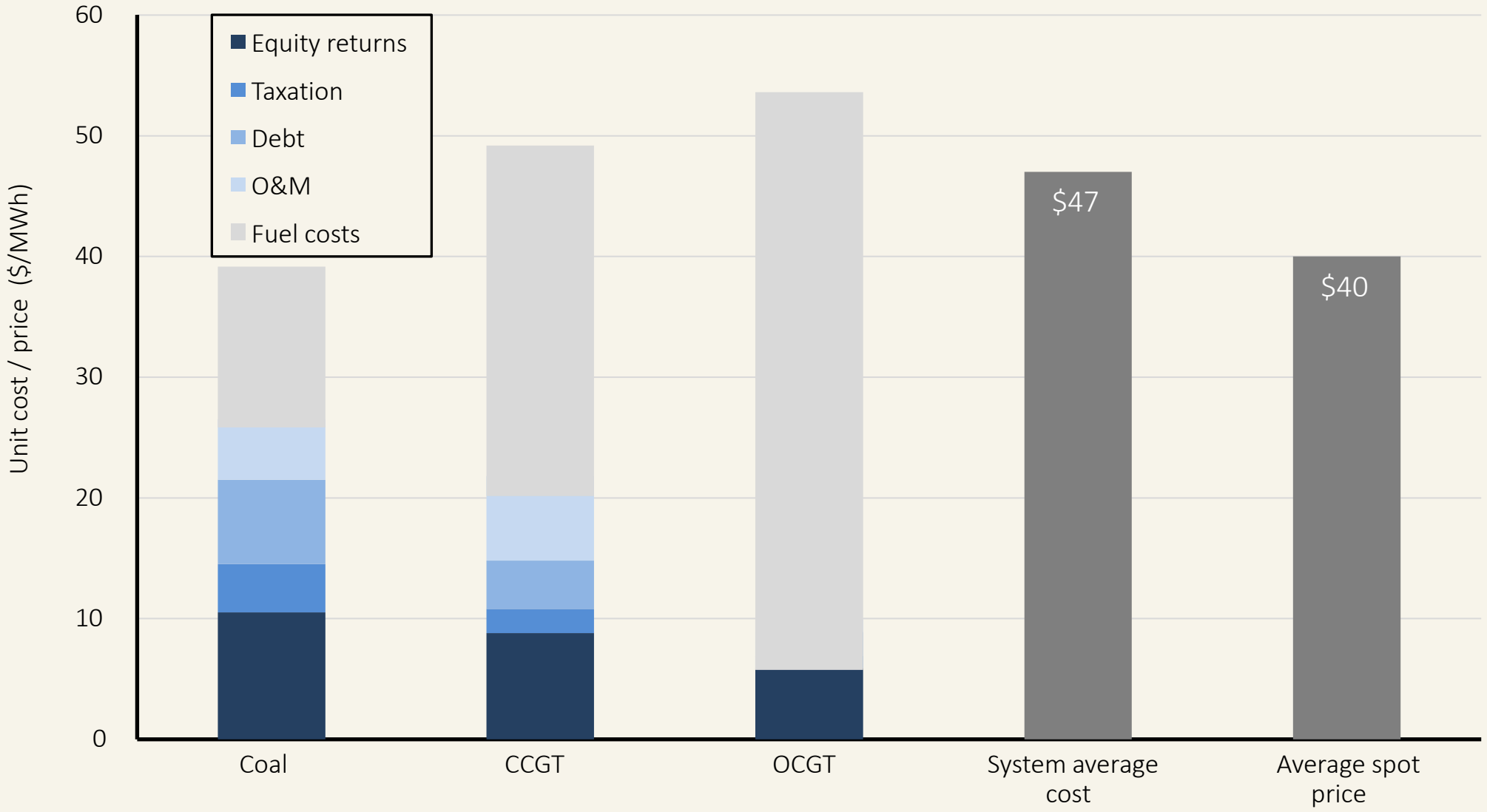
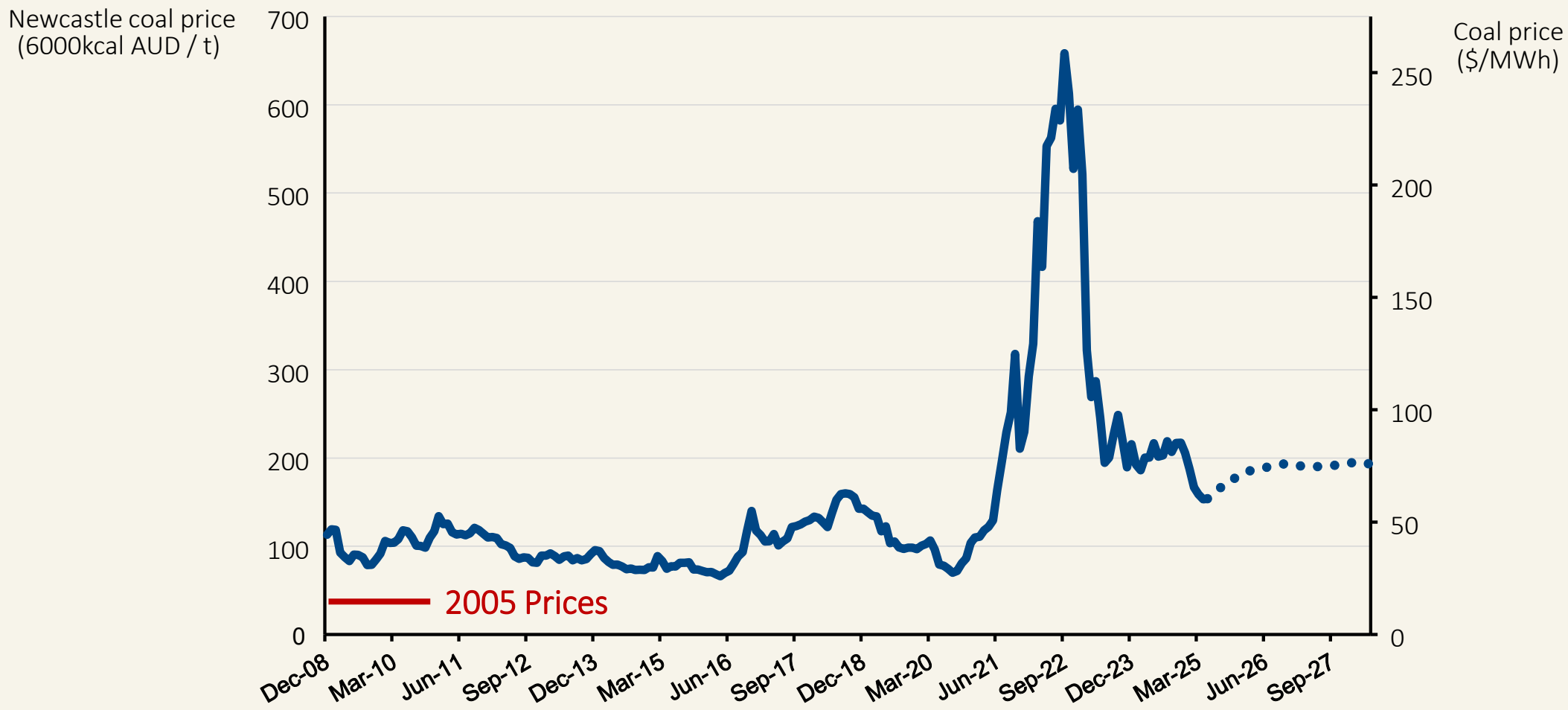
90%
95%

Power system planning in 2005



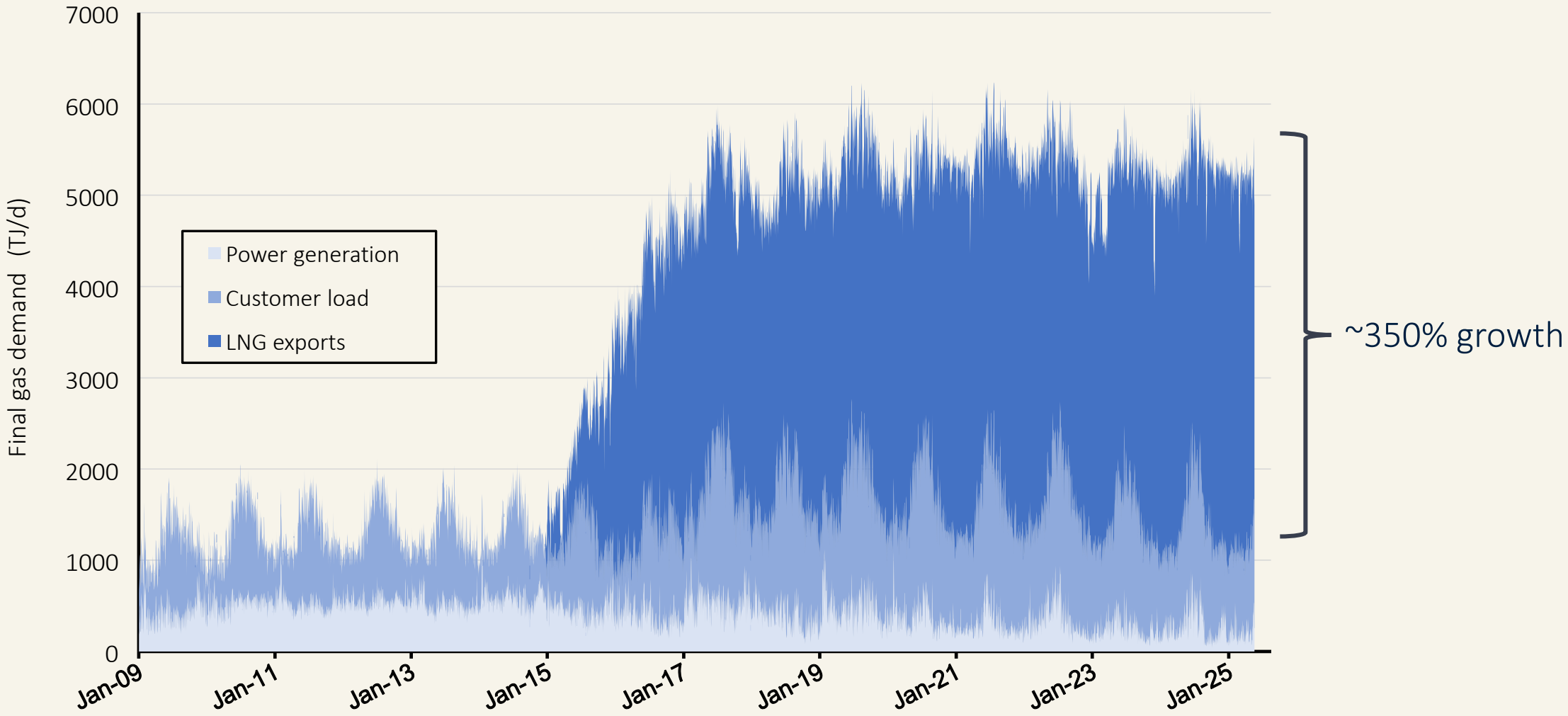
Source: Simshauser & Gilmore (2023), "The Counterfactual Scenario: are renewables cheaper?", CAEEPR Working Paper, Griffith University.

Since 2005… Coal prices – elevated

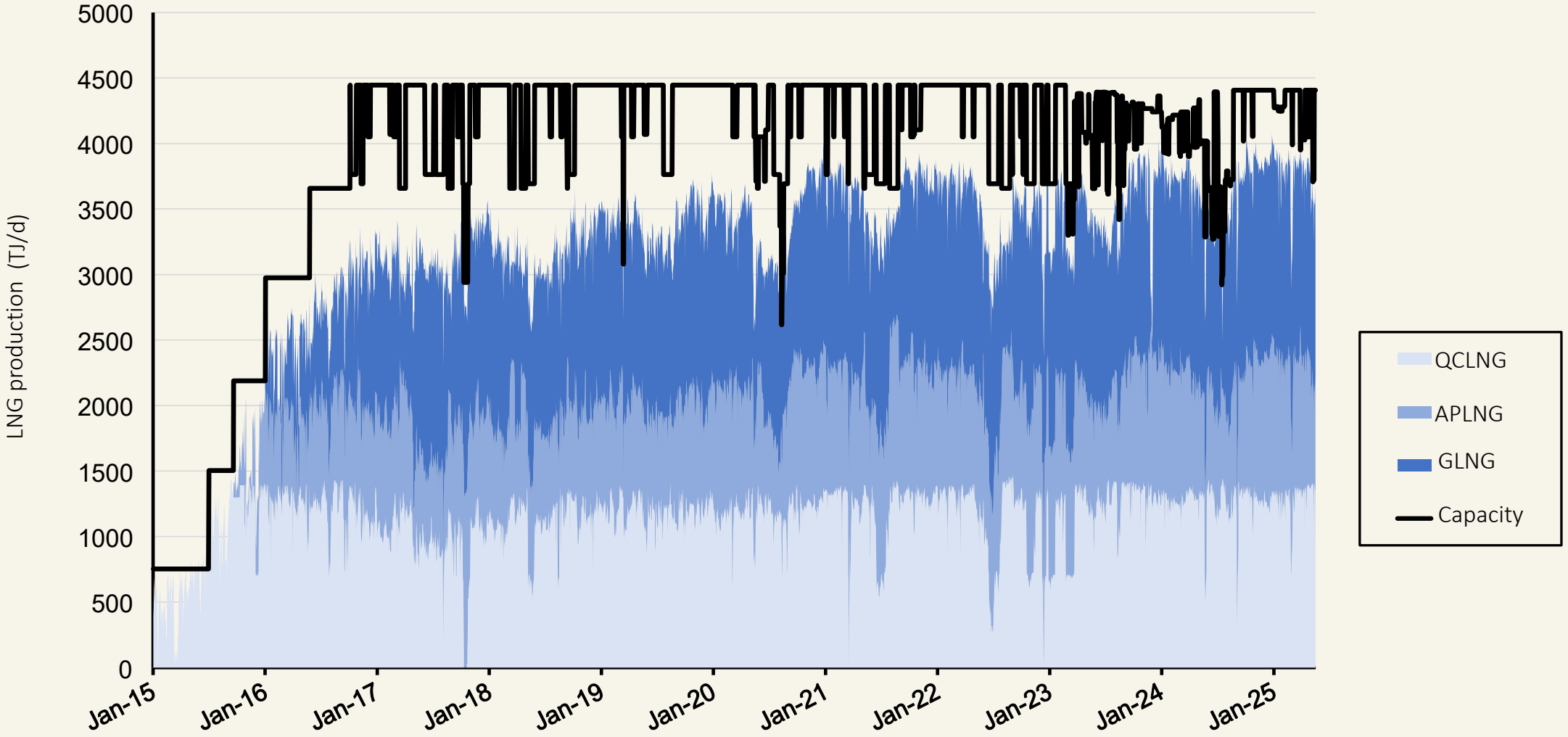


Source: Simshauser & Gilmore (2023), "The Counterfactual Scenario: are renewables cheaper?", CAEEPR Working Paper, Griffith University.

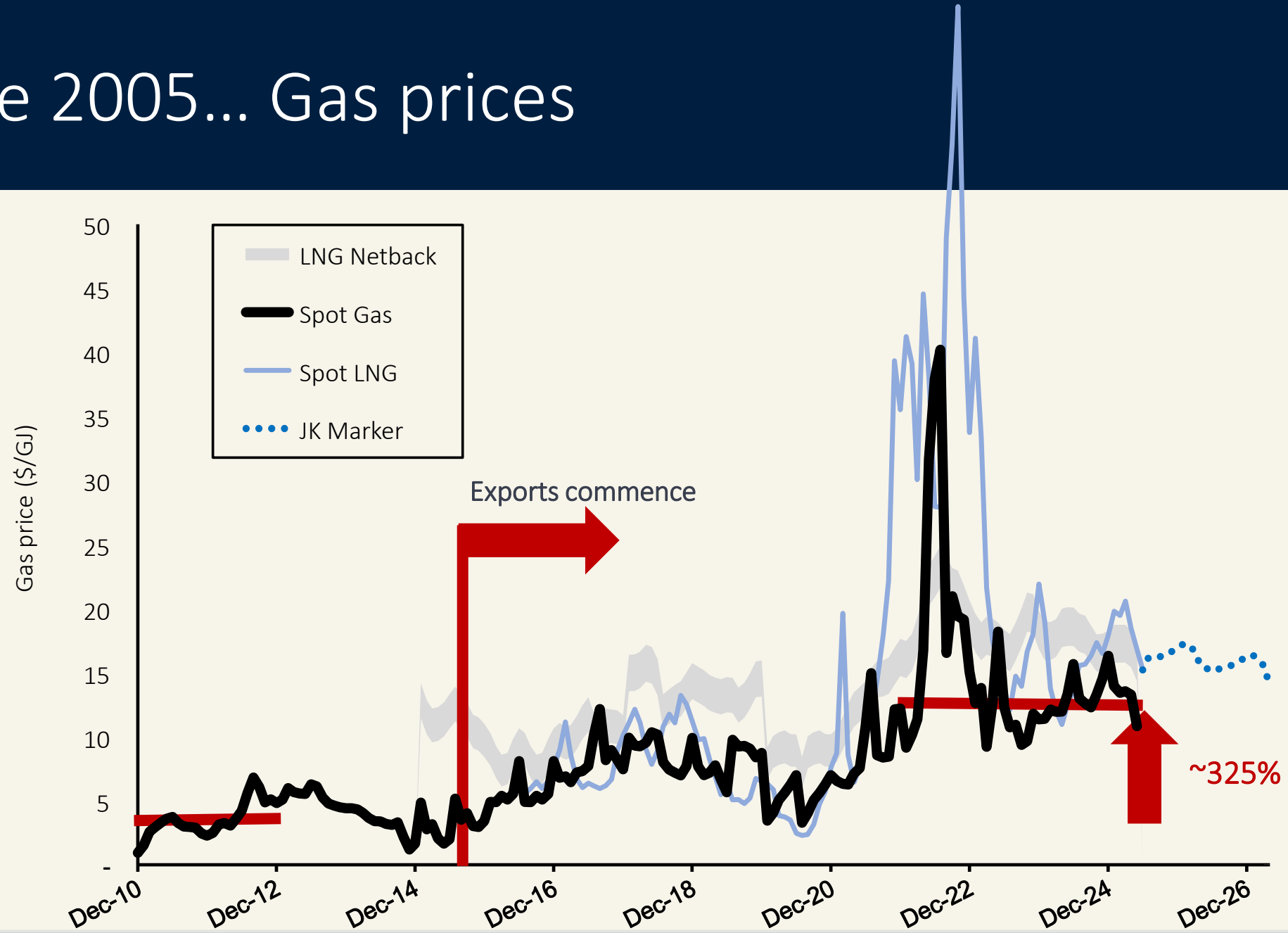
Since 2005… Gas market



LNG capacity vs production

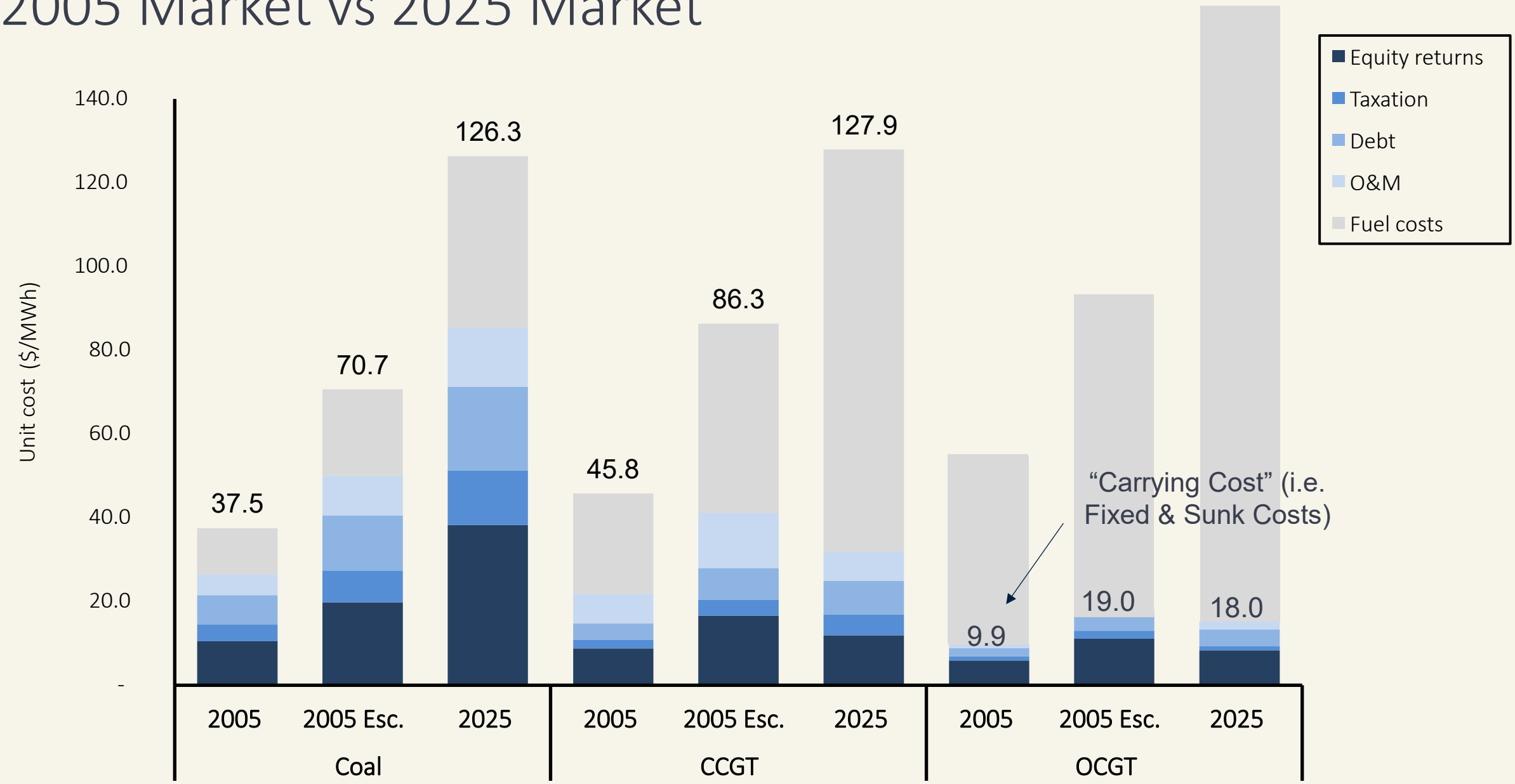


Since 2005… Gas prices



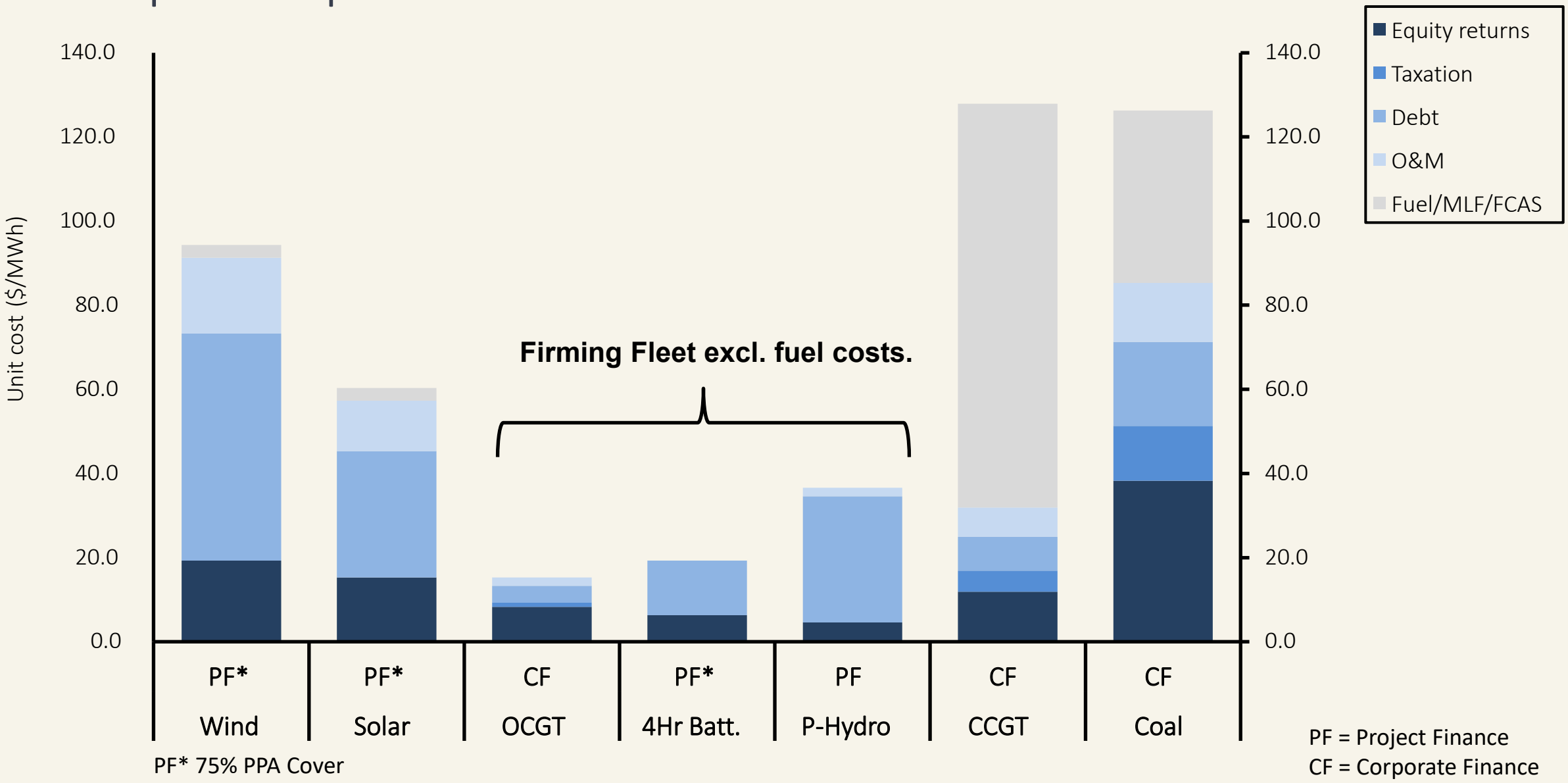
Source: Simshauser & Gilmore (2023), "The Counterfactual Scenario: are renewables cheaper?", CAEEPR Working Paper, Griffith University.

2005 Market vs 2025 Market



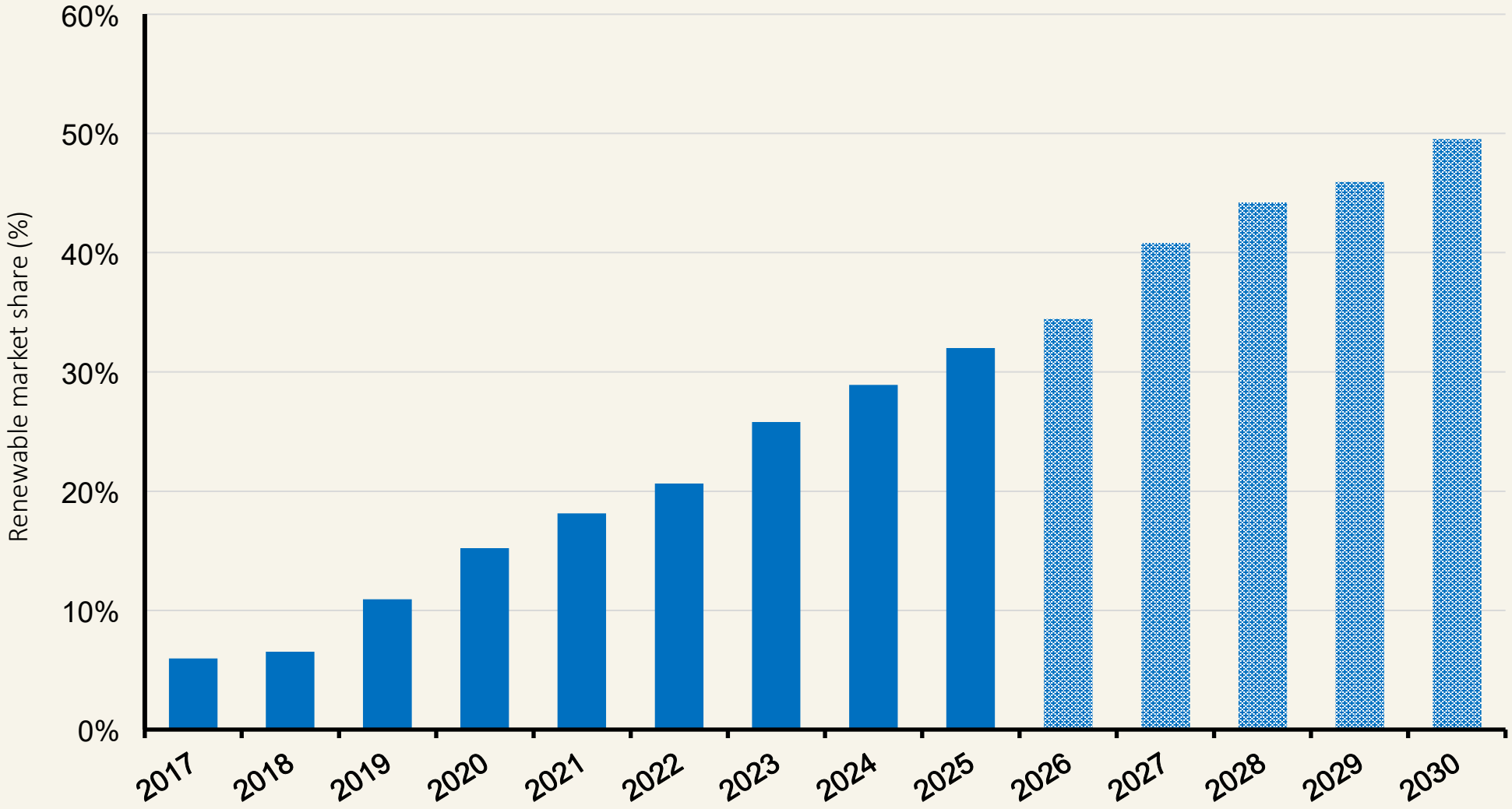
Source: Simshauser & Gilmore (2023), "The Counterfactual Scenario: are renewables cheaper?", CAEEPR Working Paper, Griffith University.

2025 plant options



Source: Simshauser & Gilmore (2023), "The Counterfactual Scenario: are renewables cheaper?", CAEEPR Working Paper, Griffith University.

Renewable market share QLD 2017 – 2025, and 2030*f*



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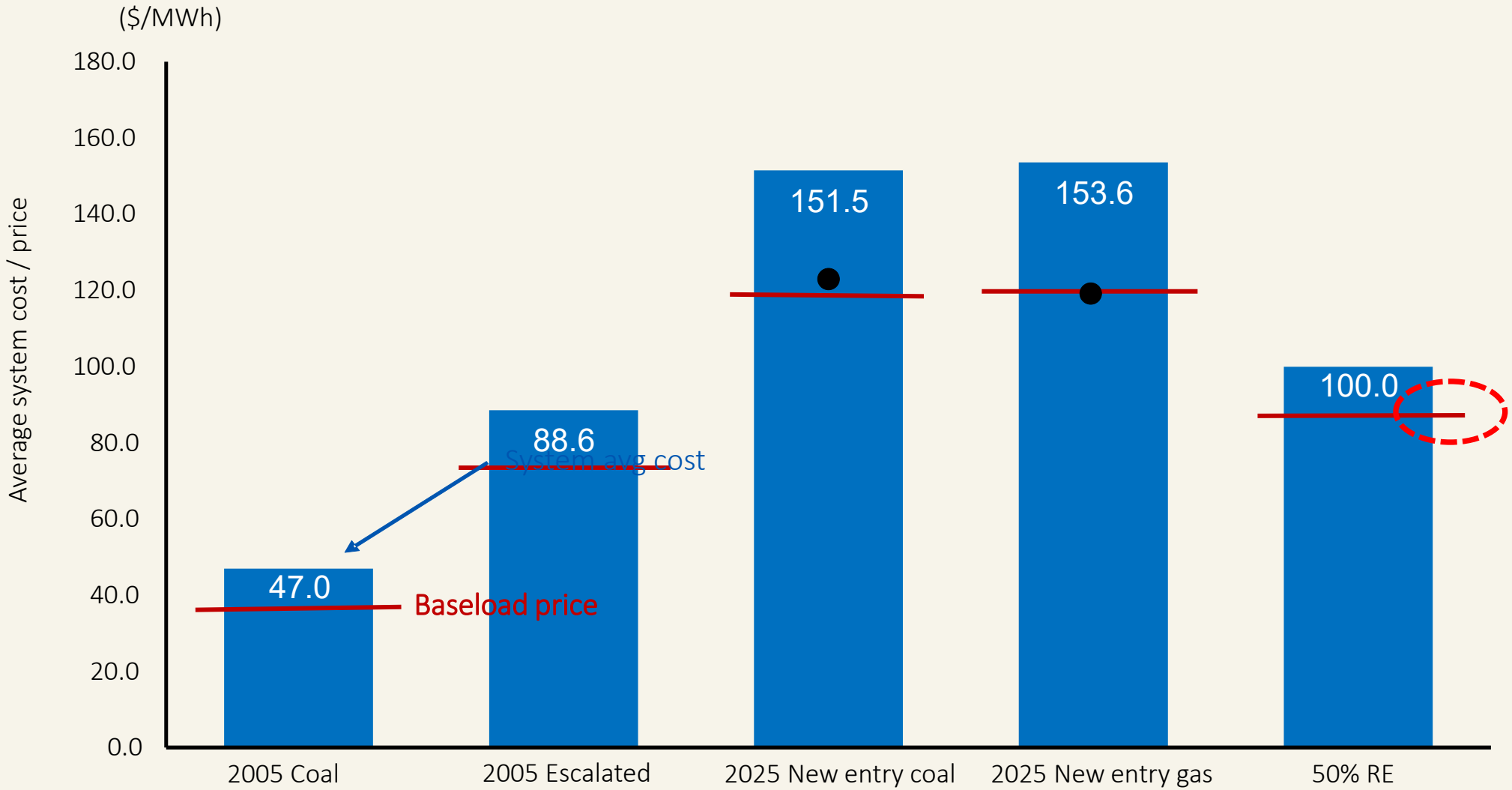
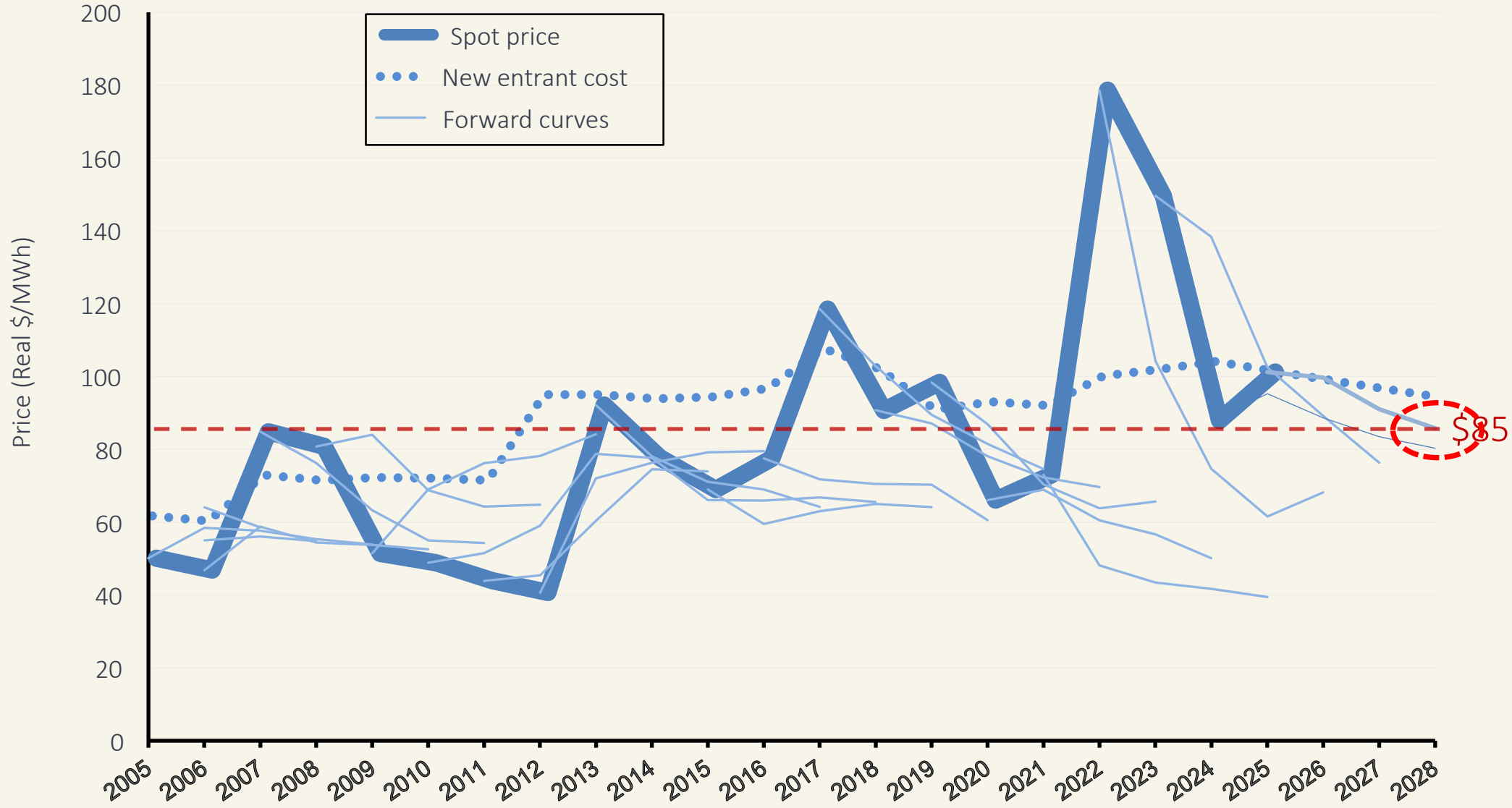
2005 Market vs 2025 Market



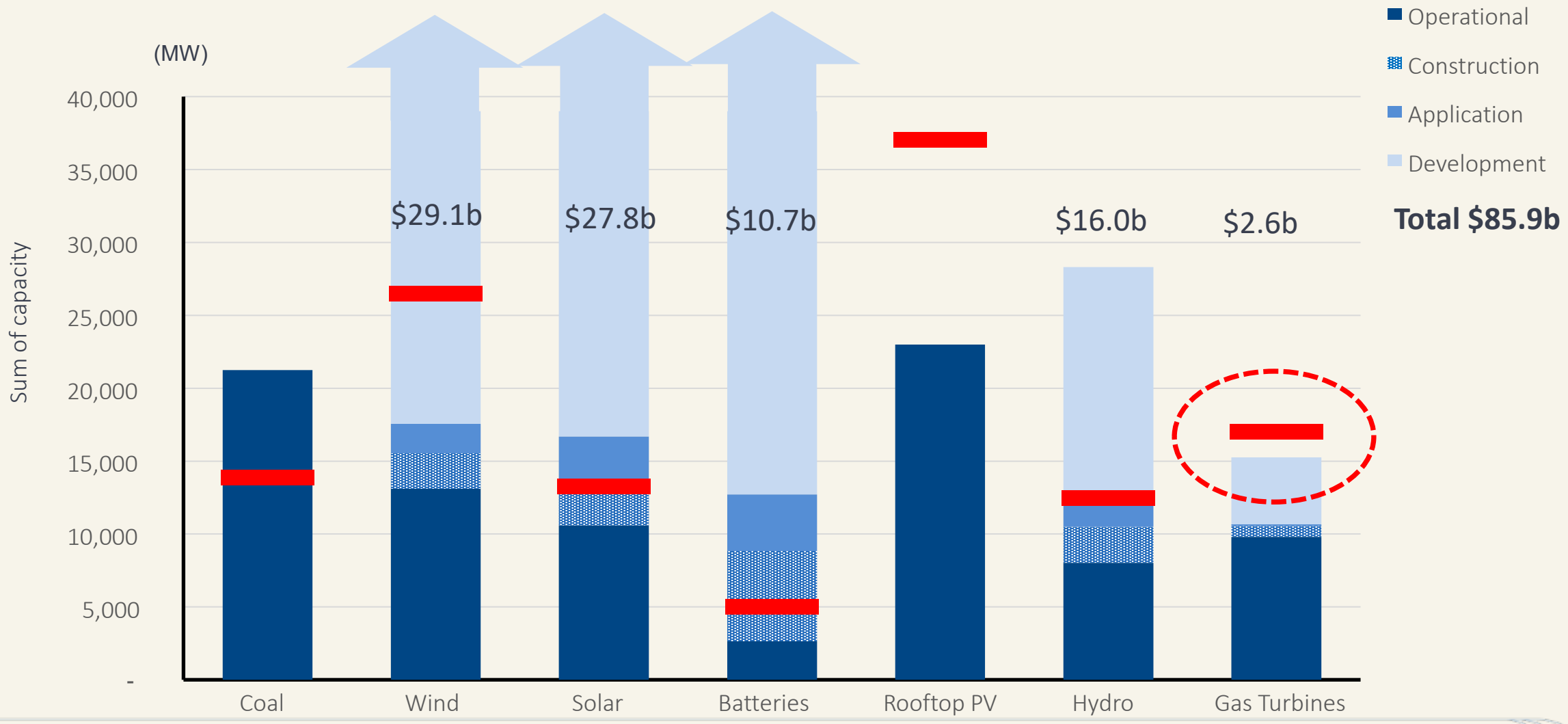
Source: Simshauser & Gilmore (2023), "The Counterfactual Scenario: are renewables cheaper?", CAEEPR Working Paper, Griffith University.

Spot and Forward Markets (QLD) 2005 – 2028



Source: Simshauser & Gilmore (2023), "The Counterfactual Scenario: are renewables cheaper?", CAEEPR Working Paper, Griffith University.

The NEM's forward pipeline is (mostly) ready



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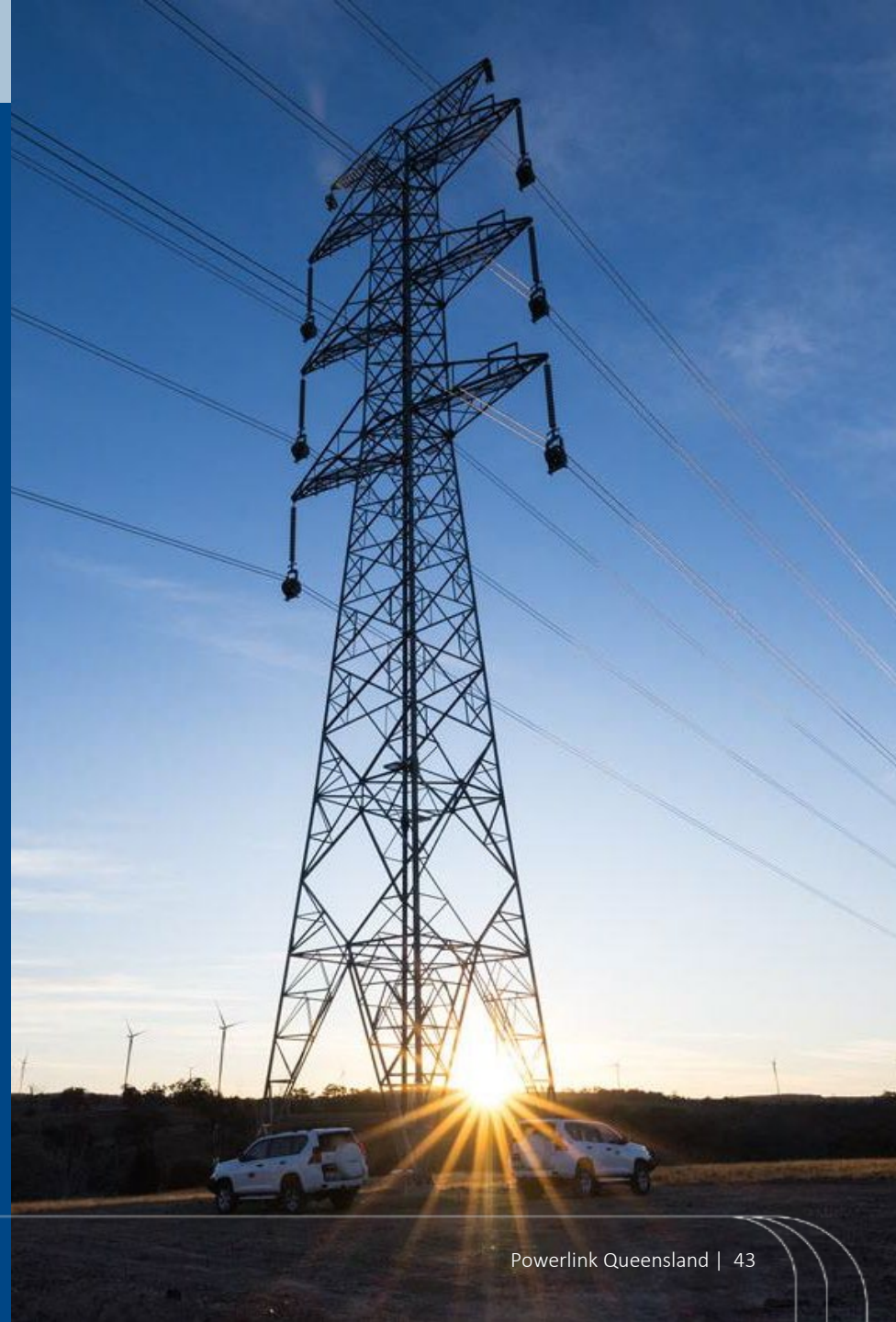
Investing in gas turbines has always been complex in energy-only markets

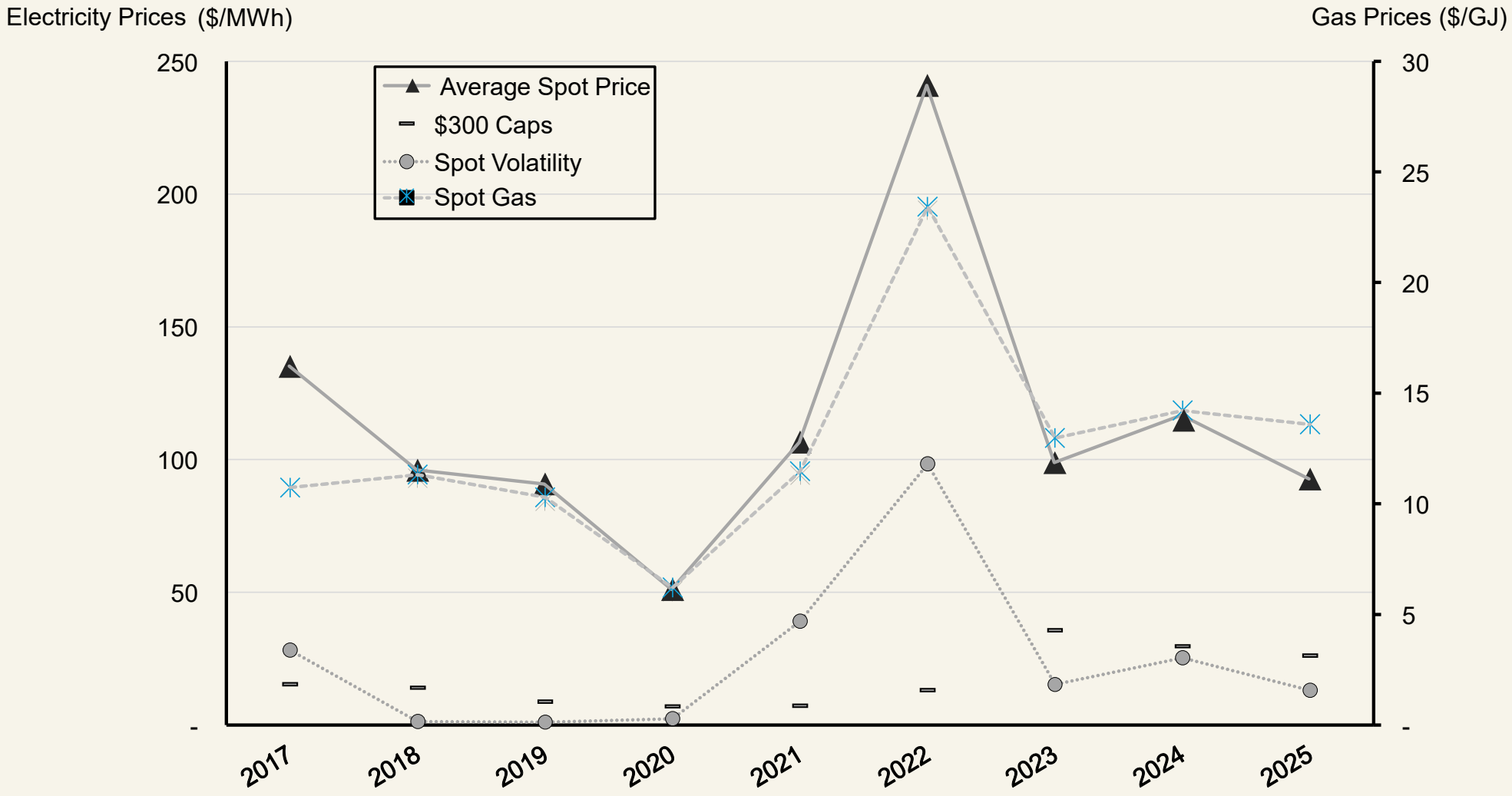
It requires a very different modelling framework:

- Power system models replicate our input assumptions accurately
- Conditions driving ‘peaking’ economics are hard to replicate in conventional LP models
- Stochastic modelling (‘block bootstrapping’) is the better tool…



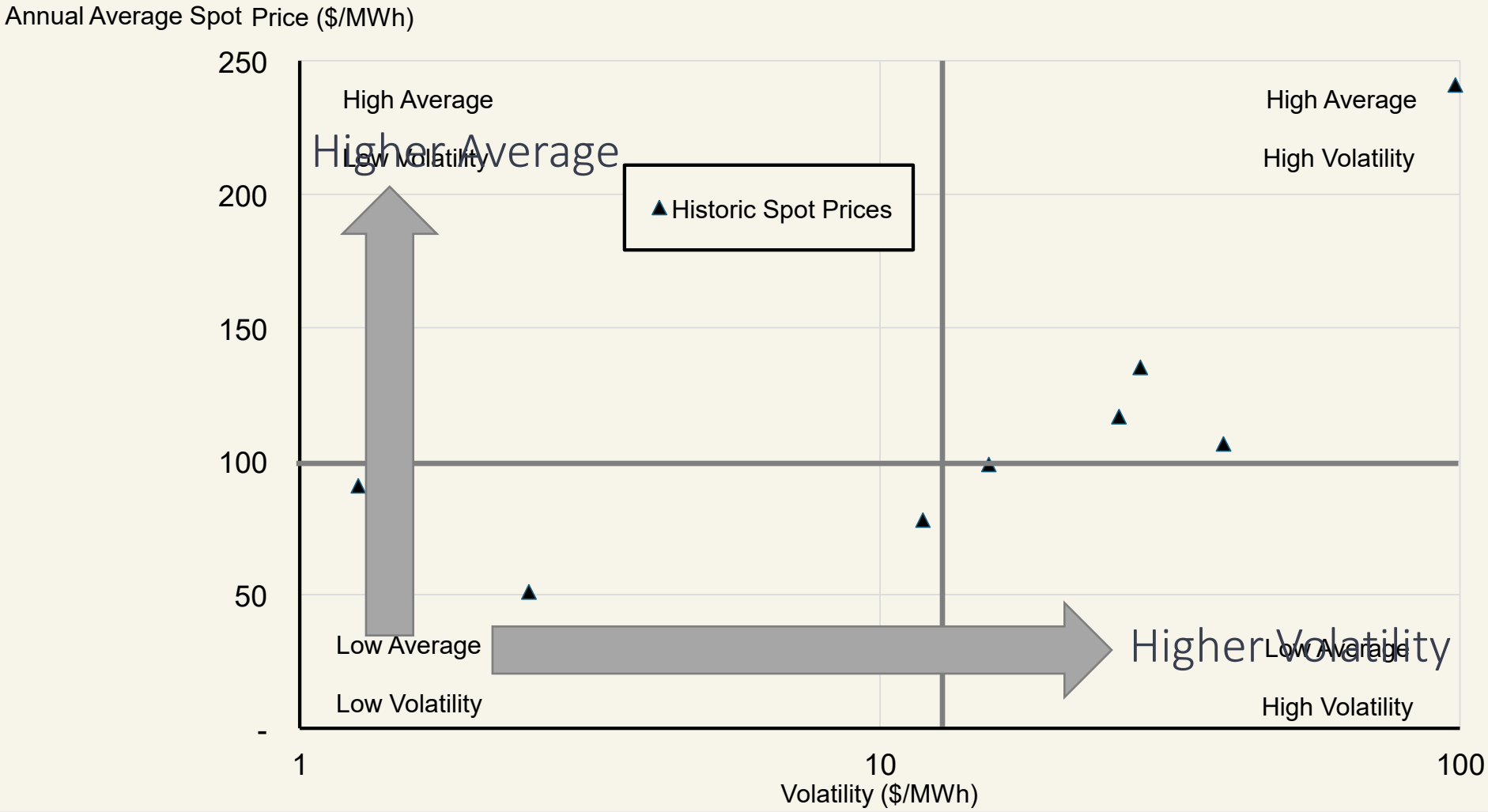
Step 1

Collate a history of Qld spot prices and $300 Caps



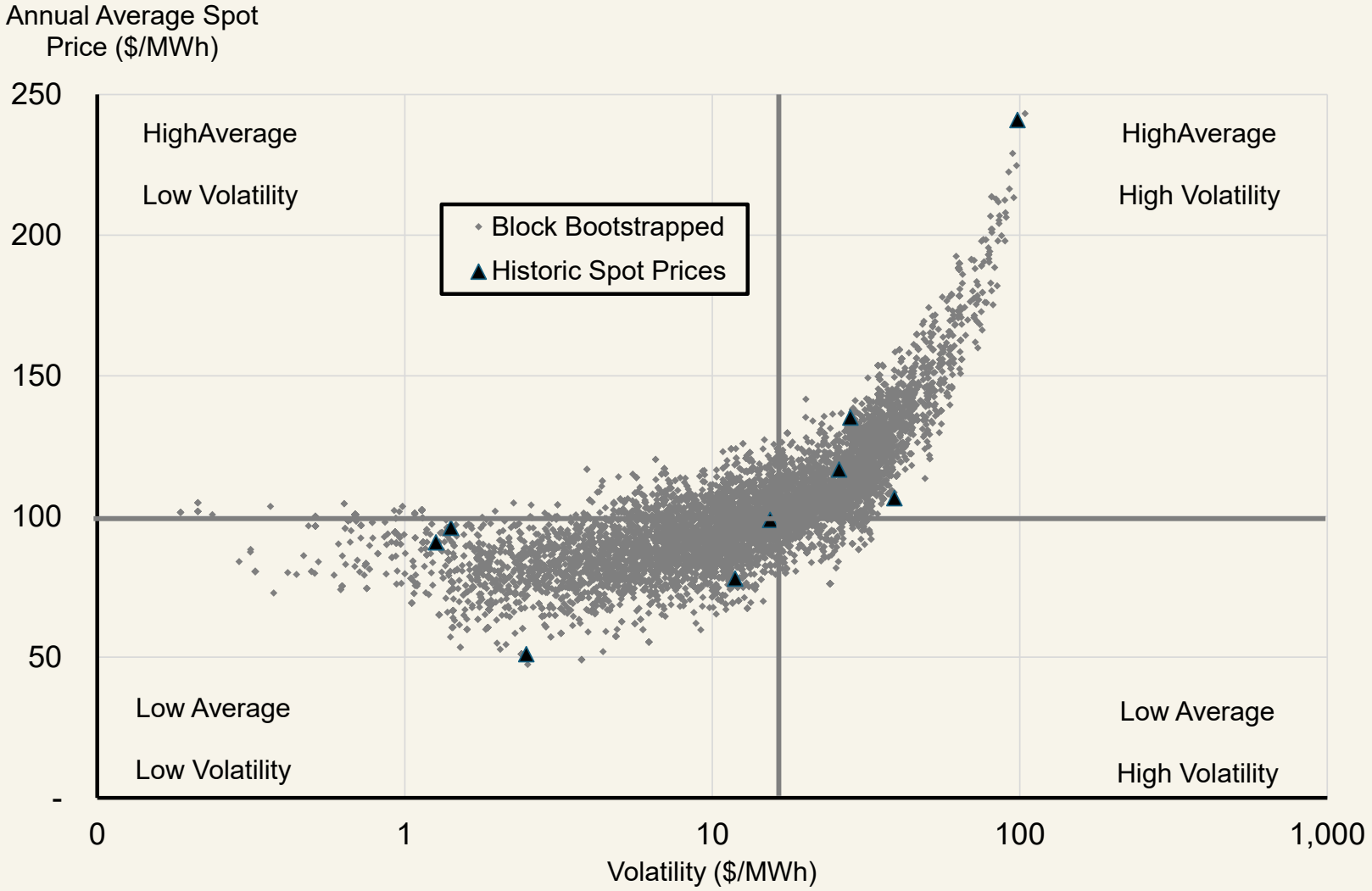
Step 2

Decompose the annual spot prices…



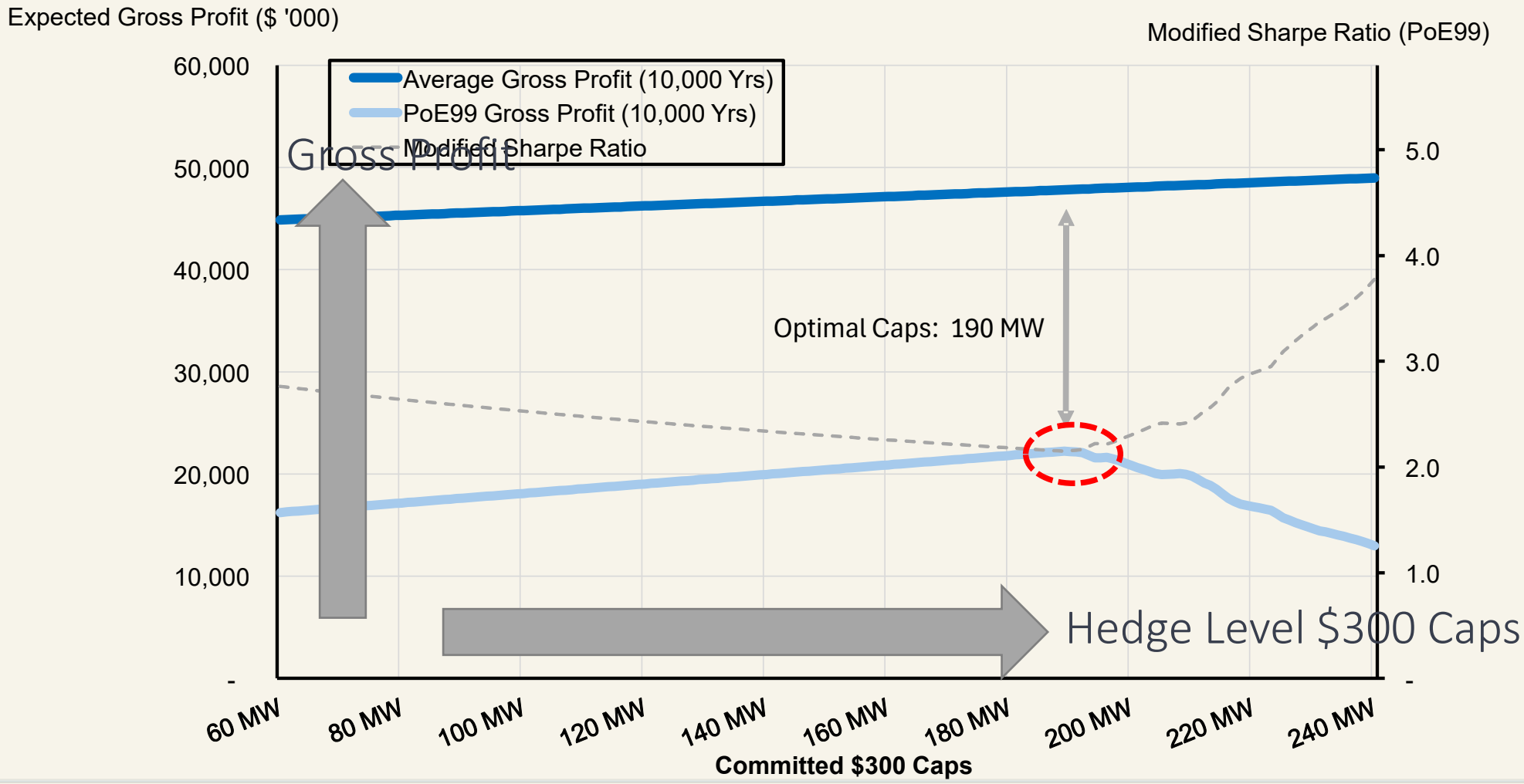
Step 3

Bootstrap to create 10,000 years of prices

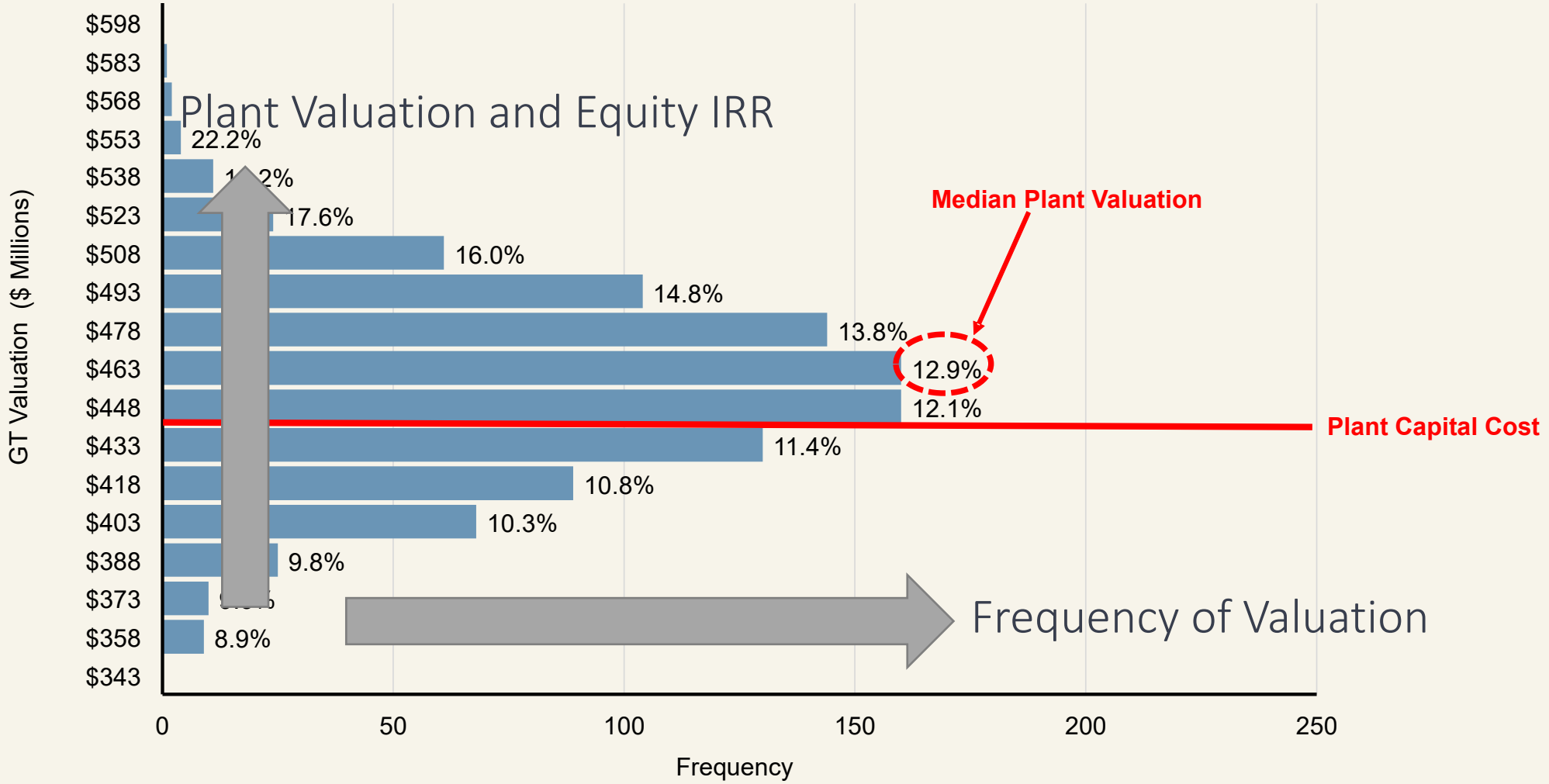


Step 4

Stress test: unit commitment with $300 Caps



Step 5
Run through a PCF Model (1000 iterations)



Agenda

1 Investment – *market led*

2 Industry cost dynamics

3 Coal plant and economic gravity

4 Power system planning

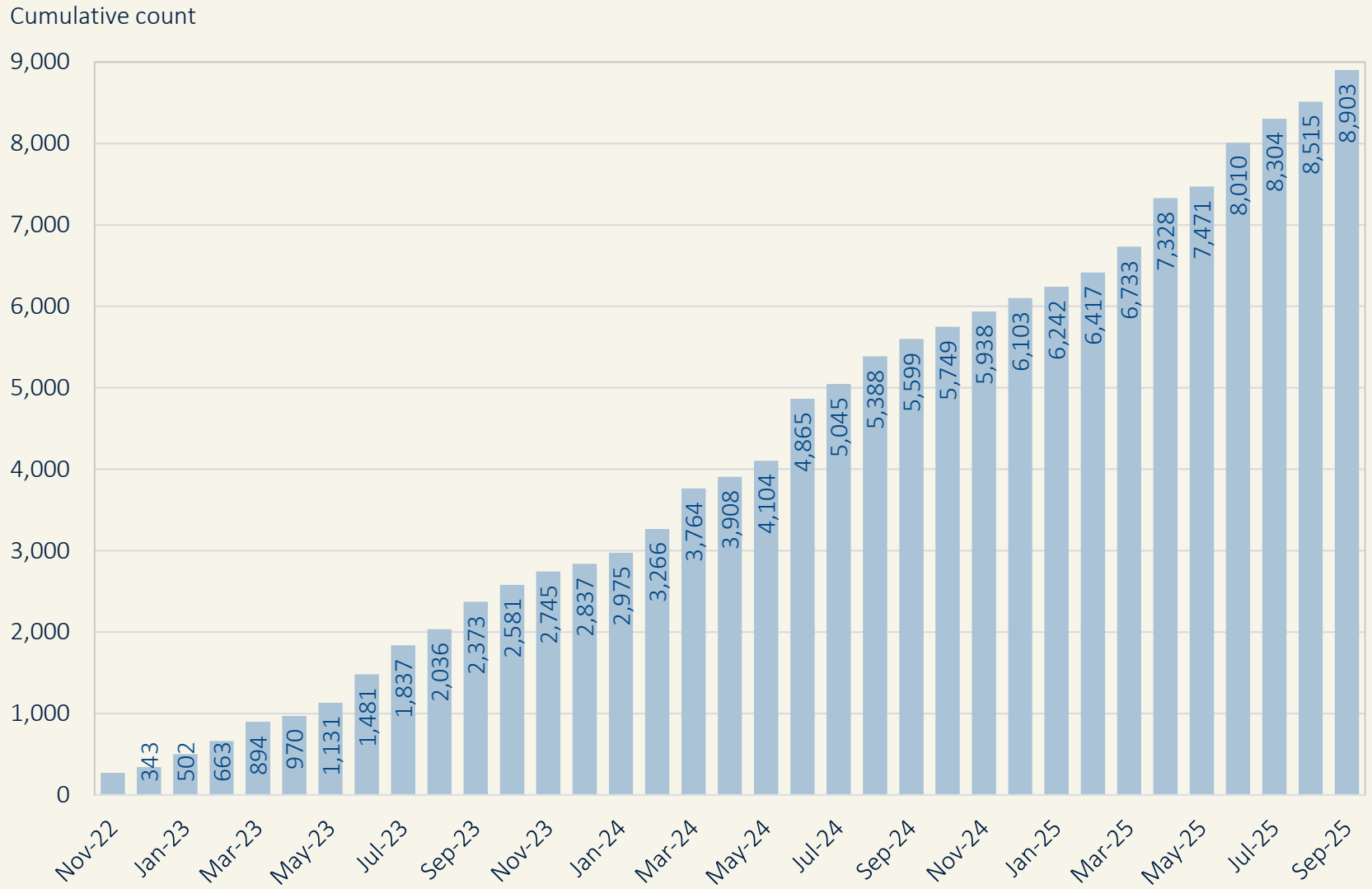
5 On gas turbines

6 The ~~trilemma~~ Quadlemma

Media count: Queensland specific mentions

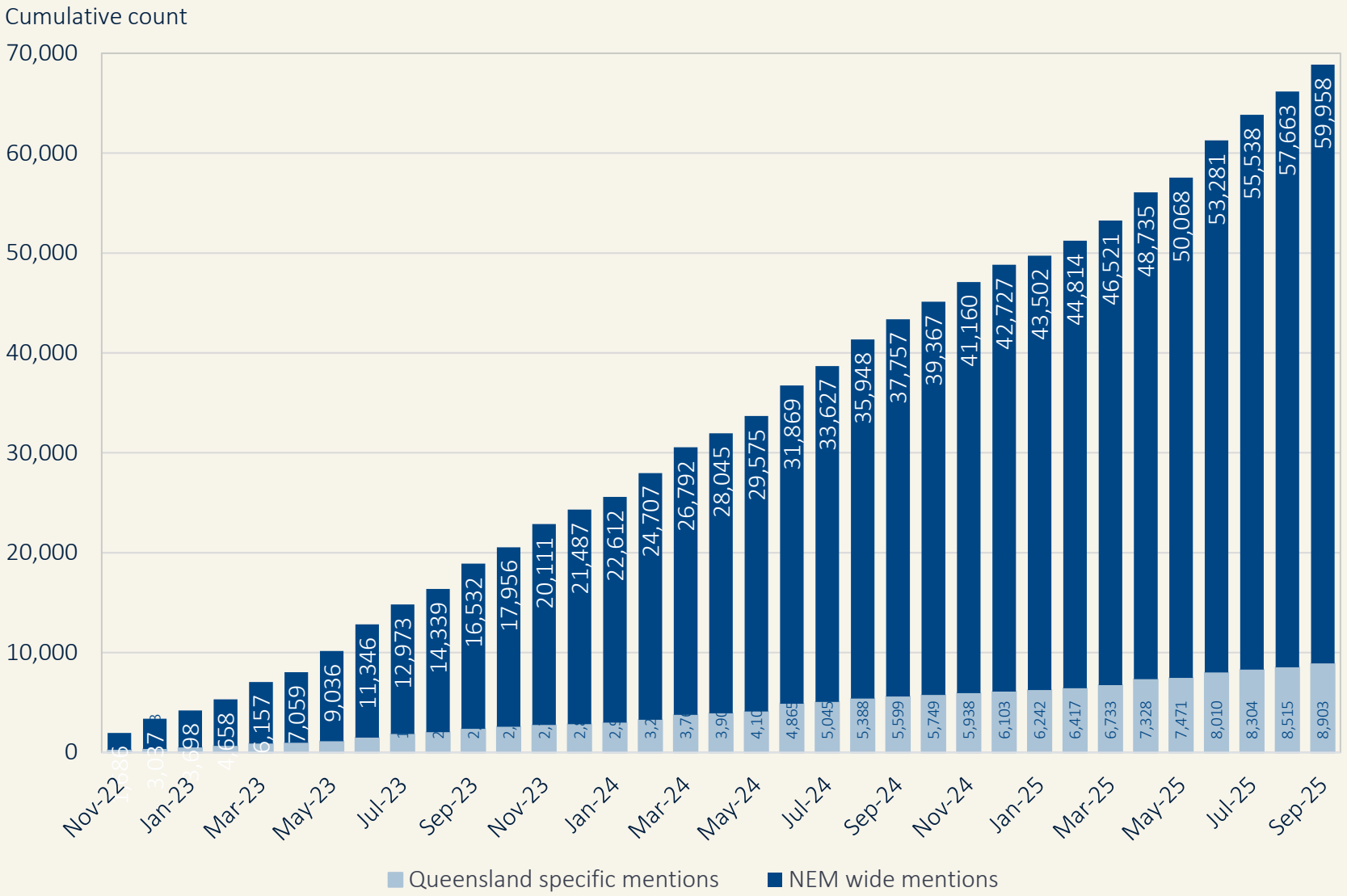
Social licence to operate + community engagement + energy + Queensland

Last updated: September 2025



Media count: Queensland specific mentions v NEM wide mentions

Social licence to operate + community engagement + energy



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Looking through the lens of the Trilemma, policy change is quite predictable.