Constrained Access Modelling

Methodology and Assumptions

Consultation Public Forum

13 March 2018

Building a better working world

Outline

- Purpose
- Modelling overview
- Assumptions
  - Scenarios
  - Generator assumptions
- General feedback

Purpose

- EY is conducting wholesale market modelling to forecast the impacts of fully constrained-access under several scenarios
- Modelling outputs include the impact on:
  - Wholesale market prices
  - Generator dispatch
  - Generator market revenues, including capacity market revenues
- Over the public consultation process we are seeking feedback and input from industry stakeholders into the assumptions and methodology proposed
- We will publish a final report with anonymised generator names. Generators can apply to find out which generator they are in the published outcomes

Overview of modelling approach

- Partially constrained access:
  - Only GIA-connected and new entrant generators have fully constrained access
  - Other existing generators retain their firm access rights
- Fully constrained access
  - All generators have constrained access

Modelling network constraints

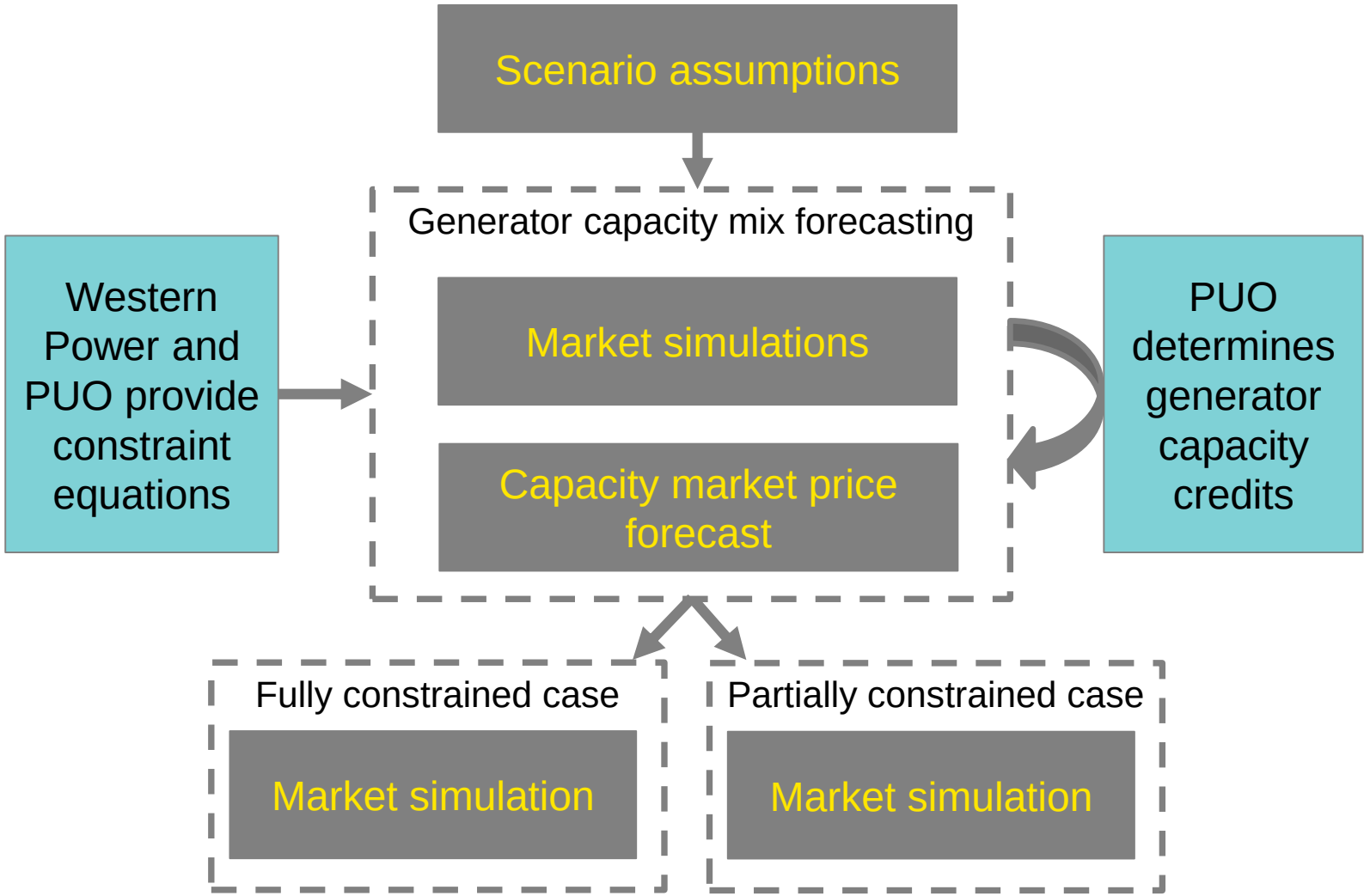
- In a constrained-access market, dispatch is conducted subject to constraint equations representing network limitations

- For this modelling, **two sets of constraint equations** have been developed by Western Power and the PUO:
  - One for fully constrained access
  - One for partially constrained access

- Pre-defined new entrant connection points are provided in the constraint equations to enable EY to forecast changes in the capacity mix in each scenario

Overview of modelling approach

- Multi-stage process for each scenario
- Each **market simulation** involves time-sequential half-hourly electricity market dispatch modelling

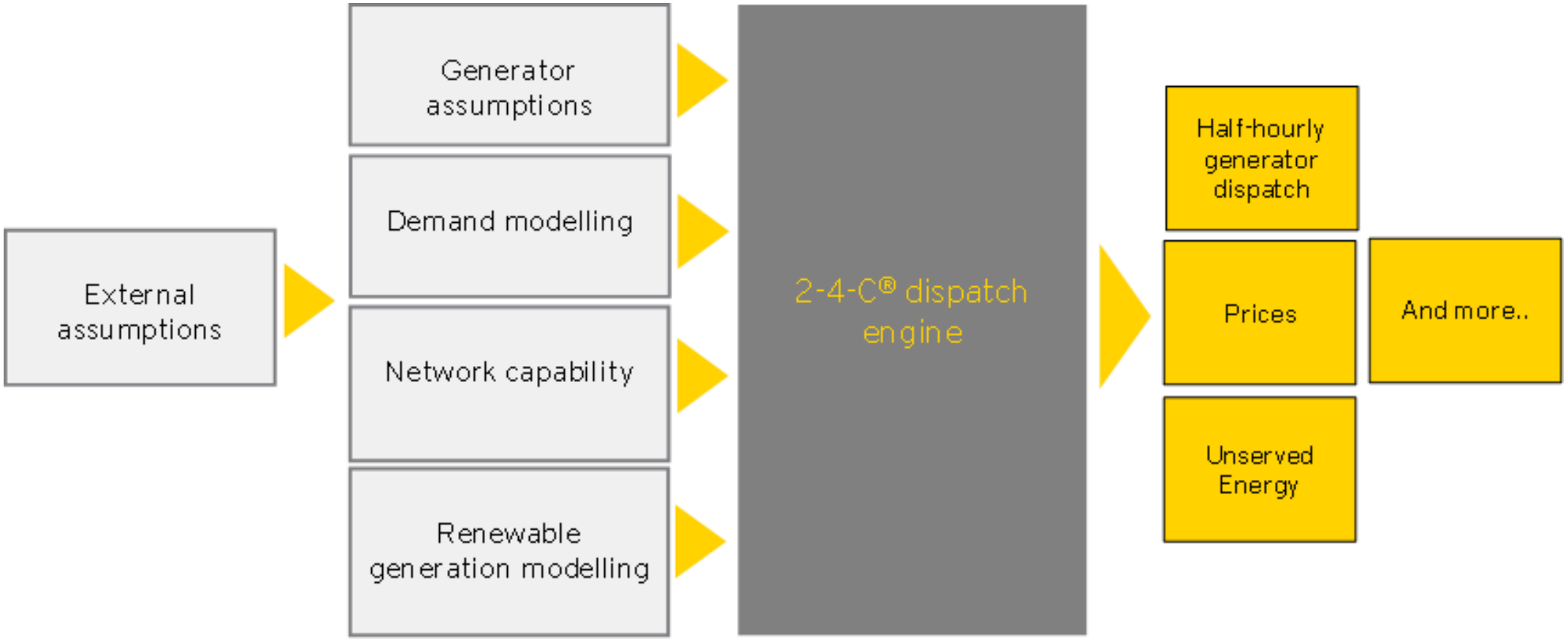


Feedback on modelling approach

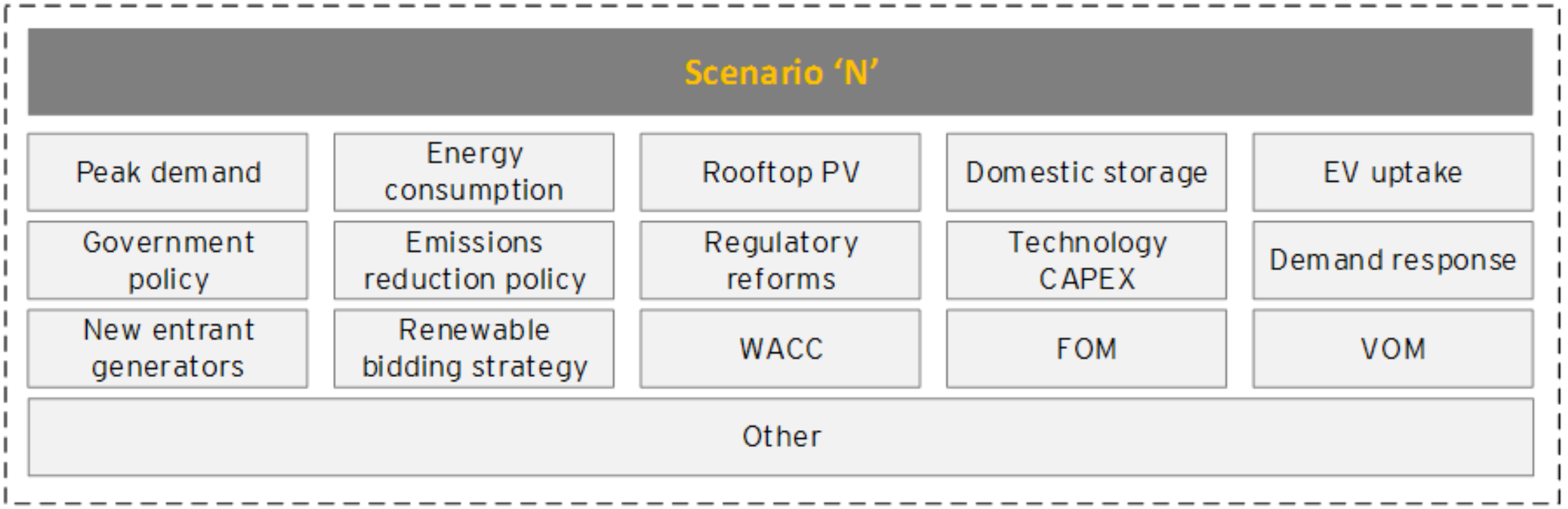
Are there any questions or concerns on the general modelling approach?

Market simulation overview

- Each scenario is defined by the input assumptions selected



Types of assumptions



Purpose of the scenarios

- There are many factors that could influence the evolution of the wholesale electricity market (WEM) in WA, and these factors are uncertain
- To capture a range of possible outcomes EY will conduct modelling of several scenarios
- The intention is to capture ‘bookends’ with respect to the potential impact of fully constrained access

Proposed scenarios

- The three scenarios proposed involve different electricity demand outlooks
  - Electricity demand on is a major driver of changes in the mix of installed capacity in electricity networks, and network congestion on a half-hour basis

Scenario	Base Scenario	High Scenario	Low Scenario
Demand forecast	Expected	High	Low
Study Period	1 July 2022 - 1 July 2032		

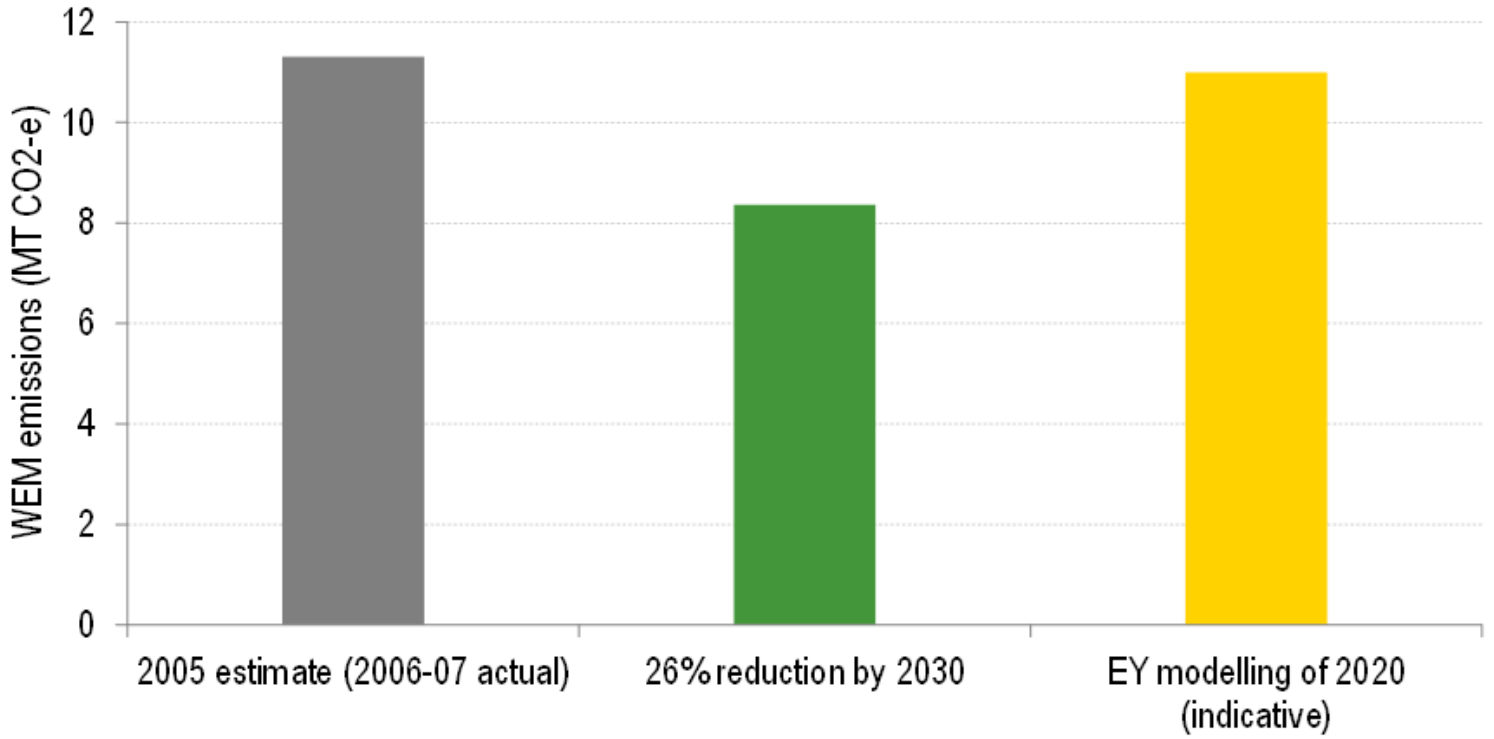
- Each June, the Australian Energy Market Operator (AEMO) publishes three outlooks for electricity demand in the WEM, including:
  - Annual energy and seasonal peak demands
  - Uptake of rooftop PV, behind-the-meter battery storage and electric vehicle

Proposed scenarios – common macro assumptions

- No emissions policy
- An assumed list of new entrants being installed in the WEM as part of the national Large-scale Renewable Energy Target (LRET)
- Coal and gas fuel price projections
- Generator parameters
  - Outage rates, bidding patterns, capex and opex, WACC, loss factors, etc.

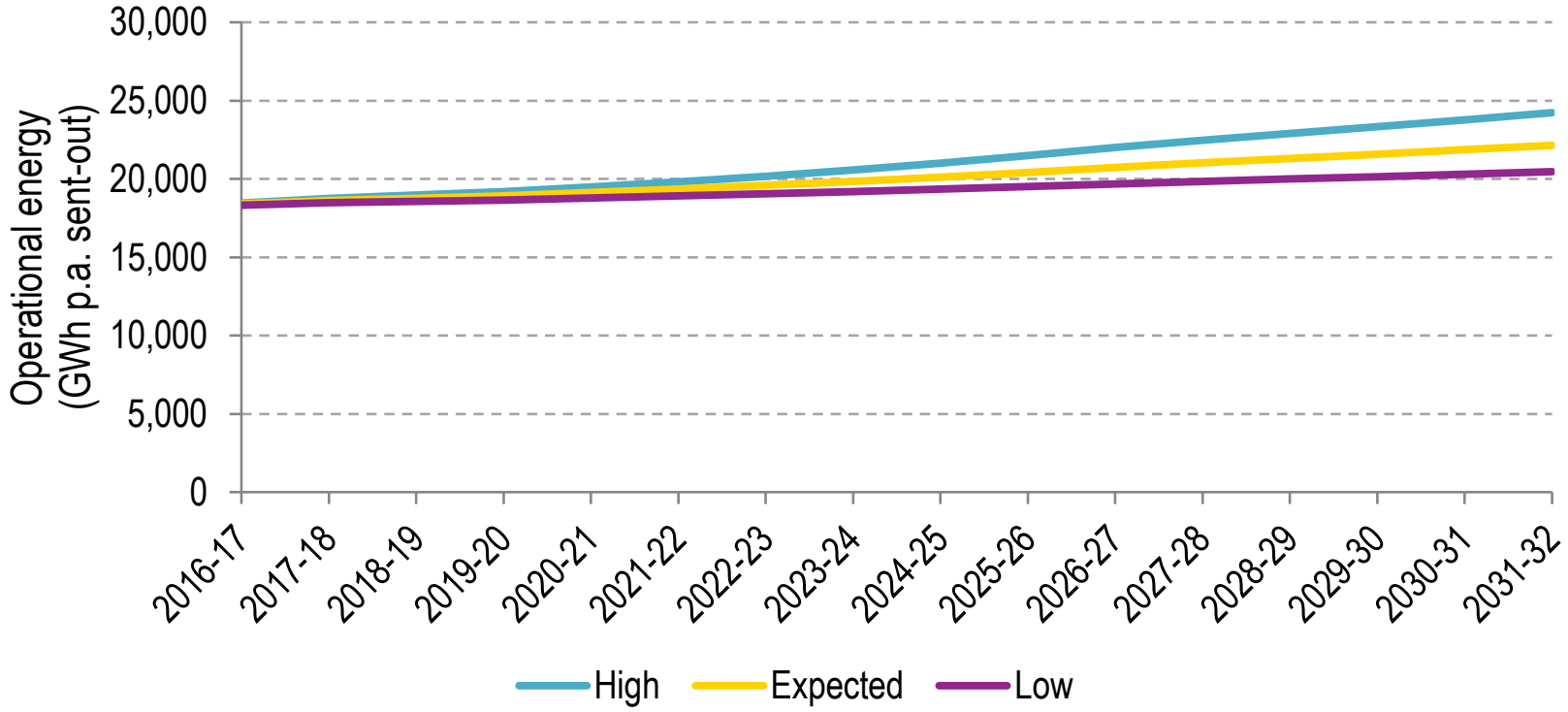
Possible alternative scenarios
Emissions reduction policy

- An emissions reduction policy could be applied to the WEM
- A possible target is for the WEM to achieve its pro-rata share of the Paris agreed target by 2020



Possible alternative scenarios
A very low demand outlook

- Whilst the AEMO demand forecasts capture a range of demand outlooks, a lower demand outlook is possible due to possible industrial load closures, energy efficiency and grid defection
- What might a very low demand scenario look like?



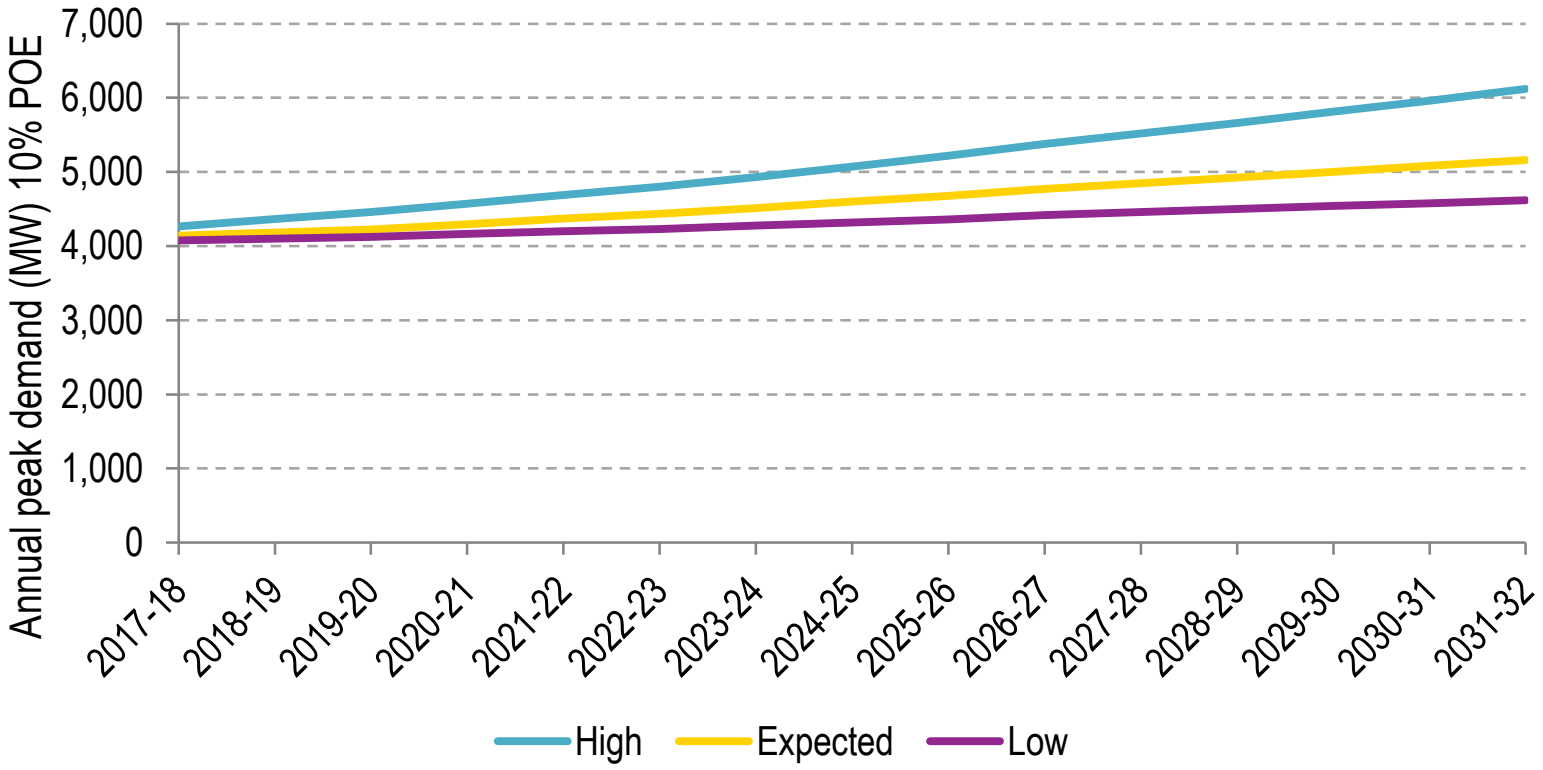
Feedback on the proposed scenarios

Do you agree that the demand outlook is a key driver to explore for the impact of constrained access?

Should the PUO be exploring other assumptions in defining the scenarios?

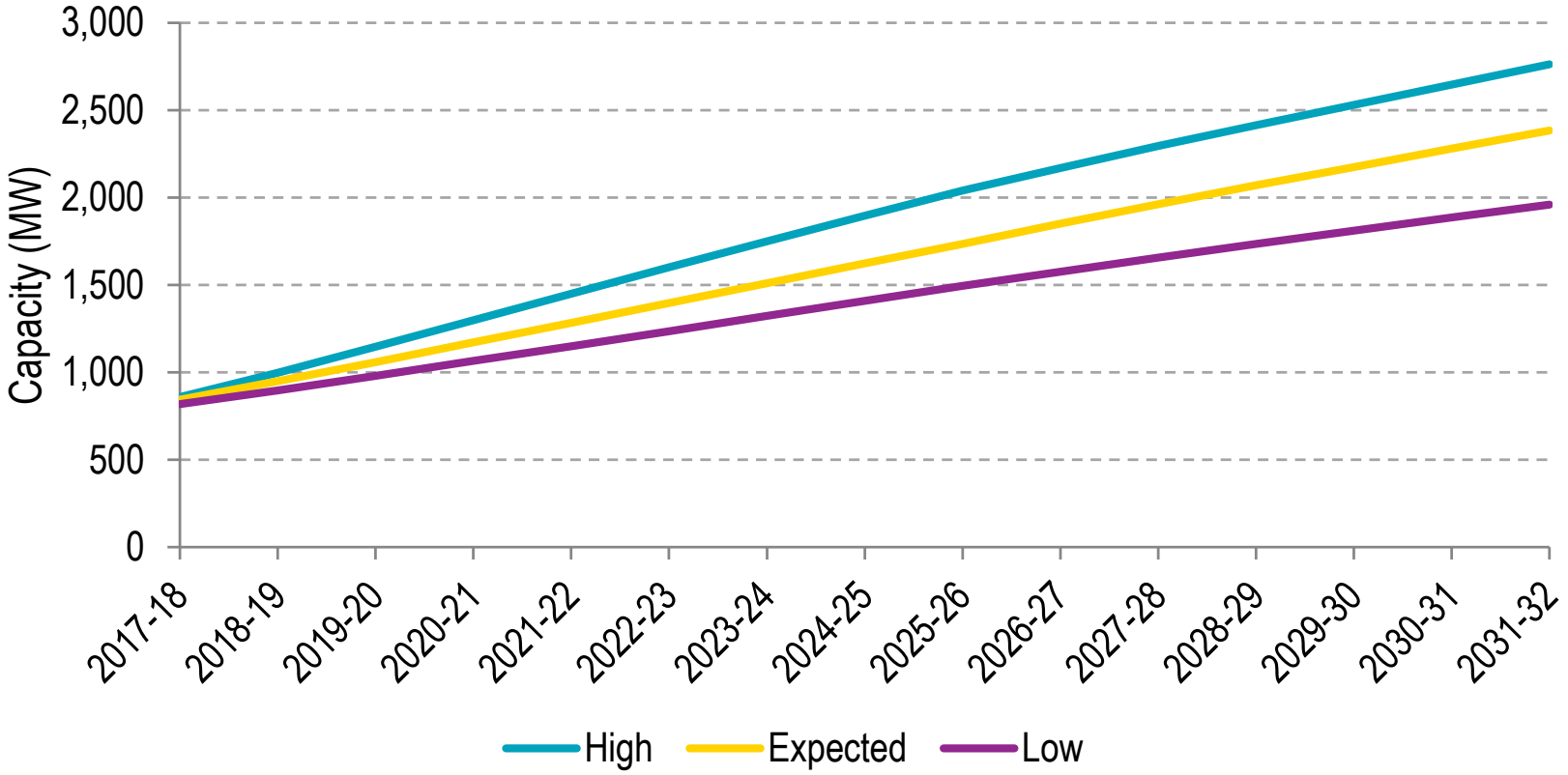
Assumptions
Peak demand

- EY models both the 10% probability of exceedence (POE) peak demand and the 50% POE peak demand and presents weighted outcomes



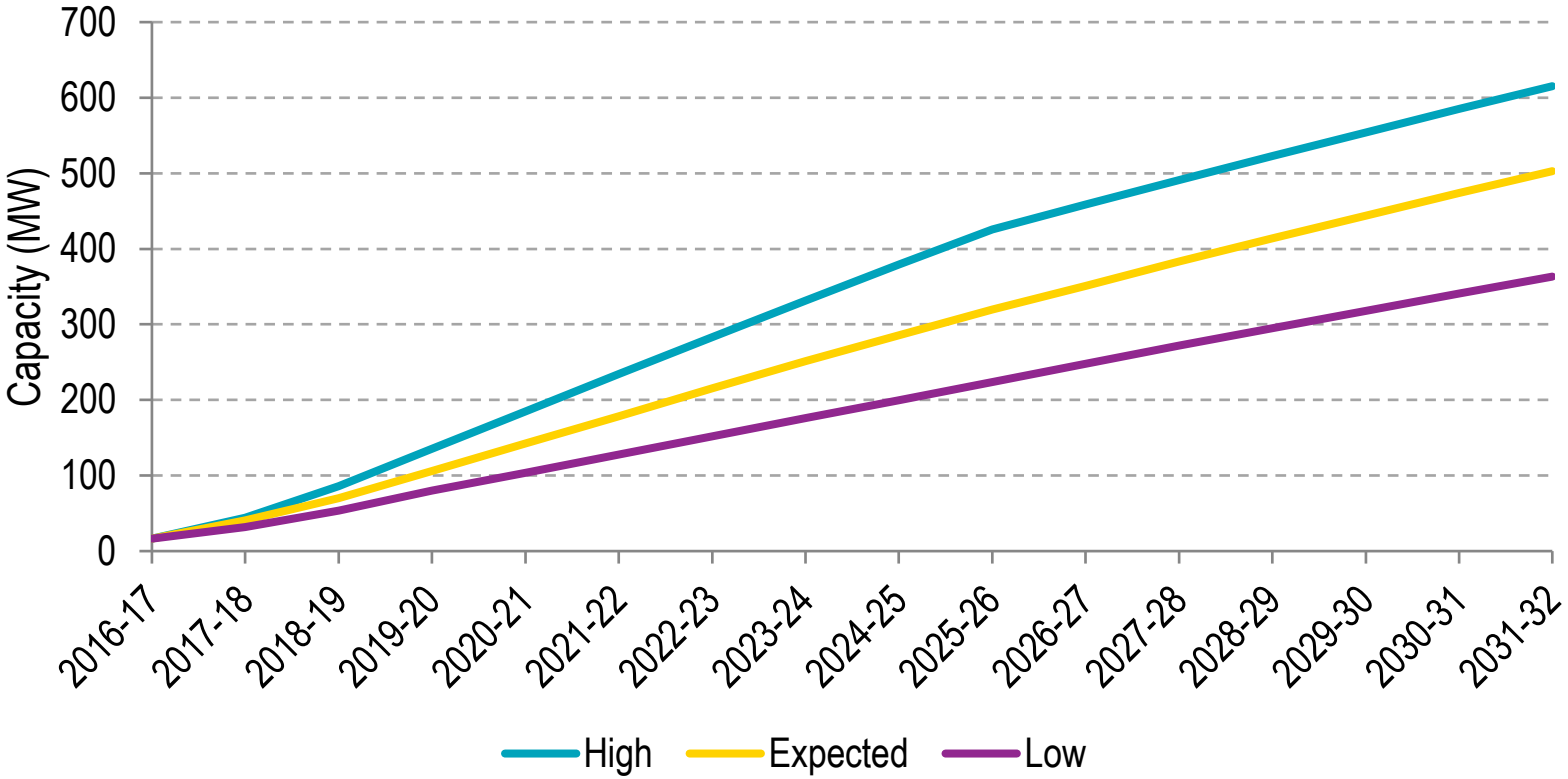
Assumptions
Rooftop PV uptake

- EY models half-hourly rooftop PV based on historical satellite data at several representative locations in the WEM

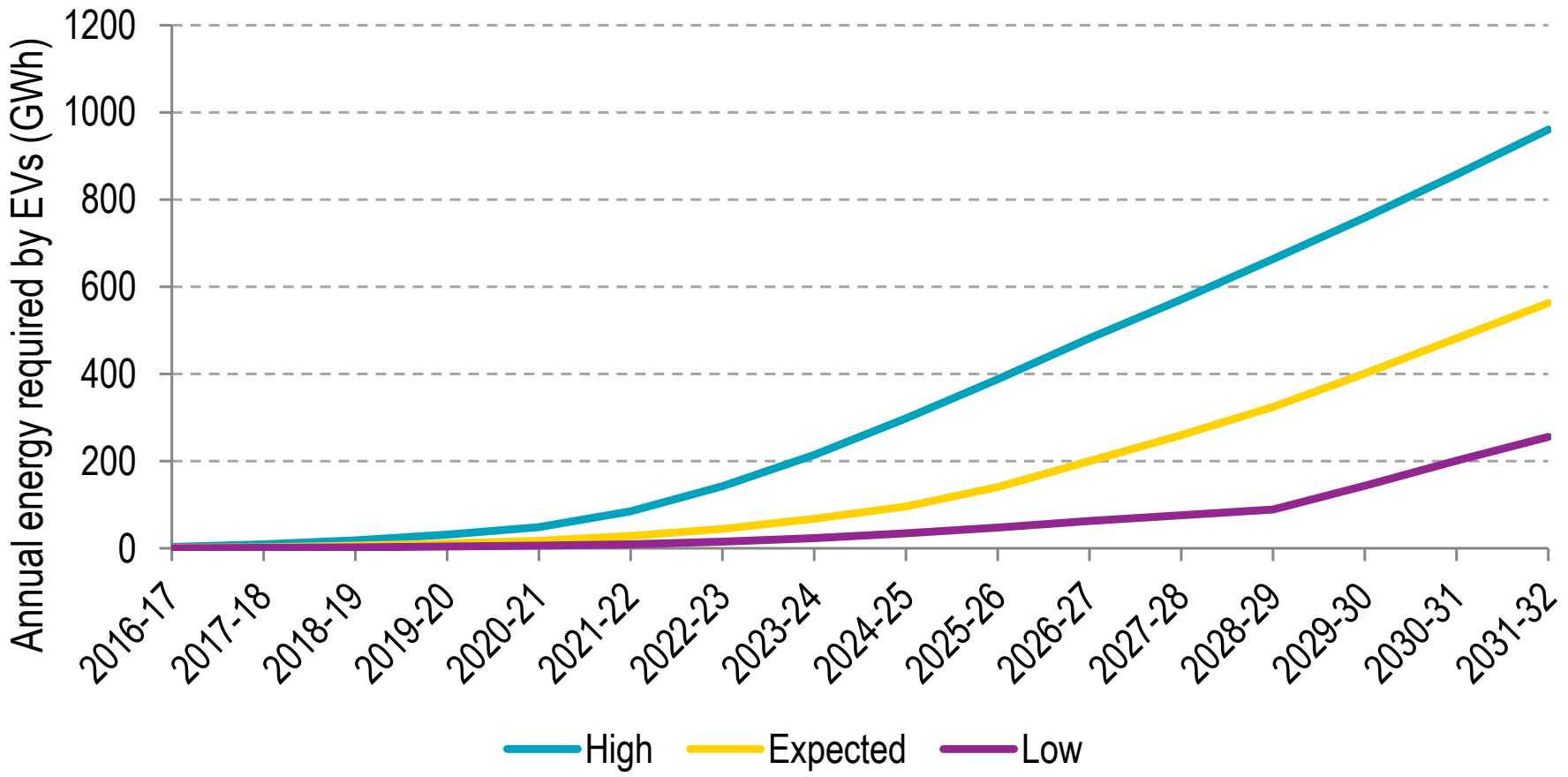


Assumptions
Behind-the-meter storage uptake

- AEMO assume that 25% of behind-the-meter storage capacity will contribute to reducing peak demand

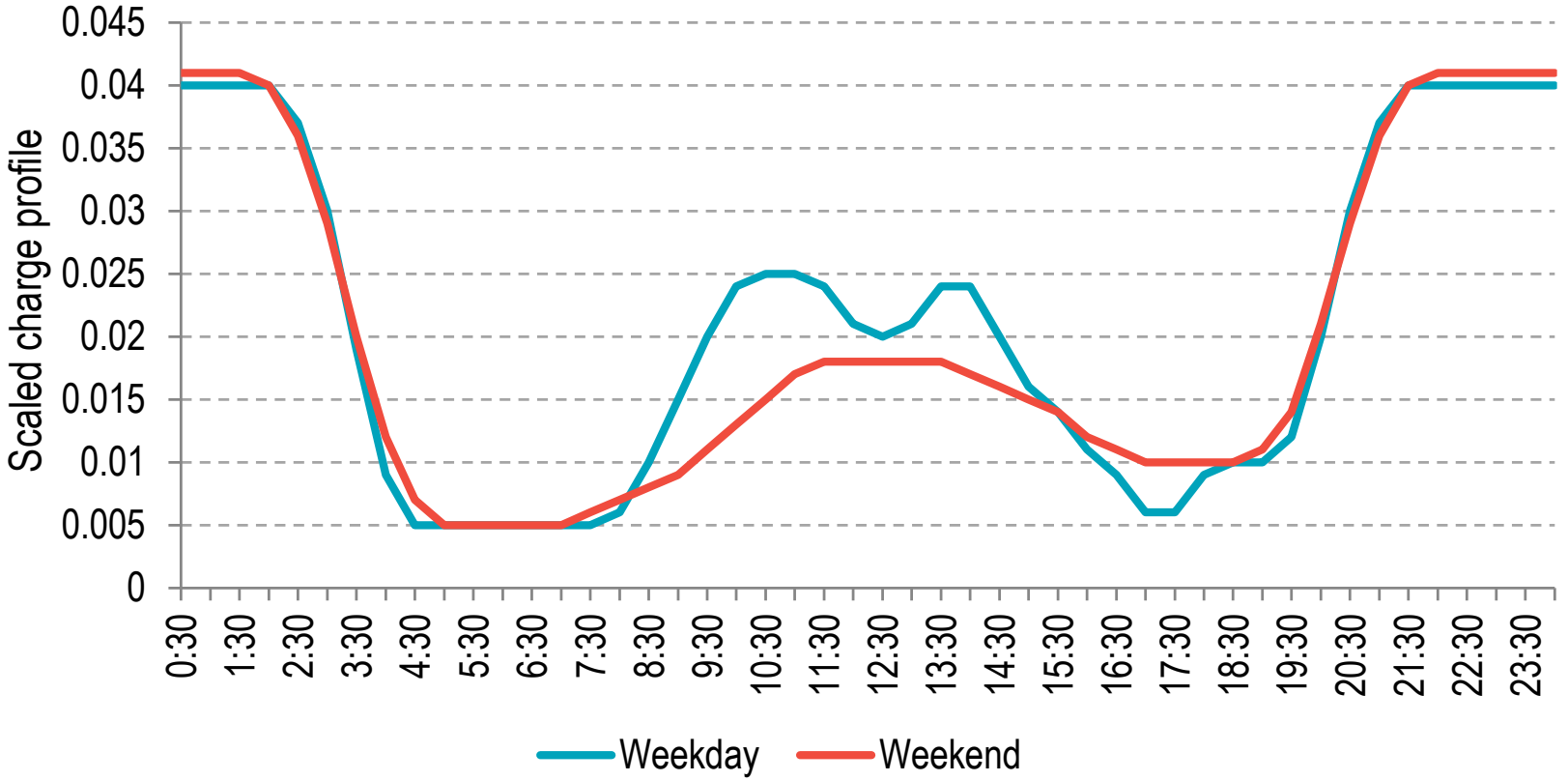


Assumptions
Electric vehicle uptake



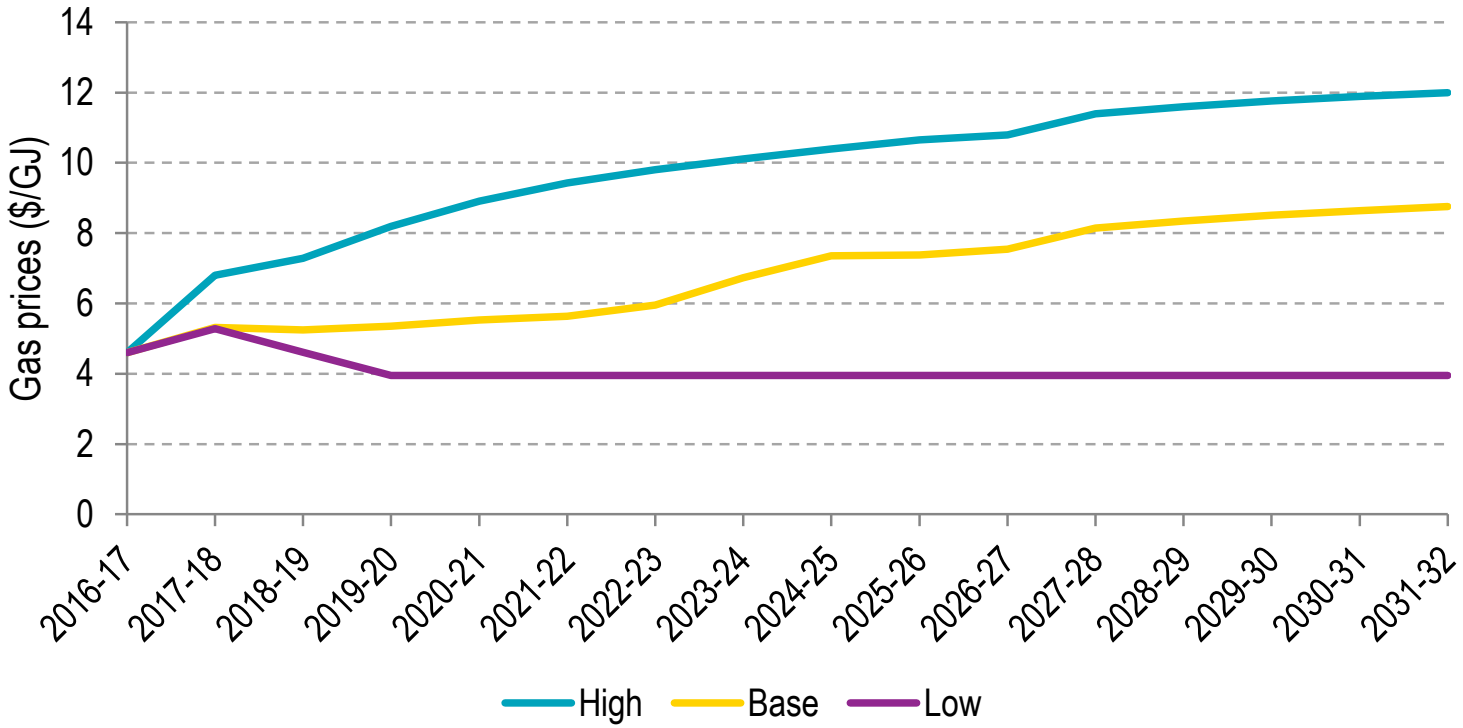
Assumptions
Electric vehicle daily charge profile

- EY uses an in-house assumption on time-of-day charging from EVs



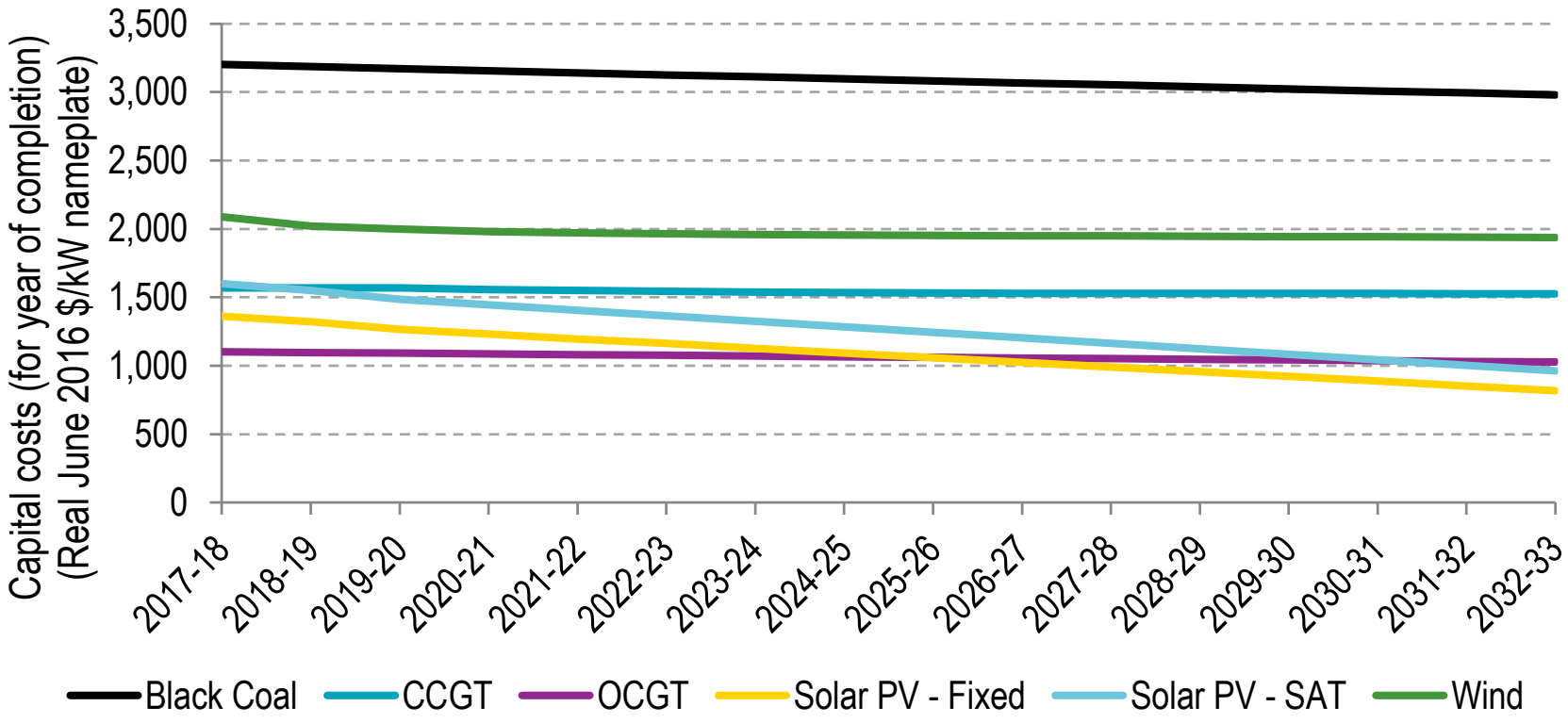
Assumptions
Gas price projections

- The latest gas price forecast for the WEM is the AEMO GSOO, Dec 2017
- Gas prices impact wholesale market prices and the cost of gas generation
- The gas price delta from 2016-17 to each future year impacts on bids
- It is proposed to use the GSOO Base gas price trajectory for each scenario



Assumptions
New entrant generator capital costs

- Source is from the AEMO NTNDP 2016, except EY has adjusted wind and solar PV capex down to be more in line with recent public information
- Capital costs trajectories will influence the market-driven new entrant capacity in each scenario, which will influence congestion



Assumptions
Other macro assumptions

Assumptions	Proposed value	Impact on outcomes
Weighted-average cost of capital (WACC)	7.5% pre-tax real	Direct impact on annual repayments on capex for new entrant generators.
Economic lifetime	Thermal: 30 years Renewables: 25 years	As above.
Available capacity factor for renewable generation	**Existing units**: as per historical generation **New entrants**: Wind (north country): 44% Wind (rest of WEM): 39% Solar PV: as modelled	Impact on dispatch patterns and new entrant commercial viability

Assumptions
Retiring generators by 2022

Project	Capacity (MW)	Region	Reason
KWINANA_GT1	20.8	OCGT	Announced by Synergy
MUJA_G1 (Muja A)	55	Black Coal	
MUJA_G2 (Muja A)	55	Black Coal	
MUJA_G3 (Muja B)	55	Black Coal	
MUJA_G4 (Muja B)	55	Black Coal	
MUNGARRA_GT1	37.2	OCGT	
MUNGARRA_GT2	37.2	OCGT	
MUNGARRA_GT3	38.2	OCGT	
WEST_KALGOORLIE_GT2	38.2	Distillate	
WEST_KALGOORLIE_GT3	24	Distillate	

Assumptions
New entrant development by 2022

- New entrants selected either have offtake agreements in place or are in Synergy's renewable project development plan

Project	Capacity (MW)	Region	Type
Byford Solar	30	Kwinana	Single axis tracking PV
Greenough River 2	30	North Country	Single axis tracking PV
Emu Downs Solar Farm	20	North Country	Single axis tracking PV
Northam Solar Project	9.9	East Country	Single axis tracking PV
Badgingarra	130	North Country	Wind turbine
Warradarge Stage 1	180	North Country	Wind turbine
Cunderdin Solar Farm	100	East Country	Single axis tracking PV

Should the PUO consider other generators to be commissioned by 2022?

Assumptions
Generator outage rates

Generator type	Full forced outage rate (%)	Mean time to repair - full (hours)	Partial forced outage rate (%)	Partial derating (%)	Mean time to repair - partial (hours)	Maintenance outage rate (weeks per year)
Black coal	1.72%	55.03	9.88%	26.17%	26.62	3
CCGT / cogeneration	3.02%	14.05	7.84%	29.88%	71.64	2
OCGT (natural gas fuel)	3.02%	33.55	7.84%	31.89%	10.75	1
OCGT (liquid fuel)	1.06%	33.55	5.22%	31.89%	10.75	1
Wind and solar	Outages captured in the modelled capacity factor / generation profiles					

Are these publically sourced outage rates reasonable?

Assumptions
Other generator parameters

Generator type	FOM ($/MW sent-out)	VOM ($/MWh sent-out)	Heat rate (%, commissioned in 2022-23)
Black coal	42,073	3	41.8%
CCGT / cogeneration	10,000	7	53.6%
OCGT (natural gas fuel)	4,000	10	36.6%
OCGT (liquid fuel)	4,000	10	36.6%
Wind	45,000	0	N/A
Solar PV – fixed	25,000	0	N/A
Solar PV - tracking	30,000	0	N/A

Are these publically sourced parameters reasonable?

Assumptions Feedback

Generators are invited to submit appropriate assumption data for specific generators to improve modelling accuracy.

These data needs to be able to be published.

Should the modelling consider alternative new entrant generation sources?

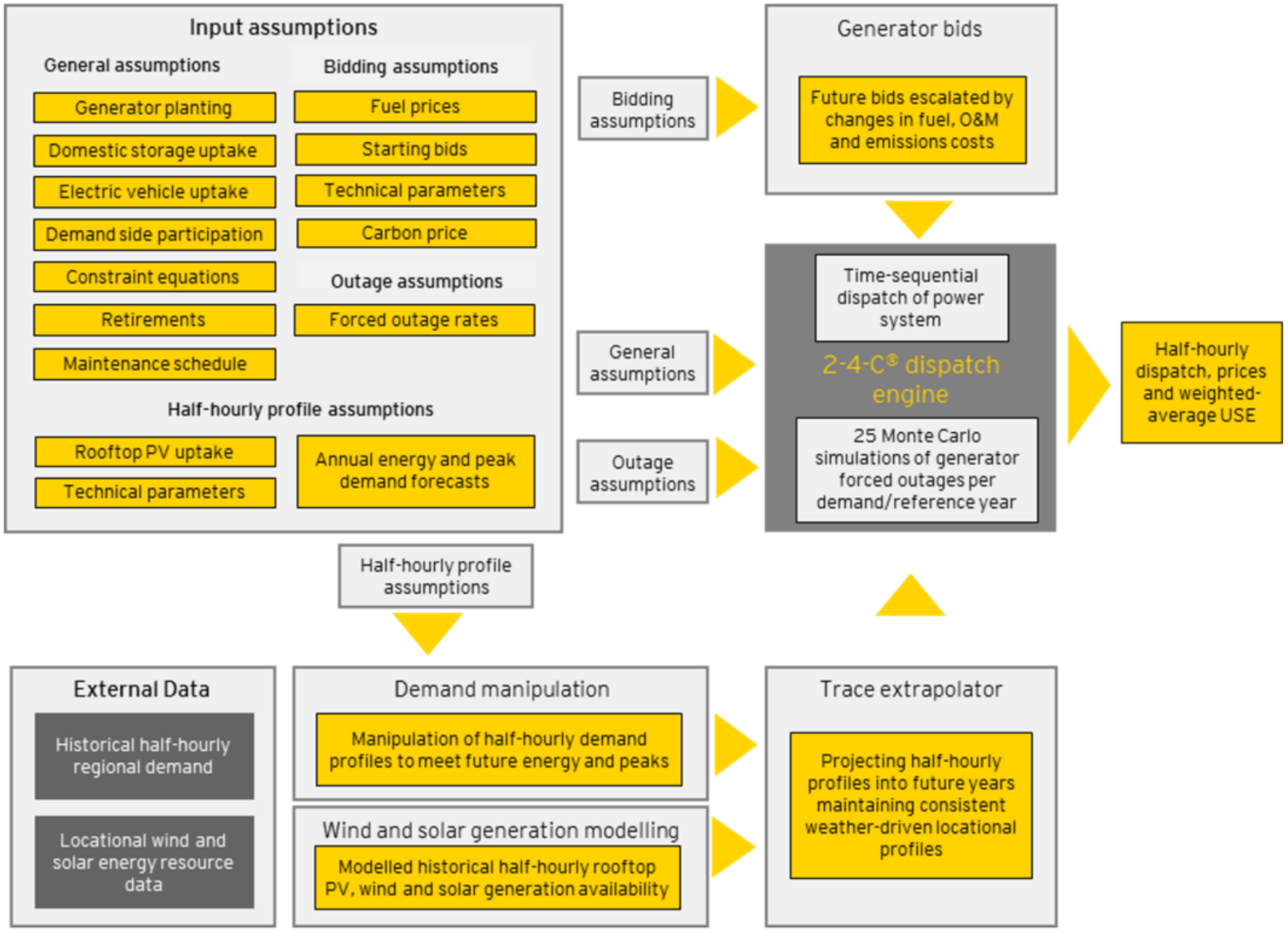
Capacity market price modelling

- To estimate the reserve capacity price, EY will apply the formula in the latest WEM market rules:

$$\mathrm{RCP} = \mathrm{MIN}\left\{\left(\frac{\mathrm{BRCP} \times \text{'Intercept'}}{1 - ((\text{'Surplus'} + 0.03) \times \text{'Slope'})}\right), \mathrm{BRCP} \times 1.1\right\}$$

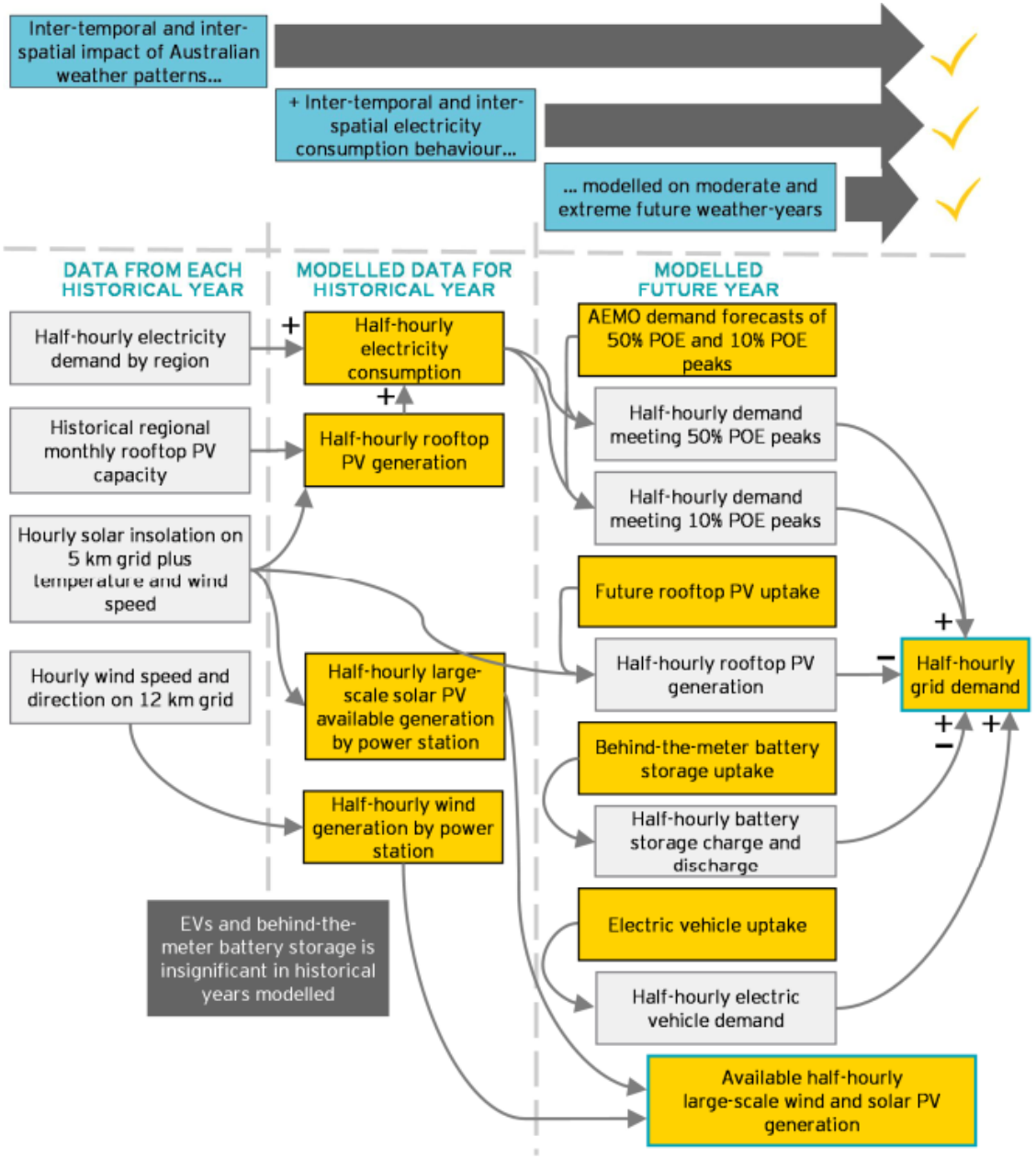
- Despite the PUO's proposed mandated capacity auction in the 2024-25 capacity year, this will not be modelled explicitly, considering the absence of specified auction design settings

Market modelling chart



Approach to half-hourly modelling

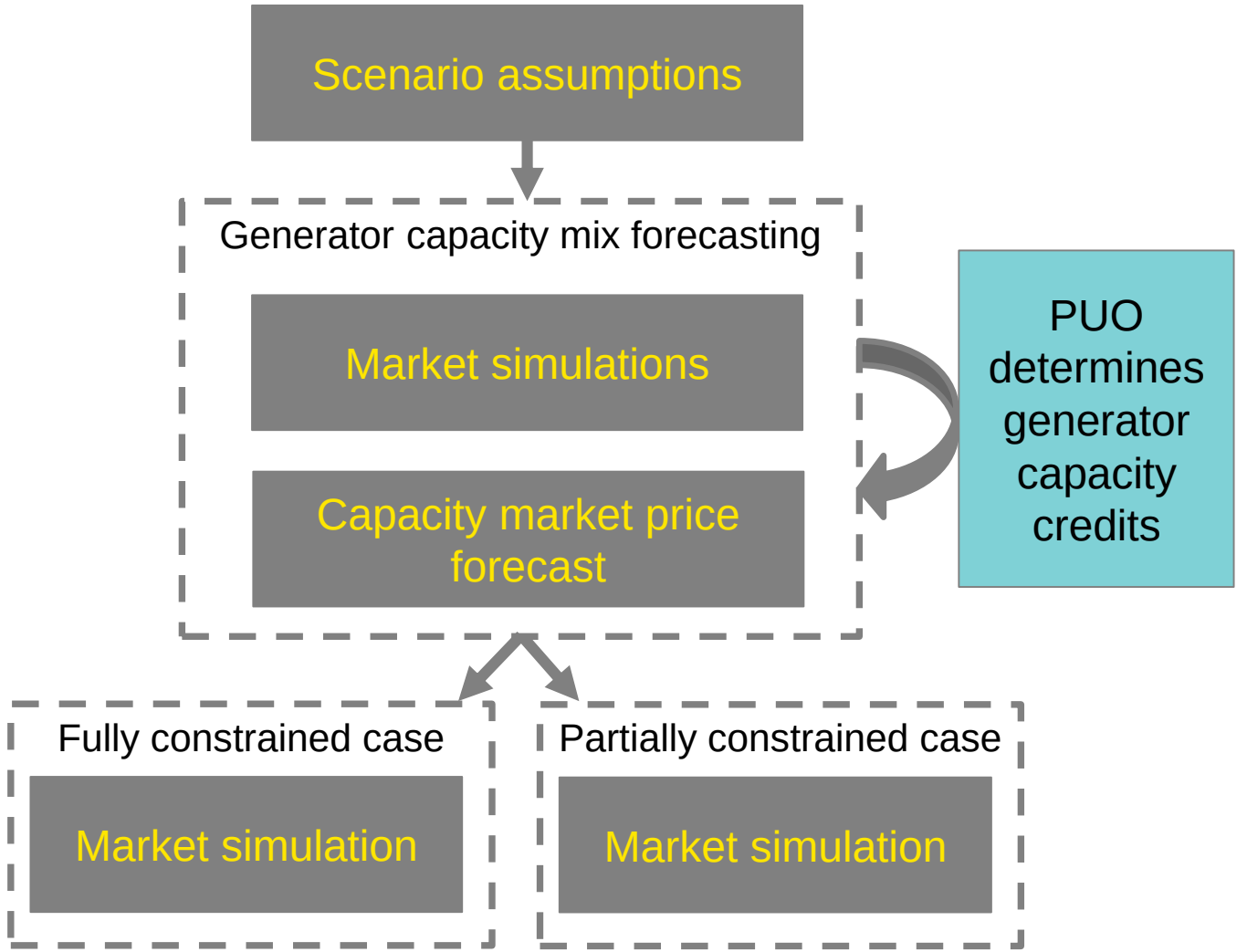
- To model future half-hourly demand, wind and solar generation, EY bases each modelled future year on historical years
- EY proposes to use two historical years for this modelling: 2015-16 and 2016-17.
- EY will test the robustness of the outcomes on individual historical years



Overview of modelling approach

- The methodology involves a feedback loop where the PUO will forecast the assigned capacity credits while EY will use these credits to forecast the capacity mix

Should the modelling consider an alternative approach?



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