Department of **Energy, Mines, Industry Regulation and Safety**
Energy Policy WA

GOVERNMENT OF WESTERN AUSTRALIA

Meeting Agenda

Meeting Title:	Evolution of Pilbara Network Rules Working Group
Workstream	Workstream 1 (PNR Workstream)
Date:	22 August 2024
Time:	9:30am – 11:30am
Location:	Online, via TEAMS

Item	Item	Responsibility	Type	Duration
1	Welcome and Agenda • Conflicts of interest • Competition Law	Chair	Noting	7 min
2	Meeting Apologies and Attendance	Chair	Noting	2 min
3	Action items	Chair	Noting	1 min
4.	Updated modelling results	RBP	Noting	10 min
5	Prioritisation of EPNR Initiatives	RBP	Discussion	20 min
6	Reliability standard and supply adequacy	RBP	Discussion	30 min
7	Balancing service	RBP	Discussion	30 min
8	Governance of the ISO	Chair	Discussion	20 min
9	Next steps	RBP	Noting	5 min
	Next meeting: 24 October 2024 (PNR workstream)			

Competition and Consumer Law Obligations

Members of the PAC's Evolution of the Pilbara Networks Rules Working Group (**Members**) note their obligations under the *Competition and Consumer Act 2010* (**CCA**).

If a Member has a concern regarding the competition law implications of any issue being discussed at any meeting, please bring the matter to the immediate attention of the Chairperson.

Part IV of the CCA (titled "Restrictive Trade Practices") contains several prohibitions (rules) targeting anti-competitive conduct. These include:

(a) **cartel conduct**: cartel conduct is an arrangement or understanding between competitors to fix prices; restrict the supply or acquisition of goods or services by parties to the arrangement; allocate customers or territories; and or rig bids.

(b) **concerted practices**: a concerted practice can be conceived of as involving cooperation between competitors which has the purpose, effect or likely effect of substantially lessening competition, in particular, sharing Competitively Sensitive Information with competitors such as future pricing intentions and this end:

- a concerted practice, according to the ACCC, involves a lower threshold between parties than a contract arrangement or understanding; and accordingly; and
- a forum like the EPNRWG is capable being a place where such cooperation could occur.

(c) **anti-competitive contracts, arrangements understandings**: any contract, arrangement or understanding which has the purpose, effect or likely effect of substantially lessening competition.

(d) **anti-competitive conduct (market power)**: any conduct by a company with market power which has the purpose, effect or likely effect of substantially lessening competition.

(e) **collective boycotts**: where a group of competitors agree not to acquire goods or services from, or not to supply goods or services to, a business with whom the group is negotiating, unless the business accepts the terms and conditions offered by the group.

A contravention of the CCA could result in a significant fine (up to $500,000 for individuals and more than $10 million for companies). Cartel conduct may also result in criminal sanctions, including gaol terms for individuals.

Sensitive Information means and includes:

(a) commercially sensitive information belonging to a Member's organisation or business (in this document such bodies are referred to as an Industry Stakeholder); and

(b) information which, if disclosed, would breach an Industry Stakeholder's obligations of confidence to third parties, be against laws or regulations (including competition laws), would waive legal professional privilege, or cause unreasonable prejudice to the Coordinator of Energy or the State of Western Australia).

Guiding Principle – what not to discuss

In any circumstance in which Industry Stakeholders are or are likely to be in competition with one another a Member must not discuss or exchange with any of the other Members information that is not otherwise in the public domain about commercially sensitive matters, including without limitation the following:

(a) the rates or prices (including any discounts or rebates) for the goods produced or the services produced by the Industry Stakeholders that are paid by or offered to third parties;

(b) the confidential details regarding a customer or supplier of an Industry Stakeholder;

(c) any strategies employed by an Industry Stakeholder to further any business that is or is likely to be in competition with a business of another Industry Stakeholder, (including, without limitation, any strategy related to an Industry Stakeholder's approach to bilateral contracting or bidding in the energy or ancillary/essential system services markets);

(d) the prices paid or offered to be paid (including any aspects of a transaction) by an Industry Stakeholder to acquire goods or services from third parties; and

(e) the confidential particulars of a third party supplier of goods or services to an Industry Stakeholder, including any circumstances in which an Industry Stakeholder has refused to or would refuse to acquire goods or services from a third party supplier or class of third party supplier.

Compliance Procedures for Meetings

If any of the matters listed above is raised for discussion, or information is sought to be exchanged in relation to the matter, the relevant Member must object to the matter being discussed. If, despite the objection, discussion of the relevant matter continues, then the relevant Member should advise the Chairperson and cease participation in the meeting/discussion and the relevant events must be recorded in the minutes for the meeting, including the time at which the relevant Member ceased to participate.

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Agenda Item 3: Action Items

Evolution of the Pilbara Networks Rules Working Group (EPNRWG) Workstream 1 – Meeting - 2024_08_22

Shaded	Shaded action items are actions that have been completed since the last EPNRWG (WS1) meeting. Updates from last working group meeting provided for information in RED.
Unshaded	Unshaded action items are still being progressed.
Missing	Action items missing in sequence have been completed from previous meetings and subsequently removed from log.

Item	Action	Responsibility	Meeting Arising	Status
5/2024	Provide an outline to the working group of which PSSR issues are being addressed by the EPNR Review and the ISO's review of Subchapters 7.3 and 7.4 respectively.	EPWA	2024_07_29	**Open** EPWA will consult with ISO during its review and consider the review's recommendation in it's Final Report in September.
6/2024	Share reflections and insights from recent experience connecting its Port Hedland battery and storage project.	APA	2024_07_29	**Open**
7/2024	Provide criteria used to inform prioritisation of issues at the 22 August 2024 EPNRWG meeting.	EPWA	2024_07_29	**Open** Addressed in Agenda item 5.
8/2024	Add categorisations and definitions of NSPs and other entities under the PNR to the list of PNR issues.	EPWA	2024_07_29	**Closed**

Government of Western Australia
Energy Policy WA

Evolution of the Pilbara Network Rules Working Group

Meeting 2024_08_22

22 August 2024

Working together for a **brighter** energy future.

Meeting Protocols

- Please place your microphone on mute, unless you are asking a question or making a comment
- Please keep questions relevant to the agenda item being discussed
- If there is not a break in discussion and you would like to say something, you can 'raise your hand' by typing 'question' or 'comment' in the meeting chat
- Questions and comments can also be emailed to EPWA - Energy Markets energymarkets@dmirs.wa.gov.au after the meeting
- The meeting will be recorded and minutes will be taken
- Please state your name and organisation when you ask a question
- If you are having connection/bandwidth issues, you may want to disable the incoming and/or outgoing video

1. Updated modelling results

Updated modelling outputs

In the June meeting, we agreed to complete the modelling work and move to the PNR review stage of the project.

EPWA had an outstanding action to report back with final modelling outputs, including a couple of additional sensitivity runs. Updated outputs are attached as Appendix A. For completeness, this includes material already presented – members will be familiar with most slides. Slides 53-66 have been updated to include scenario 2 outputs; while slides 67-70 present sensitivity analysis for three scenarios:

1. More volatile wind and solar generation (based on single year climatic profiles rather than an average profile).
2. Lower minimum demand (load duration curve adjusted to increase load variation).
3. More stringent emissions requirements.

2. List of EPNR initiatives

List of initiatives

Power system security and reliability

- Reliability standard and supply adequacy
- Long term planning
- Outage planning
- ESS definitions and procurement
- ESS cost allocation
- Responsibility for setting system strength requirements

Scheduling, dispatch and settlement

- Balancing service with (optional) reduced load following requirements
- Metering obligations
- Load shedding arrangements
- Fee allocation

New connections

- NSP to NSP connection arrangements, including constrained access
- Process for new transmission build, including transmission pricing and constrained access
- Registration category and requirements for storage facilities
- Registration category and requirements for DSR
- Exemptions and derogations from the HTR

Terminology

- **Registration constructs – definition of “NSP” (new)**
- Definition and use of “energisation” and “commercial operations”
- Consistency between PNR and HTR

Governance of the ISO

- Board composition
- Resourcing and budget
- Ringfencing and confidentiality regime

Compliance and enforcement

- Responsibilities and process for compliance monitoring
- Enforcement options

Registration categories – definition of NSP

The current PNR are built on the basis that the NWIS is a collection of networks, each of which has a responsible Network Service Provider. NSPs are the core entities on which responsibilities are placed, and the predominant model is vertically integrated companies (or groups) responsible for generation, transmission, distribution, and consumption.

In future, as more network users of different types (direct consumers, large users with behind the meter generation, large users with remote generation, transmission owners, pure-play generators) join the Pilbara networks, it may make sense to revise the entity types to put more focus on the individual parts of vertically integrated participants.

The Pilbara will continue to need to manage multiple network owners and vertical integration, so network participant constructs are unlikely to be the same as the WEM or the NEM.

The EPNR project needs to ensure the entity constructs in the rules allow effective regulation of all types of market participant.

Prioritising initiatives (1)

All these initiatives need to be addressed in the evolution of the Pilbara electricity arrangements.

The current Evolution of the PNR project will deliver:

1. A consultation paper in December 2024
2. An implementation plan in Q1 2025.

The consultation paper will describe the initiatives identified and provide a direction for the high-level design. It is not intended that the consultation paper will specify a final detailed end state for the PNR, but it needs to provide direction for the continuing reform.

The implementation plan will set out the program of work required to finalise detailed design, amend rules and other instruments, and commence new functions.

In preparation for the consultation paper, EPWA wishes to progress design of some of the initiatives.

Prioritising initiatives (2)

Not all initiatives can be addressed immediately. Which initiatives should be addressed first? Based on working group discussions, EPWA has identified six criteria to make best use of time:

- Focus on power system security and reliability matters (“PSSR”)
- Focus on removing barriers and providing incentives for emissions reduction and renewable investment (“Emissions”)
- Focus on issues that will manifest sooner than later (“Timing”)
- Focus on items likely to have low costs and/or high benefits (“Value”)
- Focus on matters which need more design activity (so as to get them underway) (“Size”)
- Avoid issues under active consideration by ISO or others so we can build on that work (“Other activity”)

	PSSR	Emissions	Timing	Value	Size	Other activity
Reliability standard and supply adequacy	Yes	Direct	Short term	Med	Med	No
Long term planning	Yes	Direct	Medium term	High	Small	No
Outage planning	Yes	Indirect	Short	Low	Medium	Yes
ESS definitions and procurement	Yes	Direct	Short	High	Large	Partially
ESS cost allocation	No	Direct	Short	High	Medium	Partially
Responsibility for setting system strength requirements	Yes	Indirect	Med	Low	Small	No
Balancing service	No	Direct	Med	High	Large	No
Metering obligations	No	Indirect	Med	Med	Small	No
Load shedding arrangements	No	No	Med	Low	Small	No
Fee allocation	No	Indirect	Short	Med	Medium	No

	PSSR	Emissions	Timing	Value	Size	Other activity
NSP to NSP connections, incl constrained access	No	Direct	Med	High	Large	No
Transmission build process, incl transmission pricing and constrained access	No	Direct	Med	High	Large	Yes
Registration category and requirements for storage facilities	No	Direct	Short	Med	Medium	No
Registration category and requirements for DSR	No	Direct	Long term	Med	Large	No
Exemptions and derogations from the HTR	No	No	Medium	Med	Medium	No
Registration constructs – definition of "NSP"	No	No	Medium	Med	Medium	No
Definition and use of "energisation" and "commercial operations"	No	No	Short	Low	Small	No
Terminology consistency between PNR and HTR	No	No	Short	Med	Small	No

	PSSR	Emissions	Timing	Value	Size	Other activity
Board composition	No	Direct	Short	High	Small	No
Resourcing and budget	No	Direct	Short	High	Small	No
Ringfencing	No	Direct	Medium	Med	Medium	Partially
Confidentiality regime	No	Direct	Short	Med	Medium	No
Responsibilities and process for compliance monitoring	No	Direct	Medium	Med	Medium	No
Enforcement options	No	Direct	Medium	High	Large	No

Prioritised initiatives to focus on in advance of the consultation paper?

Power system security and reliability

- Reliability standard and supply adequacy
- Long term planning
- Outage planning
- ESS definitions and procurement
- ESS cost allocation
- Responsibility for setting system strength requirements

Scheduling, dispatch and settlement

- Balancing service with (optional) reduced load following requirements
- Metering obligations
- Load shedding arrangements
- Fee allocation

New connections

- NSP to NSP connection arrangements, including constrained access
- Process for new transmission build, including transmission pricing and constrained access
- Registration category and requirements for storage facilities
- Registration category and requirements for DSR
- Exemptions and derogations from the HTR

Terminology

- Registration constructs – definition of "NSP"
- Definition and use of "energisation" and "commercial operations"
- Consistency between PNR and HTR

Governance of the ISO

- Board composition
- Resourcing and budget
- Ringfencing and confidentiality regime

Compliance and enforcement

- Responsibilities and process for compliance monitoring
- Enforcement options

Legend
Tier 1 (2+ criteria)
Tier 2 (1 criteria)
Progressing elsewhere

Which issues will we cover today?

Power system security and reliability

- Reliability standard and supply adequacy
- Long term planning
- Outage planning
- ESS definitions and procurement
- ESS cost allocation
- Responsibility for setting system strength requirements

Scheduling, dispatch and settlement

- Balancing service with (optional) reduced load following requirements
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- Consistency between PNR and HTR

Governance of the ISO

- Board composition
- Resourcing and budget
- Ringfencing and confidentiality regime

Compliance and enforcement

- Responsibilities and process for compliance monitoring
- Enforcement options

Which issues will we cover in October?

Power system security and reliability

- Reliability standard and supply adequacy
- Long term planning
- Outage planning
- ESS definitions and procurement
- ESS cost allocation
- Responsibility for setting system strength requirements

Scheduling, dispatch and settlement

- Balancing service with (optional) reduced load following requirements
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Governance of the ISO

- Board composition
- Resourcing and budget
- Ringfencing and confidentiality regime

Compliance and enforcement

- Responsibilities and process for compliance monitoring
- Enforcement options

Which issues will we cover in November?

Power system security and reliability

- Reliability standard and supply adequacy
- Long term planning
- Outage planning
- ESS definitions and procurement
- ESS cost allocation
- Responsibility for setting system strength requirements

Scheduling, dispatch and settlement

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3. Reliability standard and supply adequacy

Reliability Standard

Chapter 6 of the PNR provides for:

- the ISO to publish peak demand or a method for determining peak demand
- Exit Users to forecast their own peak demand and nominate a Demand Cap
- Generators to self-certify the capacity they provide
- Exit Users to provide generation adequacy certificates
- Exit Users to be restricted to withdrawing their Demand Cap.

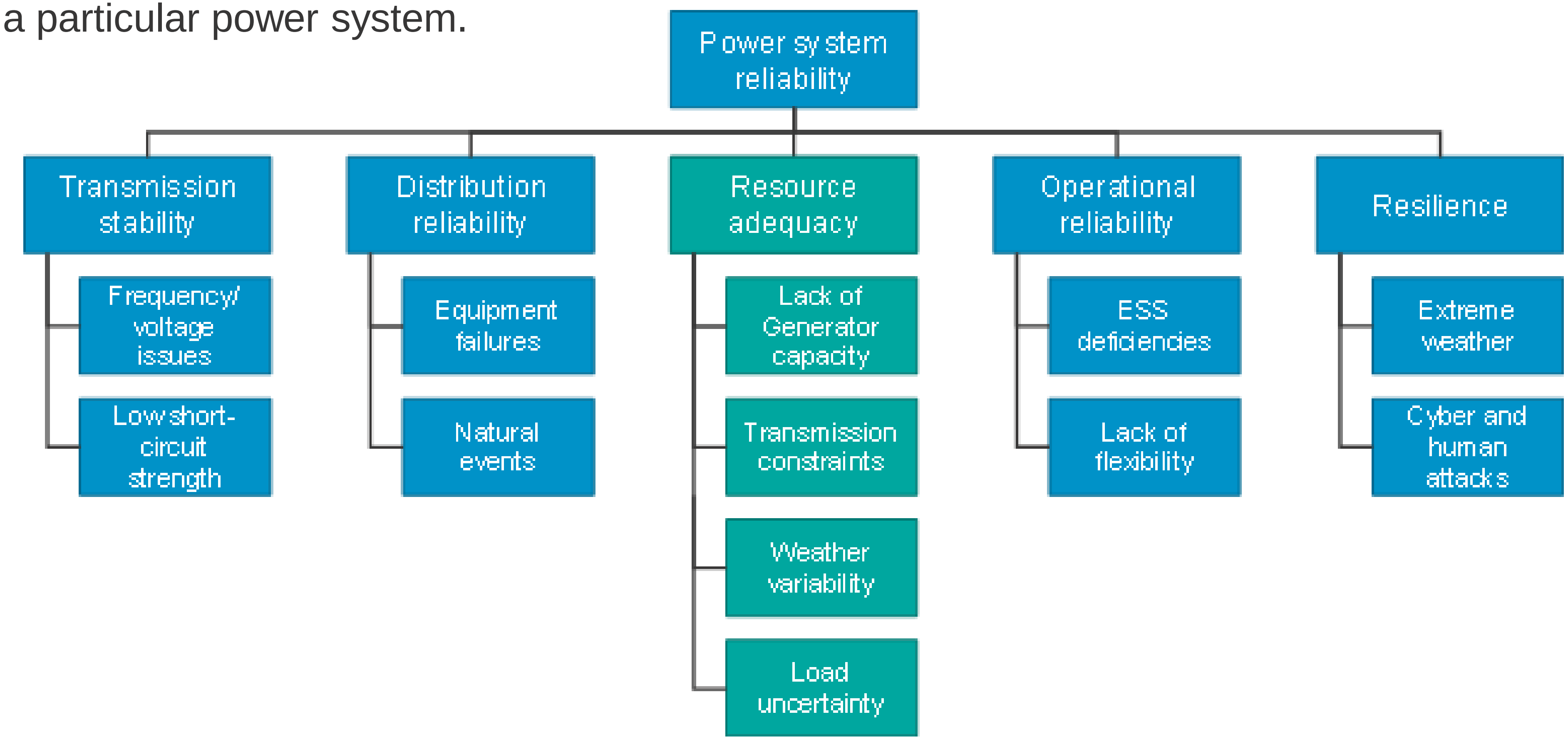
The chapter is currently suspended, and no methods have been published.

The regime needs to evolve to include a reliability standard to:

- include a method for determining the overall capacity requirement
- include intermittent renewables, storage, and demand side response
- account for correlation (or lack thereof) in the output of intermittent renewable generation (which is likely to require centralised capacity certification).
- allow different standards in different parts of the network
- while maintaining opt out for behind the meter activity where loss of generation is tied to load reduction.

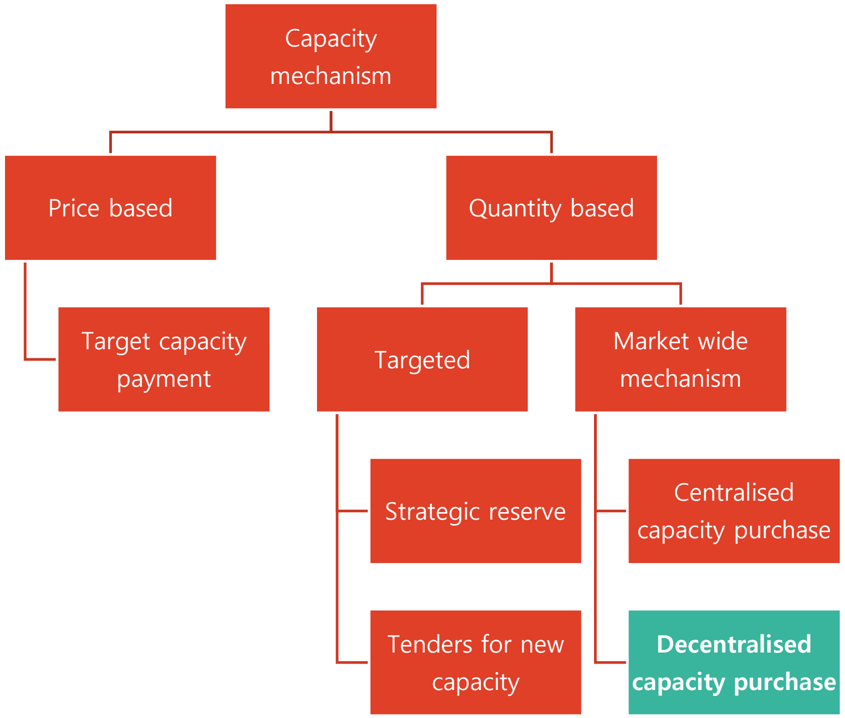
Elements of power system reliability

Power system reliability is the overall ability of the power system to meet demand for electricity within given standards. Various factors contribute to the level of reliability delivered to customers connected to a particular power system.



Adapted from Energy Systems Integration Group, Redefining Resource Adequacy for Modern Power Systems, 2021

Parameters for a Pilbara supply adequacy regime



There are a variety of ways to ensure supply adequacy.

The Pilbara currently provides for centralised forecasting, with decentralised certification and procurement.

The WEM uses centralised forecasting and certification, and hybrid procurement. The CIS is using targeted tenders for new capacity.

We see four sub-topics:

- Reliability standard.
- Reliability forecasting.
- Capacity certification.
- Capacity procurement.

Reliability forecasting

The PNR provides for the ISO to define what “Peak Demand” means in a procedure. It makes sense for the ISO to be the responsible party, to:

- forecast expected supply target for the system as a whole, based on a method set out in the rules
- identify when system peak is each year
- provide data on participant contribution to system peak.

Options for supply target:

- Single criterion focused on system peak.
- Single criterion focused on unserved energy.
- Both criteria.

Reliability standard - considerations

Level of redundancy in network equipment:

- How many concurrent network outages must be managed without losing energy supply? 1, 2?
- Is this the same in all parts of the network?
- This affects network planning, outage assessment, and pre- and post- contingency mitigation measures.

Supply adequacy target:

- Many jurisdictions use 1/10 year peak load.
- Some jurisdictions (NEM) use a proportion of unserved energy.
- WEM uses hybrid of both, plus a parameter to account for high system ramp requirements.

As used in the PNR modelling:

Build sufficient generation and storage to avoid unserved energy in 10% POE peak events, while also meeting n-1 generation standard (for spinning reserve).

Capacity certification

The PNR currently require generators to self-certify the quantity of capacity they provide. This is relatively straightforward for traditional technologies, but is more difficult for intermittent technologies which cannot guarantee how much energy they will be able to provide at any time.

We propose that ISO centrally assesses reliability contribution of generators, storage systems, and demand side resources using different methods for different types of facility:

- Firm generation: nameplate capacity backed up by practical demonstrations.
- Intermittent generation: a probabilistic method based on Effective Load Carrying Capacity.
- Storage: derating based on expected performance duration – likely to be longer in the Pilbara than the WEM.

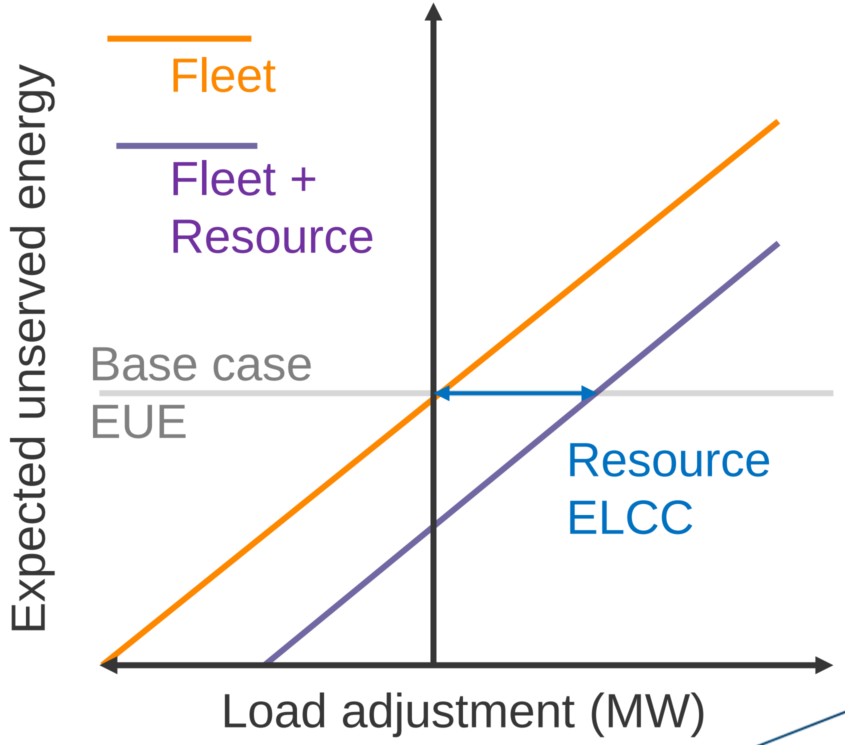
Depending on procurement arrangements (next slide), certification could happen all year round, and the certification and testing regime may not need to be as rigorous as in the WEM.

Effective Load Carrying Capacity

A supply resource's ELCC value measures the equivalent amount of additional load the system could serve ("carry") with the resource (versus without it), while meeting the same expected unserved energy (EUE).

- Determine EUE without the resource (base case).
- Add resource to base case.
- Adjust load until EUE is back to same level.

$$ELCC = \frac{Load\ added\ (MW)}{Resource\ nameplate\ added\ (MW)}$$



First-in ELCC: Contribution to reliability if this were the only supply facility.

Last-in ELCC: Incremental contribution to reliability measured relative to an existing portfolio.

Portfolio ELCC: the combined capacity contribution of a set of resources. This method inherently captures all interactive effects (e.g. wind + battery, solar + battery).

Capacity procurement

In the current PNR, Exit Users nominate a Demand Cap, and procure generation adequacy certificates to match their nominated cap. They surrender the certificates to the ISO which, if necessary, restricts their consumption to that quantity of offtake.

This approach avoids centralised procurement of capacity, and the consequential allocation of costs based on contribution to system peak (or other reliability metric).

Unlike the WEM, participants are responsible for finding enough supply to meet their desired demand. This also allows participants to overprocure for greater assurance of reliability.

Options:

- Retain a decentralised approach to nominating capacity requirements and procuring sufficient capacity to meet them.
- Introduce centralised procurement for some or all suppliers
  - with an administered price, like the WEM
  - With the price determined by auction, like in the US and Europe.
- Introduce centralised procurement for shortfalls from the supply target (like WEM supplementary capacity).

4. Balancing service

Balancing service with (optional) reduced load following requirements

Currently, Balancing Nominees must maintain an Imbalance as close to zero as possible within each Trading Interval, and in real time. Consumers can source energy from outside their portfolio, through direct contracting or by nomination via the settlement process.

Any mismatch between real-time supply and demand is met by ESS providers, or by ISO direction if ESS is insufficient to meet the gap. Sometimes there can be payment shortfalls or surpluses.

A key finding of the modelling was that with increasing penetration of renewables, there is benefit from having more flexible balancing arrangements.

The EPNR project needs to explore design for a balancing service procured by the ISO, allowing:

- participants to avoid increasingly complex multi-party nominations
- balancing energy to be centrally procured closer to real time
- the ISO to manage intermittent volatility.

A broader centralised balancing service will require review of the dispatch arrangements, nomination rules, imbalance tolerances, and imbalance pricing.

Procurement

A balancing mechanism uses centralised energy dispatch to balance supply and demand on the power system. It operates on a timeframe of 5 to 60 minutes, while ESS operate at shorter timeframes.

For example, in the UK electricity market, participants nominate their generation ahead of time. They have the option to make bids and offers to depart from their pre-planned schedules. The SO assesses the supply-demand gap, and dispatches sufficient balancing energy to meet it.

In the Pilbara, a balancing mechanism could be:

- an open platform, where anyone can submit bids and offers to depart from their scheduled position
- a closed platform, where the ISO contracts specific facilities to provide balancing services, and only those facilities are adjusted up or down.

Even when there is no mismatch between supply and demand, a balancing mechanism can still result in altered dispatch, for example dispatching a generator with a lower offer price while curtailing a generator with a higher offer price.

Either way:

- the ISO needs to have accurate load and intermittent generation forecasts
- ISO must use all available supply to avoid load shedding.

Cost recovery

Participants are currently required to balance their own energy. They can purchase energy from others, and this can either occur through direct contracting or through the nominations process through the settlement engine.

A balancing mechanism would use a similar pricing regime, where:

- Participants pre-nominate their schedules for net energy balance (or separately generation and consumption)
- Participants pre-nominate bilateral contract quantities (when buying or selling energy to others)
- ISO dispatches balancing providers to balance the system
- ISO calculates actual imbalances based on meter data
- Participants pay or are paid based on their imbalance, and their balancing position, at the price determined by the ISO
- balancing buy and sell prices may be different to incentive participants to minimise their imbalance where possible.

Other design parameters

- An open platform would need to allow participants to change their offer prices day to day, as bids and offers represent changes from self-scheduled positions.
- A closed platform could require fixed offer prices from contracted facilities, compensated by a fixed payment.
- It would be inefficient to require facilities to maintain headroom or footroom to offer in balancing, but participants could be required to offer as much capability as they have in either direction.
- Input submissions could be required to include a separate declaration of intermittent generation component, to allow ISO to assess likely volatility.
- There could be different pricing for imbalance quantities advised in advance compared to imbalance quantities that only manifest in real time.

5. Governance of the ISO

Evolution of SO independence

Jurisdictions around the world have gone through similar journeys to the Pilbara. From vertically integrated, to industry self-governance, to independent facilitation.

New Zealand began retail competition in 1993 with a self-regulating industry body overseeing competition, and moved to independent oversight in 2004.

The Philippines began wholesale market operations 2006 with a market operator governed by participant nominees, and moved to a fully independent board in 2018.

In the WEM, system operations was part of Western Power until 2016, when it moved into the independent operator.

In the UK, the monopoly transmission network operator National Grid is the system operator and owns (without any control or financial interest) the market operator Elexon. SO functions are being spun out into a separate independent system operator, and ownership of Elexon is expected to be transferred to industry, although governance arrangements will still require independent directors and finances.

Board composition

Pilbara ISOCo Limited has been appointed to the ISO role.

In line with Pilbara ISOCo's constitution, the current board consists of an Independent Chair, a government appointed Director, APA member director, Horizon Power member director and Rio Tinto member director.

An expanded ISO role means a need for clearer independence of ISO governance, from a board with the knowledge and experience to navigate the energy transition.

Board appointment rules could:

- be retained as is
- require all directors to be independent of participants in the sector
- require a majority of directors to be independent, but retain some participant representation.
- What else?

6. Next steps

Next steps

- EPWA to prepare options for selected initiatives.
- Upcoming meetings :
  - **29 August –** PAC meeting
  - **24 October –** PNR workstream meeting:
    - Proposals for issues discussed 22 Aug
    - Long term planning, fee allocation, ISO resources and budgeting, enforcement options, confidentiality regime, ESS definitions/procurement/cost allocation
  - **21 November –** PNR workstream meeting:
    - Proposals for issues discussed 24 Oct
    - NSP to NSP connections, storage registration, terminology
  - **5 December** – PAC meeting
  - **Dec - Feb** – Consultation paper
- *Do we need to consider scheduling an overflow meeting in November?*

Questions or feedback can be emailed to energymarkets@dmirs.wa.gov.au

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Western Australia.

Appendix. Stage 2 Modelling Outputs

Appendix contents

1. Summary of modelling outputs and implications

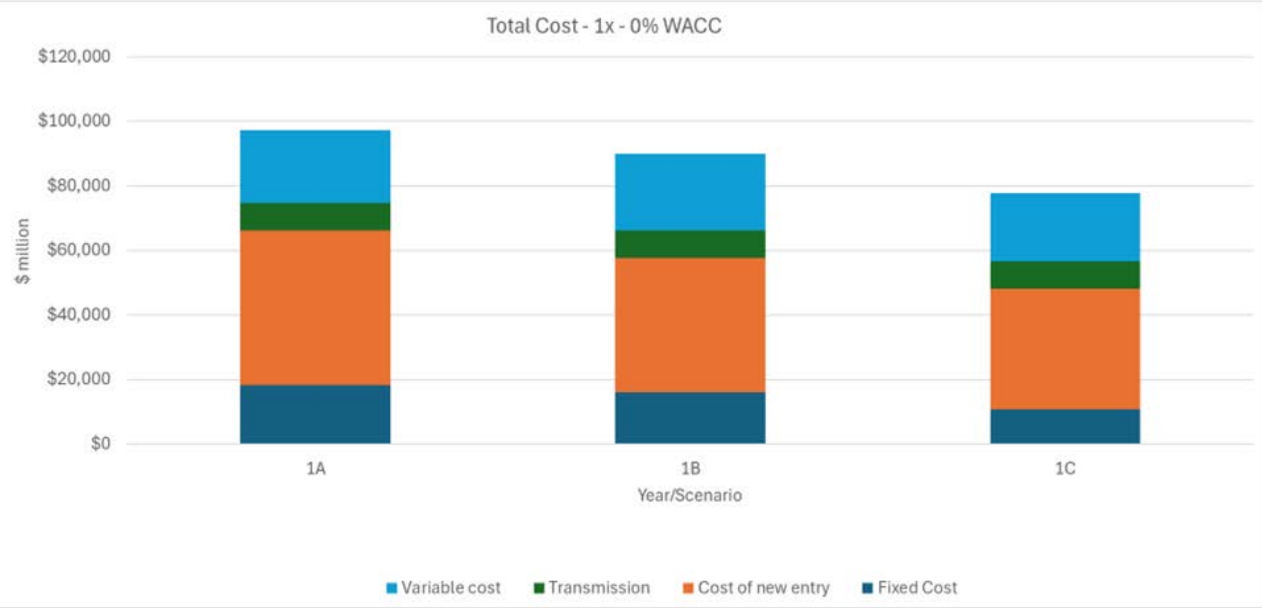
EPNR Project and modelling

- The purpose of the review is to consider whether the Pilbara Networks Rules (PNR) and Harmonised Technical Rules (HTR) are fit for purpose in a low-carbon future
- Context of current PNR:
  - Mostly vertically integrated participants with weakly interconnected, self-sufficient power systems
  - Gas generation is predominant
  - Transition to intermittent renewable generation plus firming is likely to require changes to the existing arrangements
- The project has been scoped for delivery in four stages (table below).
- This slide deck summarises the outputs of the Stage 2 modelling exercise
  - The EPNR modelling aims to provide insights into how the PNR will perform in different future states (with increased levels of renewable generation)

Project Delivery	Timeframes
Stage 1: Establish the Working Group	February 2024
Stage 2: Scenario development and modelling	March – July 2024
Stage 3: Assessment of PNR	July – Nov 2024
Public Consultation	Nov – Dec 2024
Stage 4: Implementation Plan	Q1 2025

Stage 2: Summary of modelling outcomes

- Scenarios were designed across two dimensions - sectoral drivers (#) and level of integration (a/b/c)
- Modelling results indicate significant system and operational cost savings can be achieved through increased integration. Chart indicates 20-30% lower costs in Scenario 1C in contrast to Scenario 1A
- Initial results indicate that a centralised balancing service would bring substantial savings when compared to self-procurement



Modelling indicates that:

- With high penetration of variable renewables, electricity users in the Pilbara will see significant cost efficiencies from more integrated operations
- Most of the benefit can be delivered by incremental change rather than a completely new paradigm

The Pilbara Networks Rules need to start describing requirements and obligations for a power system with more participants and more contracting between parties, to give confidence that all parties will meet their obligations to maintain power system security and reliability

2. Modelling approach and scenarios

Scenarios

Six core scenarios have been modelled, plus three sensitivity scenarios.

Scenarios are built on two dimensions while keeping the transmission build the same

1. Sectoral drivers:

- Reuse data from 2023 Pilbara Energy Transformation Assessment, including scenario demand assumptions and transmission build outputs
- Scenario 1x: CT - Current Trajectories
- Scenario 2x: CT+ - Current Trajectories + Loads (load from Strategic Industrial Areas - SIAs and CCS facilities)

2. Level of integration:

- Scenario nA: Current practices: self-capacity procurement, self-balancing
- Scenario nB: Partial integration: self-capacity procurement, central balancing service
- Scenario nC: Full integration: system-wide capacity procurement, system-wide merit-order dispatch

Sensitivity scenarios explore the effects of changes in assumptions around intermittent generation volatility, shape of the load duration curve, and emissions limits.

		Level of Integration		
		A	**B**	**C**
Sectorial drivers	**1**	1A	1B	1C
	2	2A	2B	2C

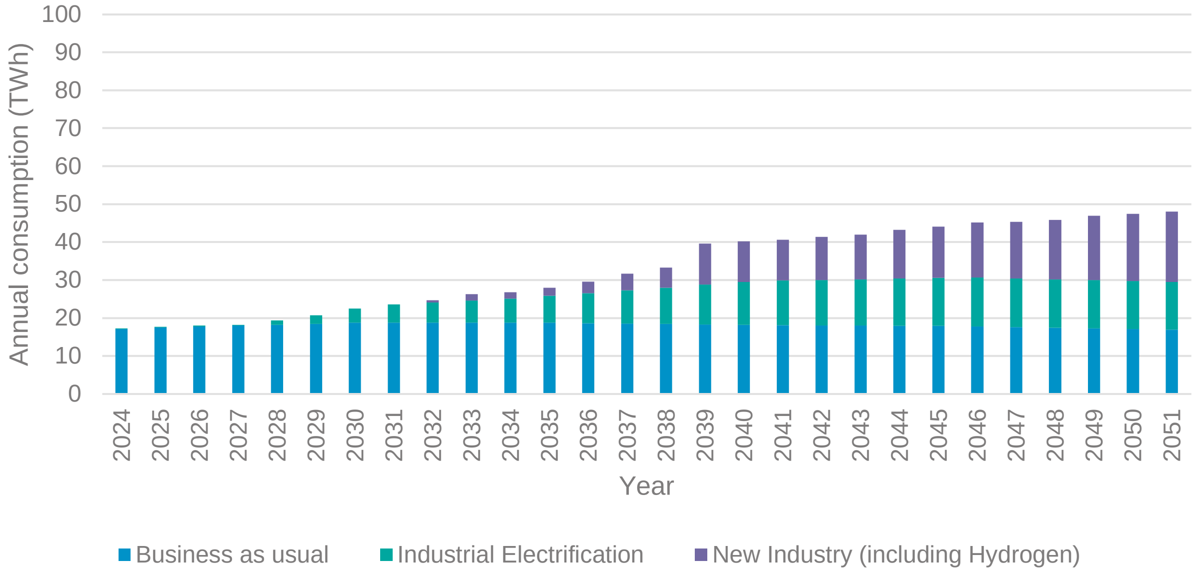
Differences between the scenarios

- None of the scenarios are achievable without new transmission build. Transmission build is assumed in the sectoral driver dimension, aligning with PETA outputs
  - Scenarios A, B, and C all have the same transmission assumptions, allowing us to focus on differences in generation build and operation. Capacity is built to avoid unserved energy within and across portfolios
- WEMSIM optimises dispatch across the entire power system based on cost minimisation with specified constraints
  - Status quo PNR - In scenarios 1A and 2A, each participant's load must be met from its own generation portfolio (whether owned or contracted). Sufficient capacity is built to avoid unserved energy
  - Partial integration - In scenarios 1B and 2B, participants still have their own generation portfolios, but the modelling assumes storage facilities can be used to meet any participant's load. This means less overall capacity is required, and more efficient overall dispatch
  - Full integration - In scenarios 1C and 2C build sufficient capacity to meet load and balancing services on a system wide basis and allow optimised dispatch across the whole system
- To manage solve time, these results cover every fifth year: 2025, 30, 35, 40, 45, and 50

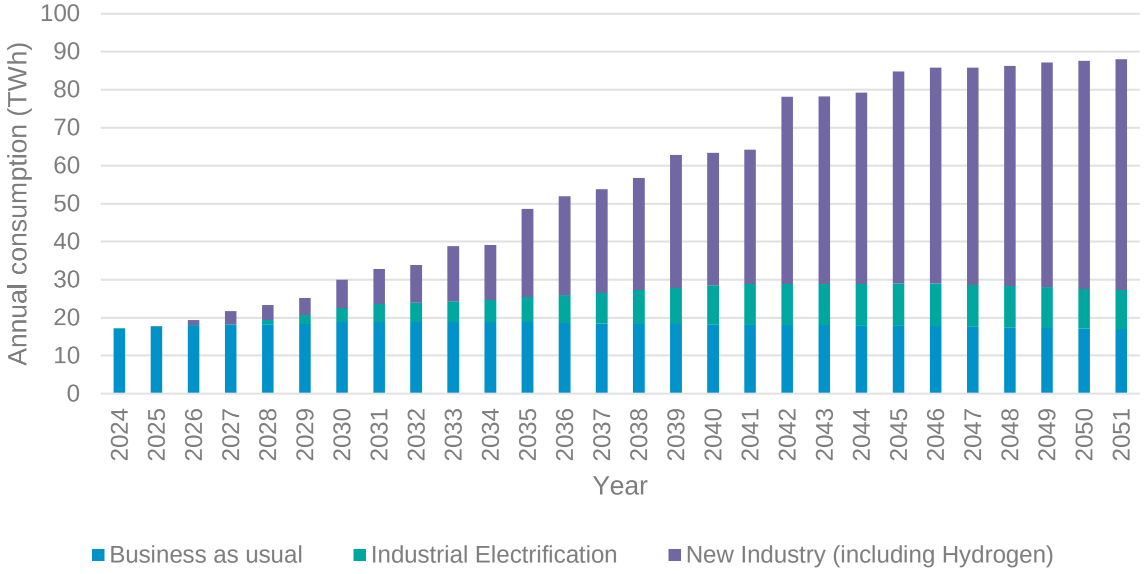
Representing the scenarios in the model (1)

Increasing volumes of non-vertically integrated demand, and potentially more flexible demand

Scenario 1 (CT)



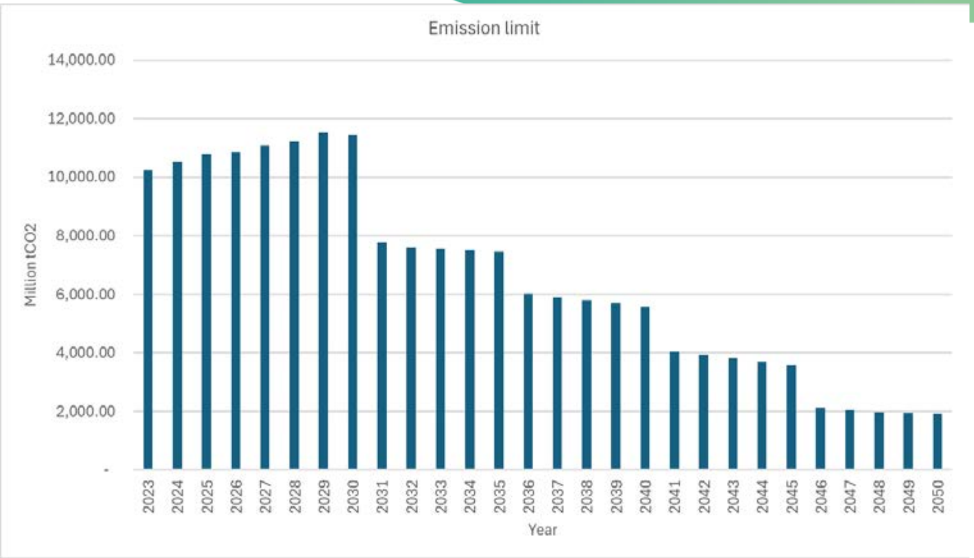
Scenario 2 (CT+)



Input assumptions are drawn from PETA modelling. New load comes from:

- CT: industry announced plans for decarbonisation. Mine haulage electrification, onside electricity at LNG plants, growth of lithium mining sector. Modest hydrogen export consistent with AEMO Step Change scenario.
- CT+: a portion of potential new industrial demand at the Maitland, Boodarie, Ashburton strategic industrial areas. CCS facilities for emissions in LNG and chemical sectors.

Representing the scenarios in the model (2)



Objective function: Lowest overall cost to meet

- Reliability (zero energy not served)
- Industry carbon emission targets (core scenarios reflect PETA 2023 inputs)

Costs

- Fixed & Variable Operation and Maintenance Cost
- Cost of new entry
- Supply cost (including fuel cost)

10% is added to temperature dependent load to approximate 10% POE demand

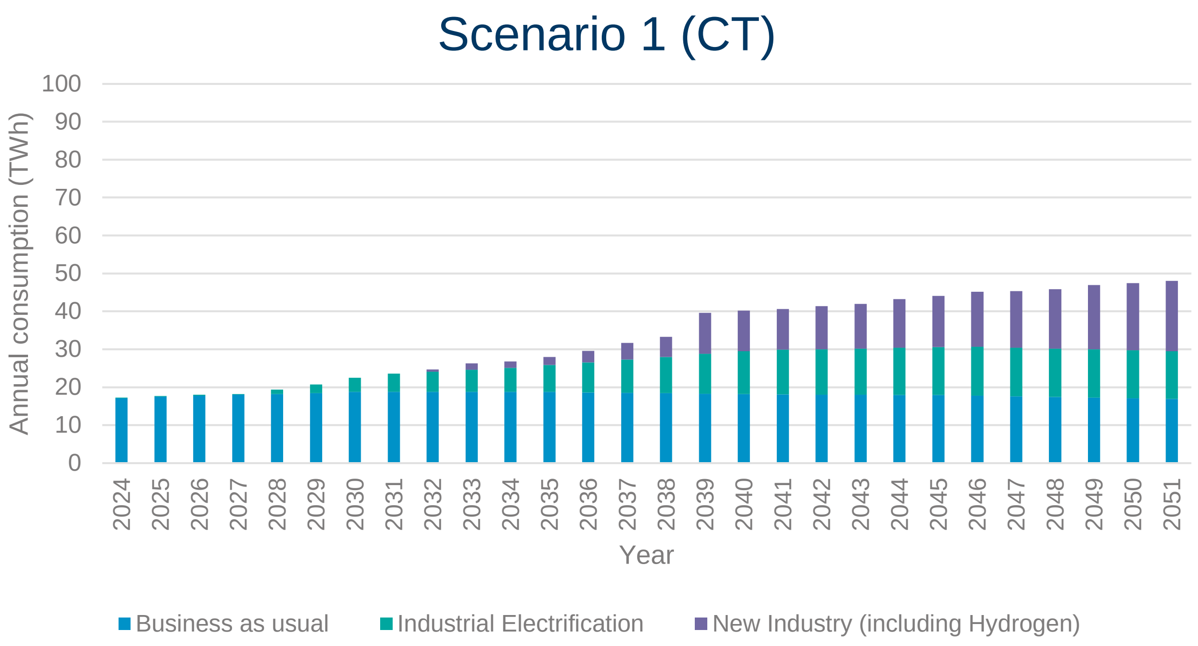
Transmission assumptions use specific scenarios from 2023 modelling, with the same transmission assumptions in each of A/B/C.

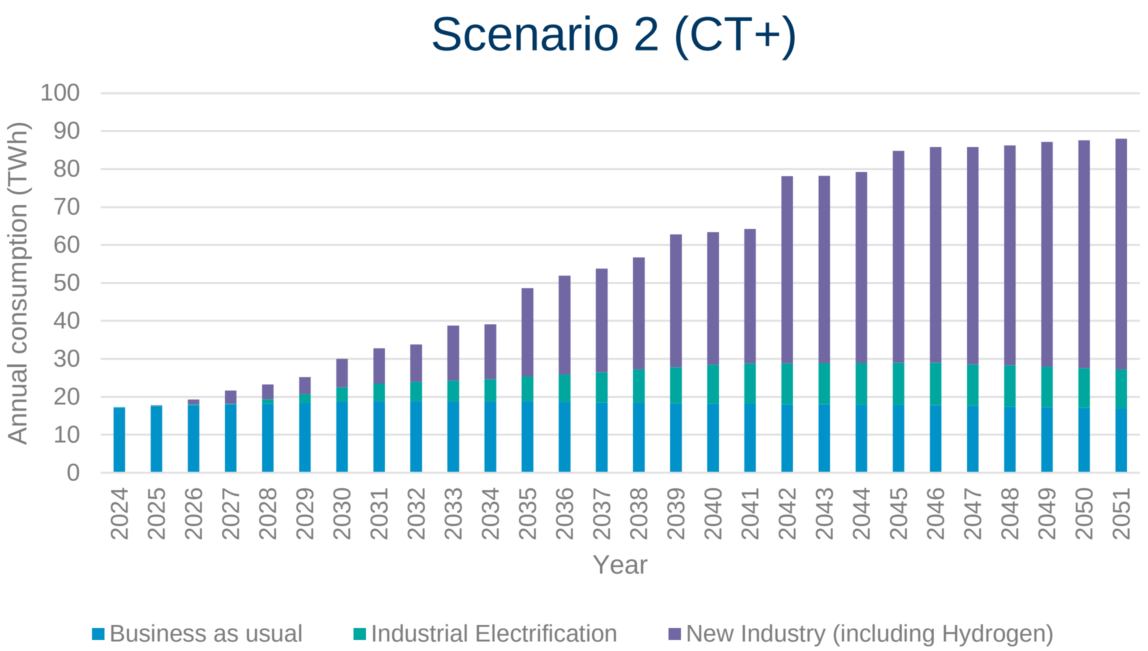
Integration Scenario	Transmission	Capacity
A	PETA "Current Trajectories – Semi Interconnected" transmission scenario	Portfolio capacity added to meet 100% of portfolio load
B		Portfolio capacity + system wide storage added to meet portfolio load
C		Capacity added to meet system-wide load

3. Demand insights

The type of load will change

Increasing volumes of non-vertically integrated demand, and potentially more flexible demand





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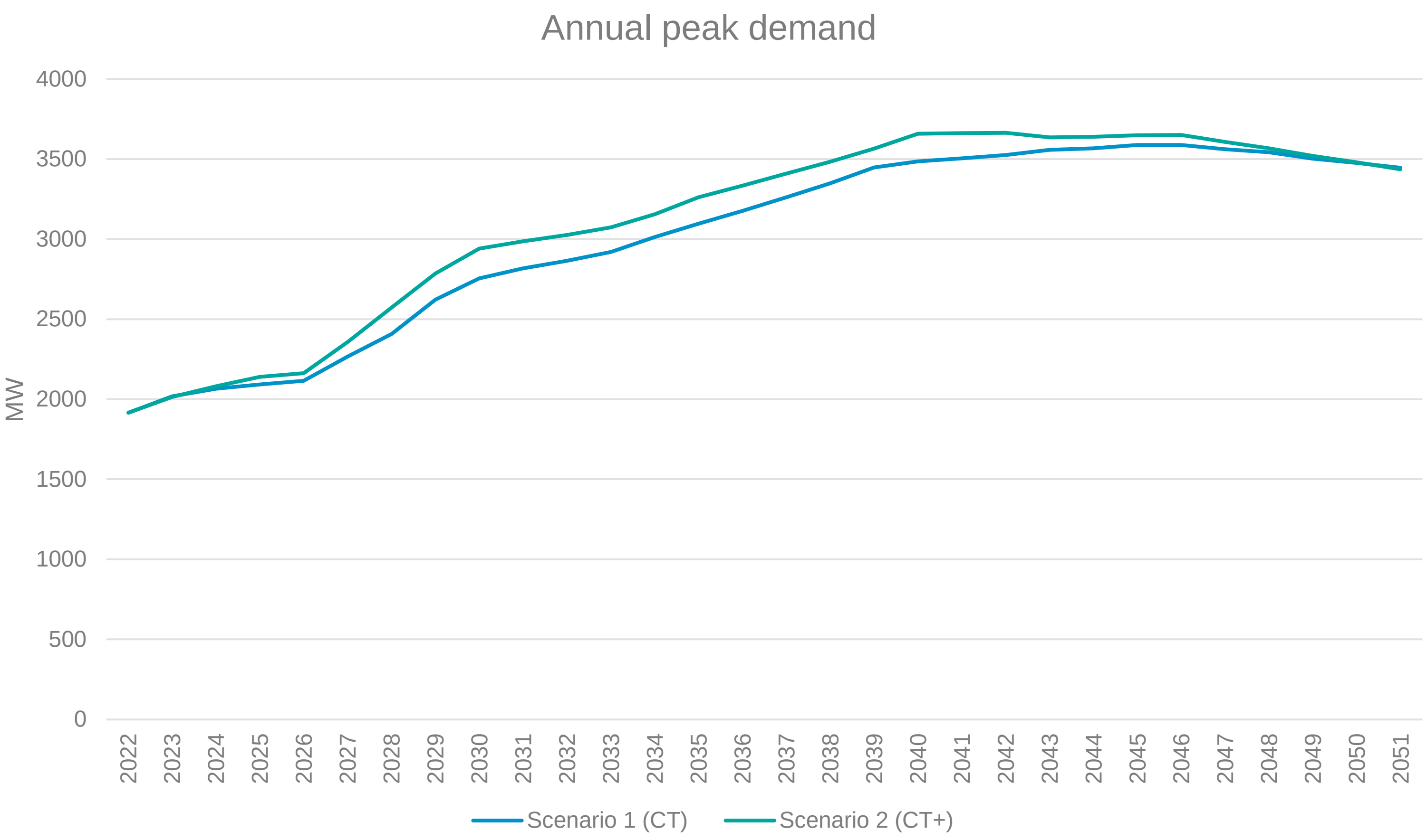
- CT+: a portion of potential new industrial demand at the Maitland, Boodarie, Ashburton strategic industrial areas. CCS facilities for emissions in LNG and chemical sectors.

The peak load will increase significantly…

Chart shows underlying operational peak demand excluding flexible load, for the whole modelled area.

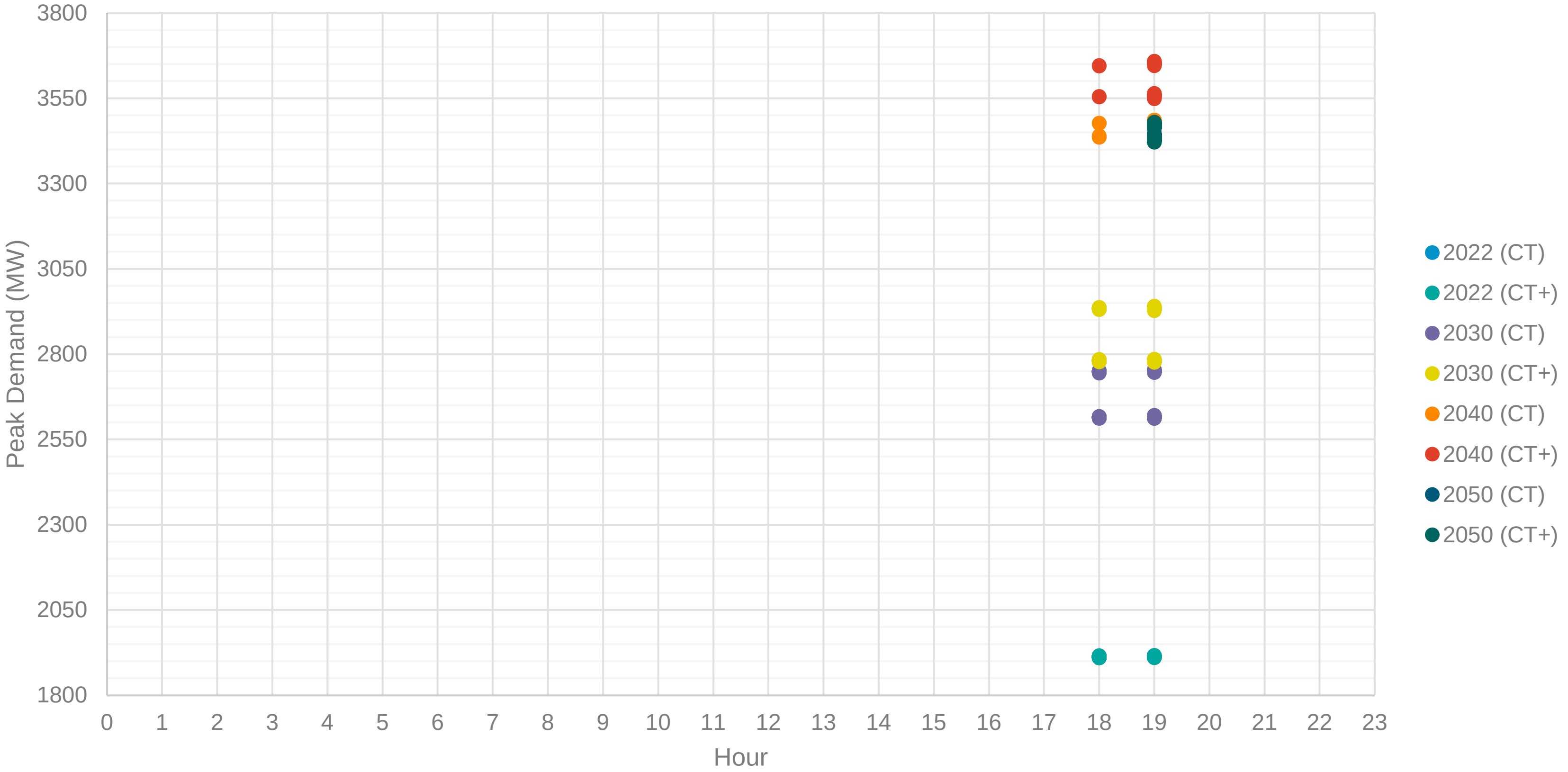


… but timing remains similar.

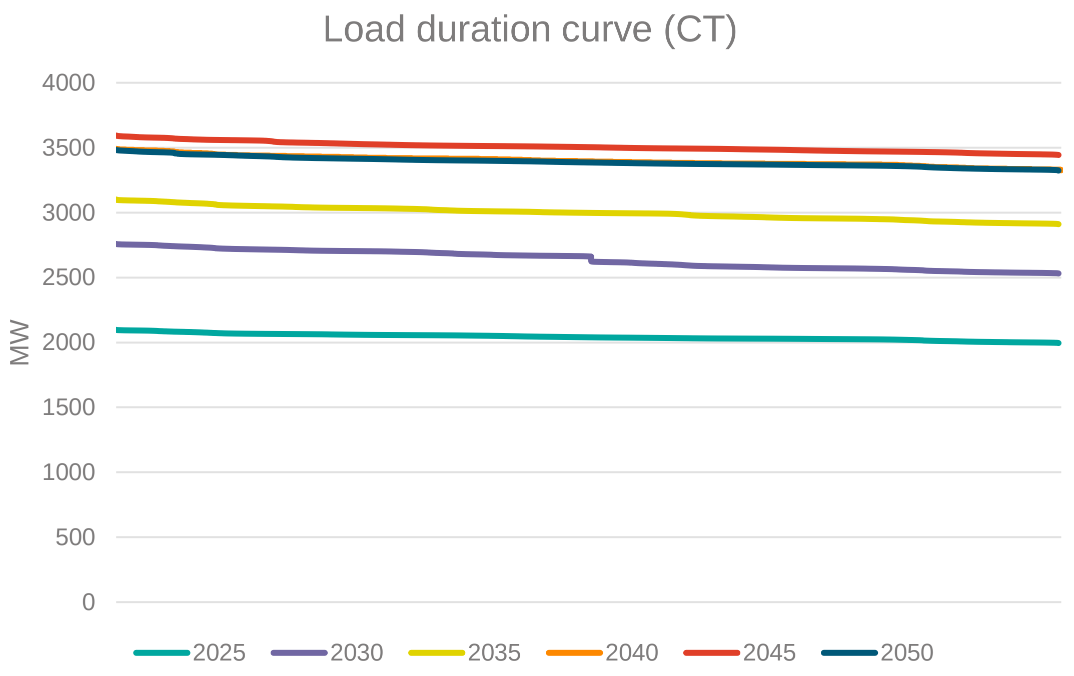
Minimal load volatility means minimal difference season to season.

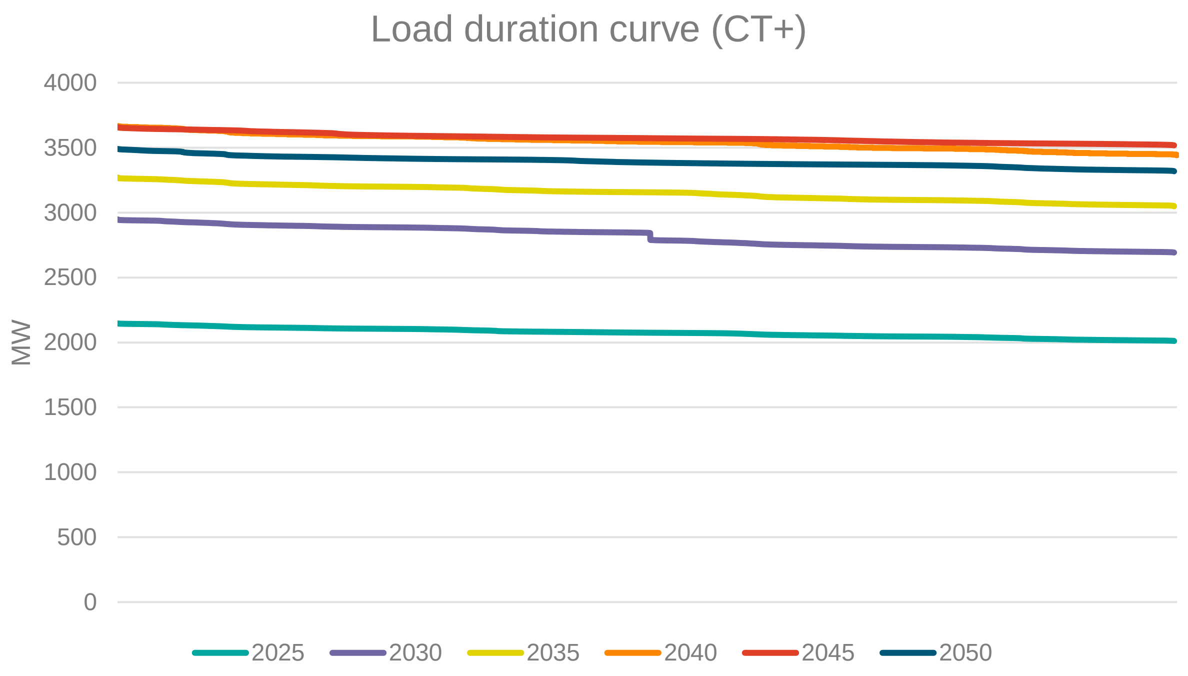
Timing of the peak remains in the early-mid evening.

Chart shows timing and magnitude of daily peak demands for selected years, for the whole study area.



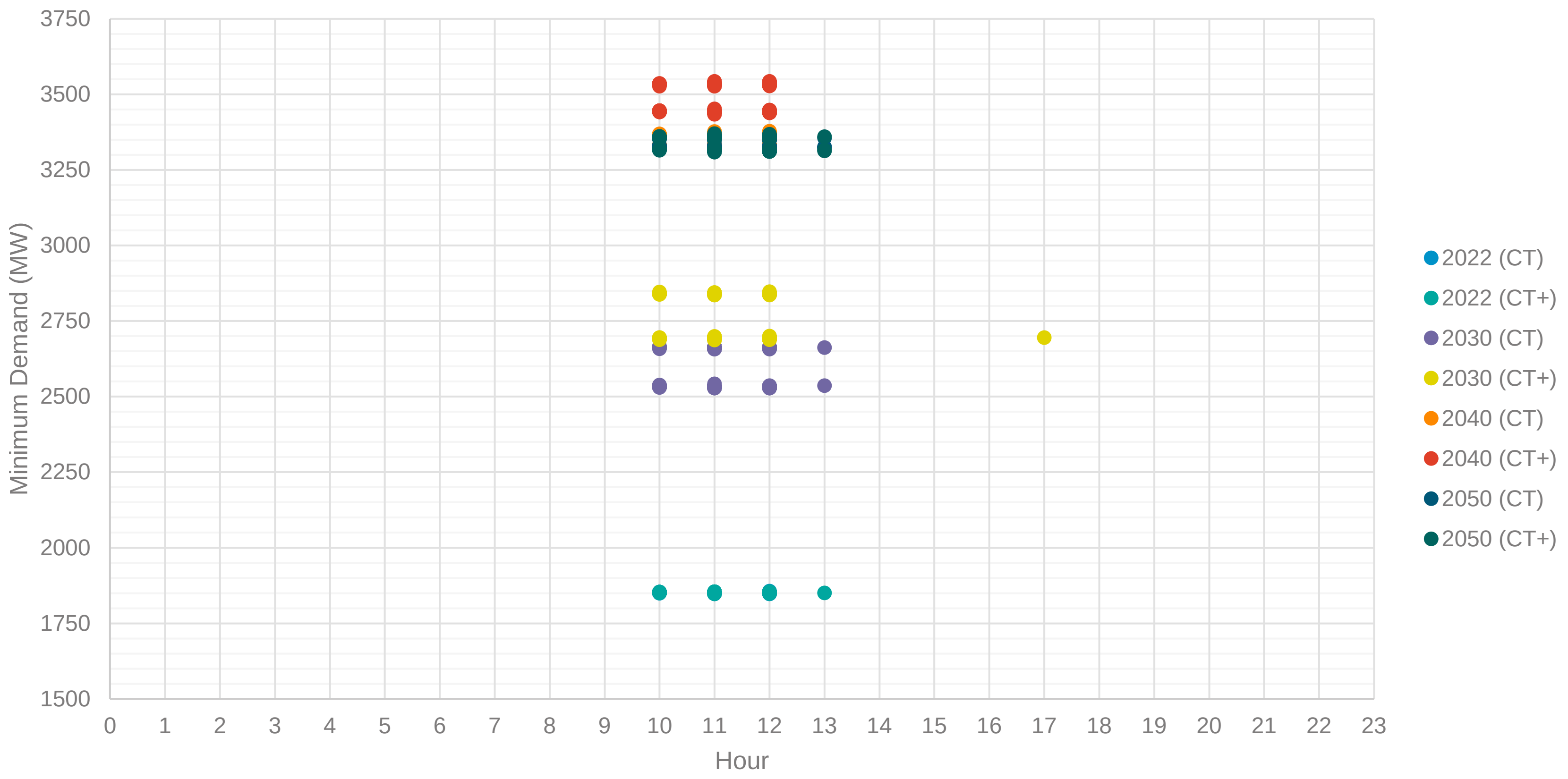
Underlying Load Duration Curve remains much flatter than other systems…





…so minimum demand is unlikely to be a problem

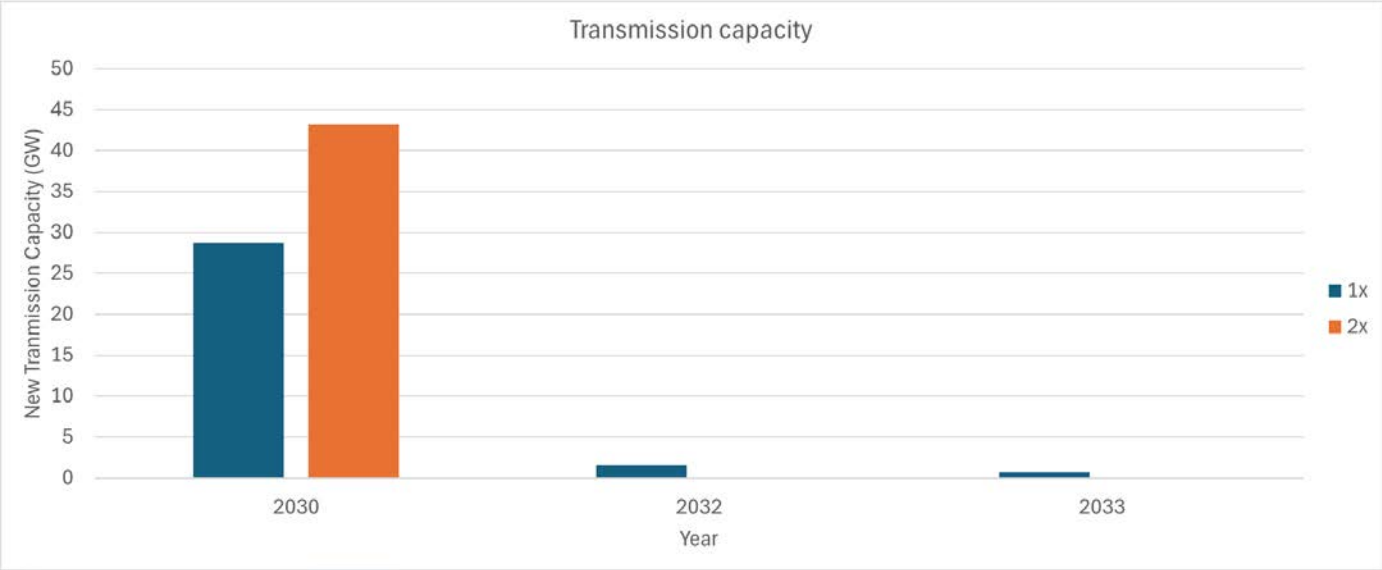
Chart shows timing and magnitude of daily minimum demands across the whole study area for selected years. The Pilbara has minimal temperature dependent load, and minimal uncontrolled non-utility scale solar, we do not see a “duck curve” in the underlying load.



4. Capital costs

Transmission Build

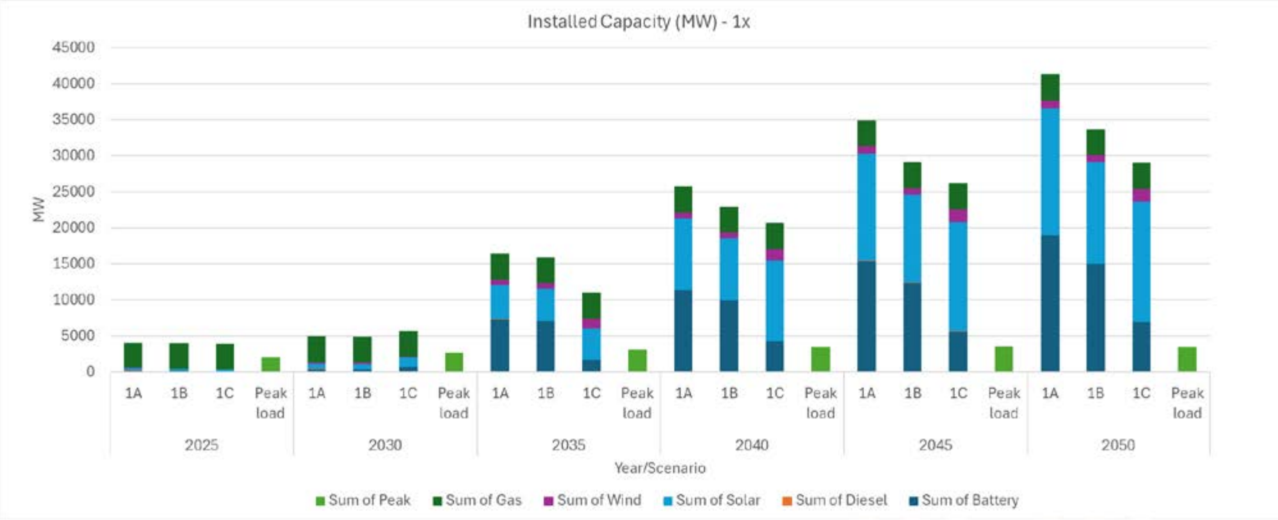
- We use the transmission build settings from the 2023 Pilbara Energy Transformation Assessment
  - Most transmission build coincides with the steep fall in the emission limit between 2030-2031 to accommodate new capacity
  - The 2x load scenario requires more transmission build to meet the higher industrial demand from SIAs and CCS
  - The transmission cost is 45% higher to accommodate the new builds for meeting the higher demand in 2x
- EPWA has commenced a refresh of the PETA modelling to further investigate transmission requirements and staging

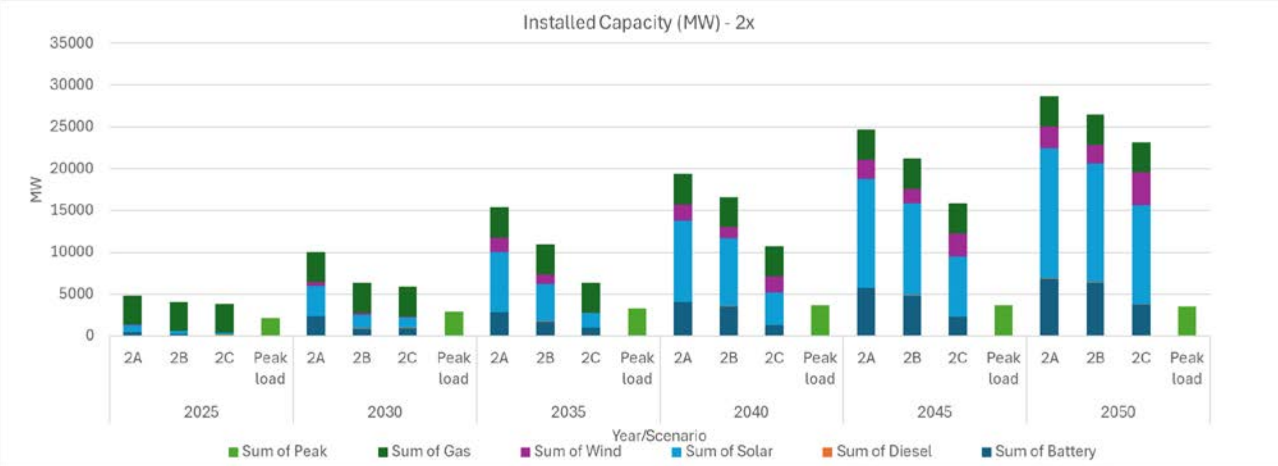


Load scenario	Transmission cost ($ million)
1x	$8,625
2x	$12,477

Generation Build

- In a high renewable future, significant overbuild is needed due to the intermittent nature of the facilities, and to meet the carbon emission targets
- The 2x scenarios have a greater proportion of new capacity coming from wind, enabled by the higher transmission build.
- Even though the overall demand is higher in the 2x scenarios, because there is more wind, the total installed capacity in the 2x scenarios is lower
- The fully integrated scenario (nC) requires less capacity when compared to nA and nB as resources are shared among the participants in the network
- Storage is integral in all scenarios to distribute intermittent capacity to other parts of the day and to provide firming capability to the system as gas facilities are restricted by emission targets



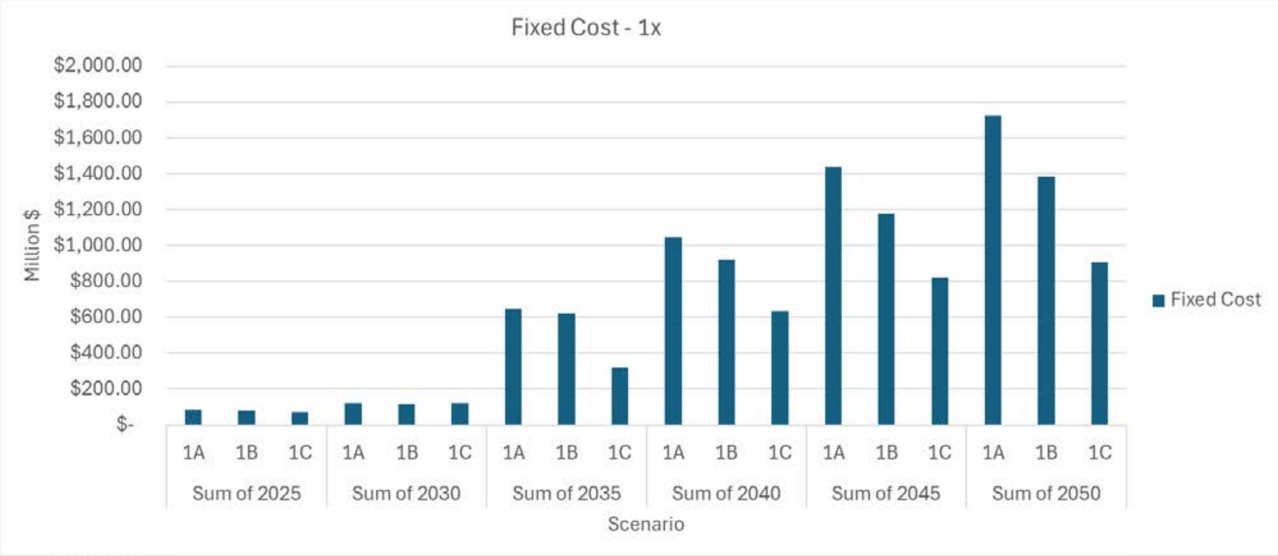


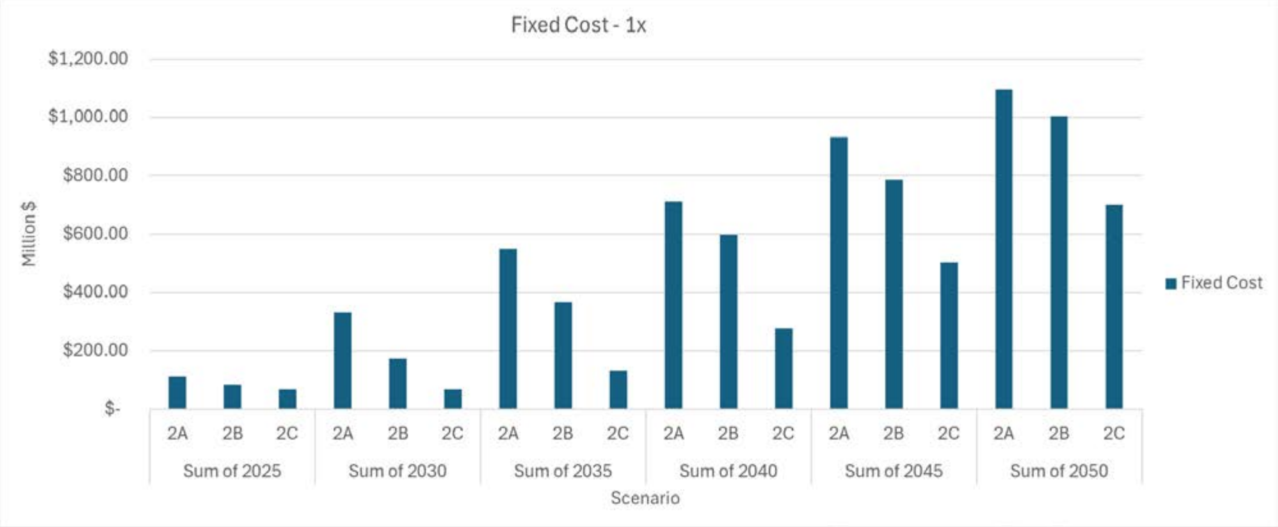
Note: The % of new capacity addition is based on PETA modelling data

Generation Build Cost

- The fixed cost is closely proportional to the installed capacity
- Build cost is higher for scenario nA, nB than nC as capacity is reserved to meet demand within the portfolio and this requires significant overbuild and leads to inefficient use of resources
- In terms of generation build cost, there is a potential to reduce 20-30% of the capacity cost by procuring capacity to meet reliability needs on a system-wide basis when compared to self procurement in both the sectoral driver scenarios

Scenario	Generation build cost (fixed + cost of new entry) (Million $)	
	1x	2x
1A	$ 66,175.59	$ 49,660.42
1B	$ 57,662.25	$ 40,719.94
1C	$ 48,103.63	$ 35,677.80

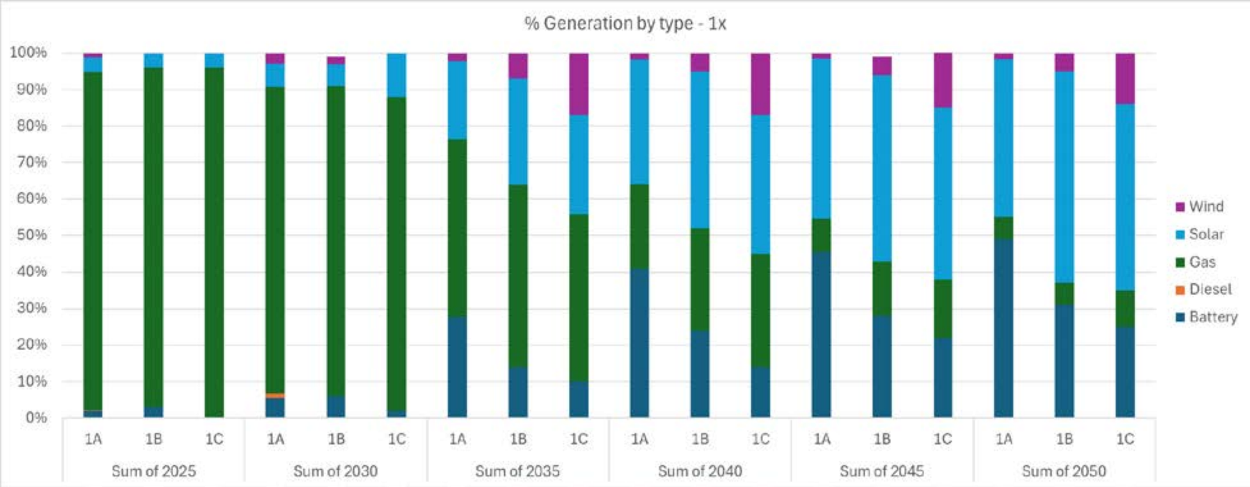


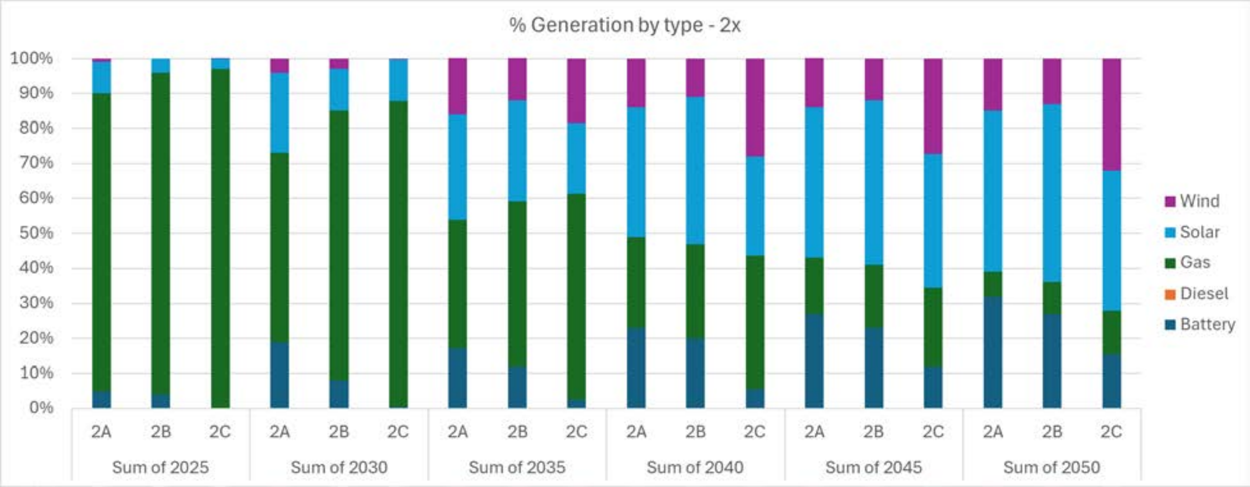


5. Operational costs

Generation dispatch

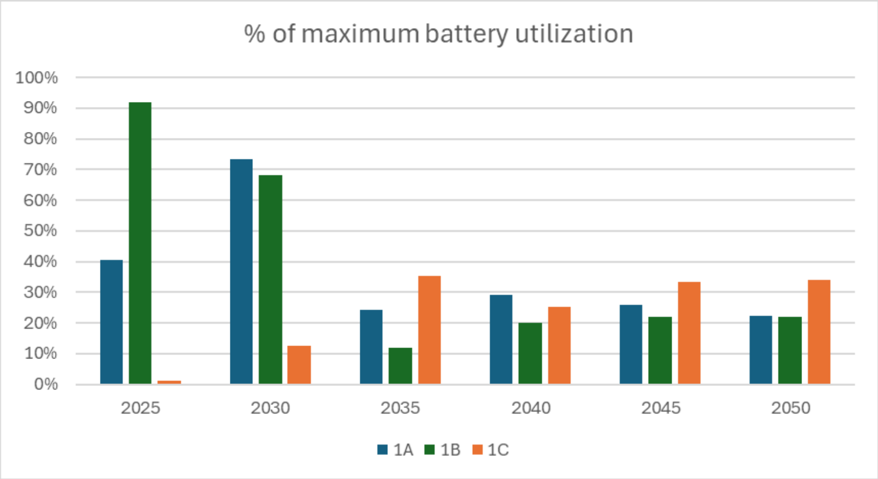
- Thermal generation drops steadily to meet the assumed emission targets
- Batteries remain integral to meeting load when the intermittent generation is low
- Higher installed wind capacity in 2x when compared to 1x leads to two outcomes:
  - Contribution of wind is higher in 2x because wind is available through out the day and can contribute during peak periods (evening)
  - Battery contribution is lower in 2x since wind can provide when solar cannot (evening and overnight)

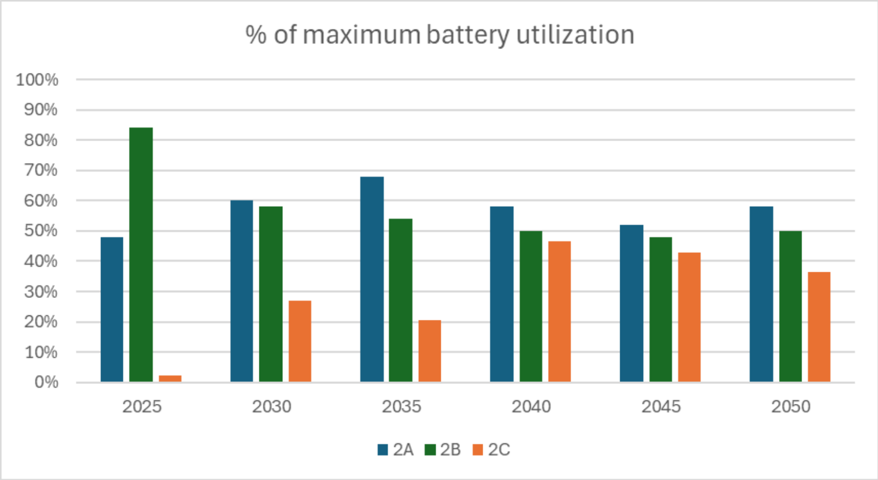




Battery utilization

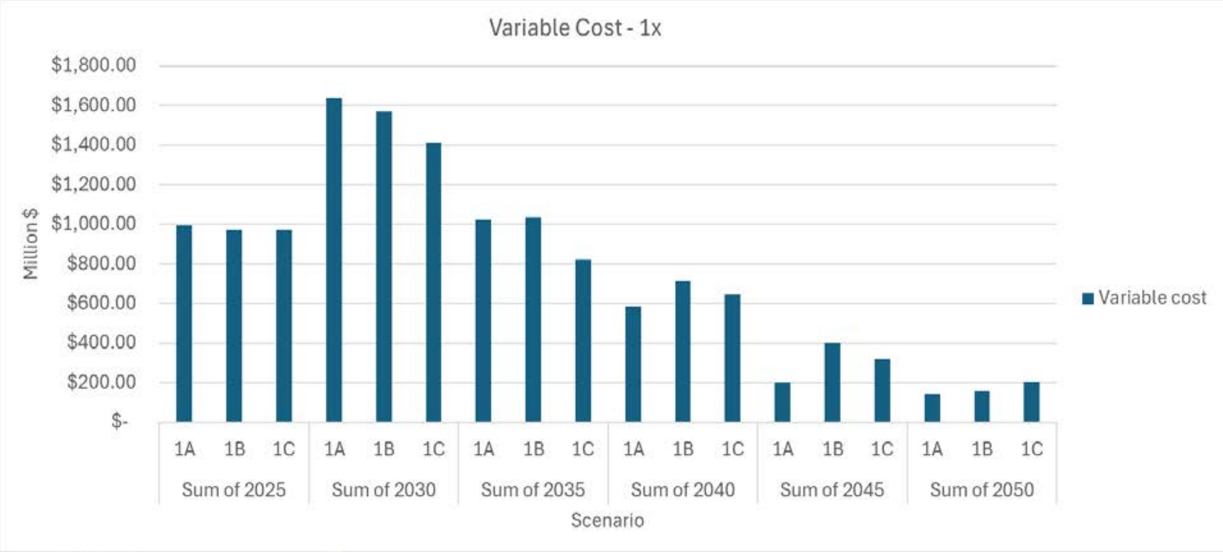
- The battery utilization depends on the capacity mix for the battery to charge effectively during off-peak periods and discharge during peak periods
- In early years, scenario 1A makes heavy use of a small amount of storage. In later years, storage is needed more sparingly (as renewable overbuild increases). Scenario 1C makes better use of a smaller quantity of storage to deliver a smaller overall quantity of energy
- In scenario 2x, battery is used less since the amount of wind in the fleet is high.





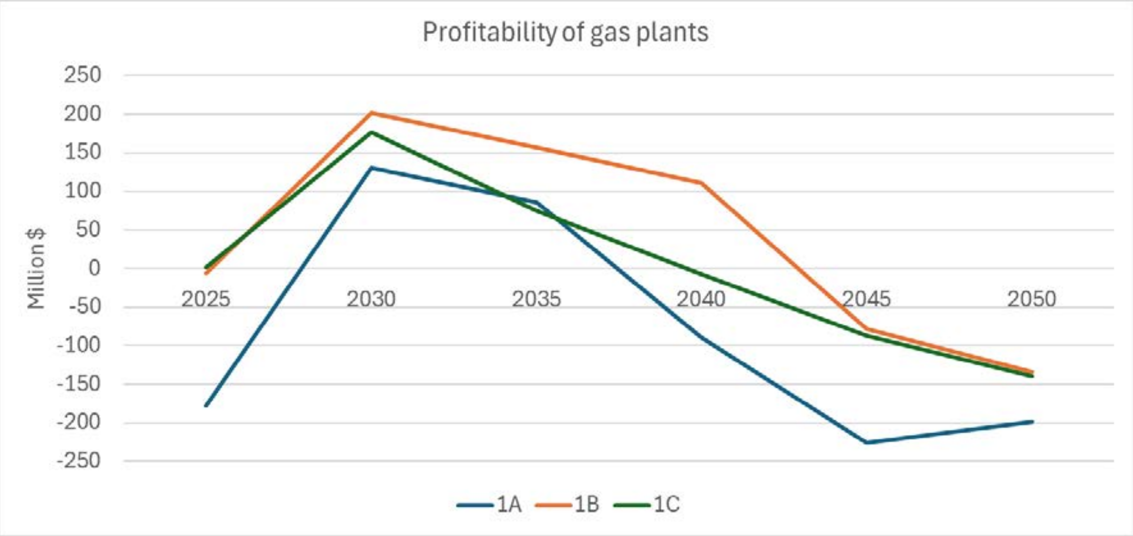
Generation Cost

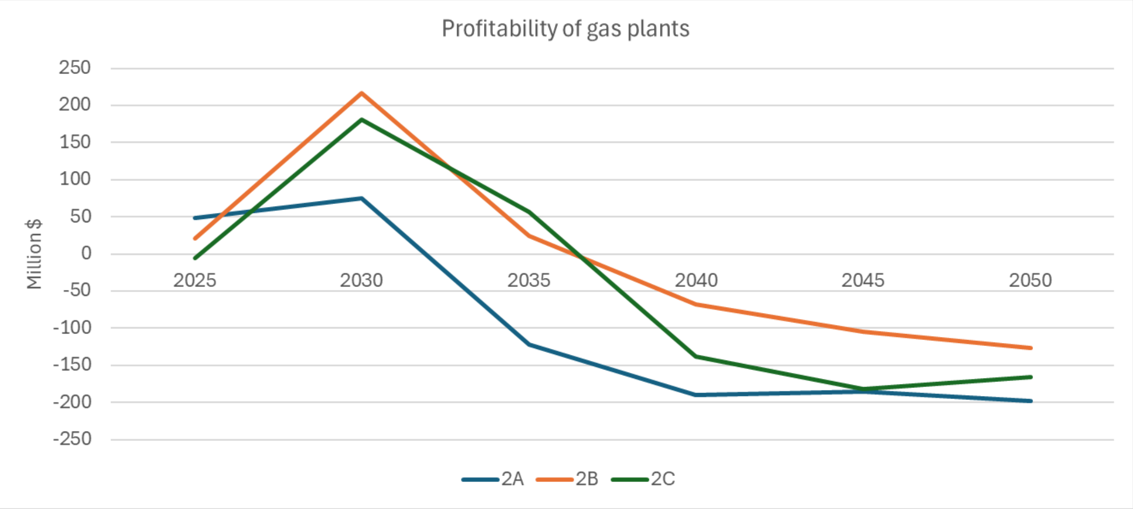
- Variable cost tracks with gas usage. Storage and variable renewables run at $0 variable cost, so variable costs closely relate to gas generation
- In later years, scenarios 1B and 1C have slightly higher variable cost, matching the slightly higher gas usage. Less overbuild translates to greater profitability
- In 2x scenarios, as the contribution of wind increases, the amount of overbuild is less and replaces gas usage.



Gas build profitability

- In all scenarios, gas profitability drops from 2030 as the transmission lines are built leading to delivery of wind and solar facilities from the Renewable Generation Hubs.
- By 2040/2045, gas facilities become unprofitable in all scenarios.



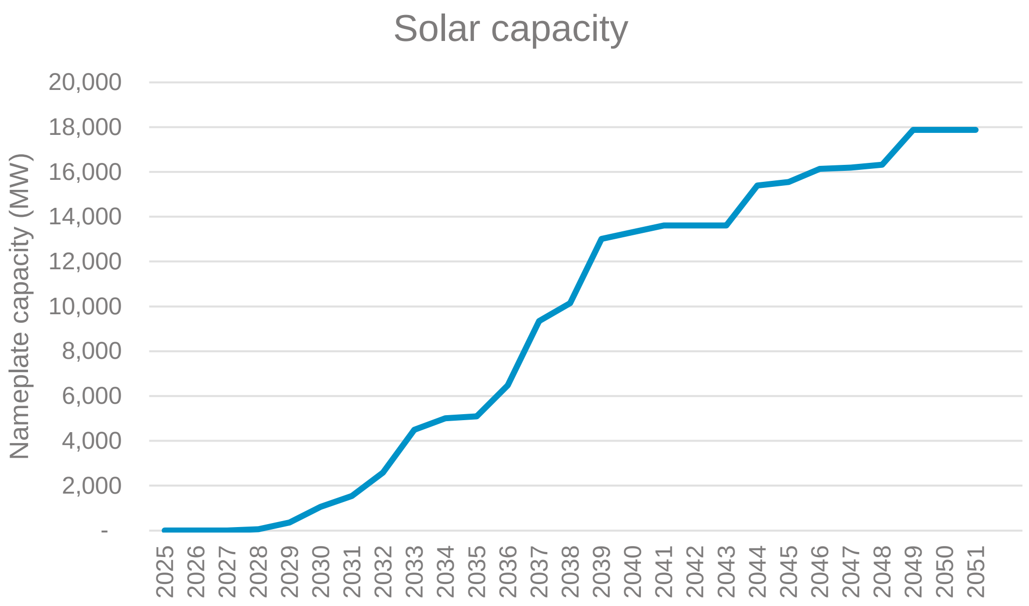


The largest contingency will be intermittent volatility

The largest credible contingency in the NWIS today is around 60MW.

In the future, the largest contingency on the system will be sudden loss of output from intermittent renewable facilities.

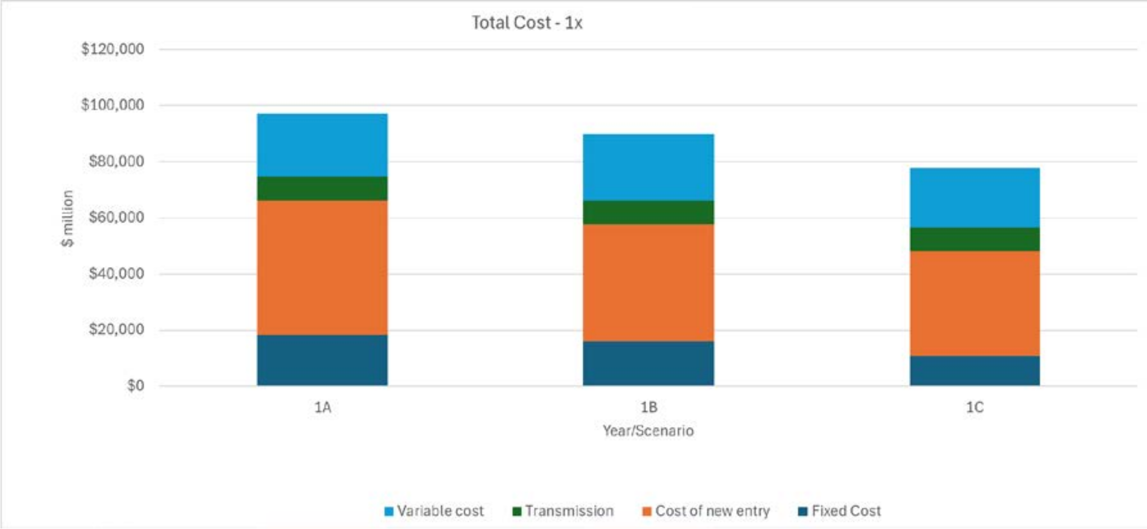
In the SWIS, over a half hour trading interval, unpredictable output changes have reached 20% of installed solar capacity.

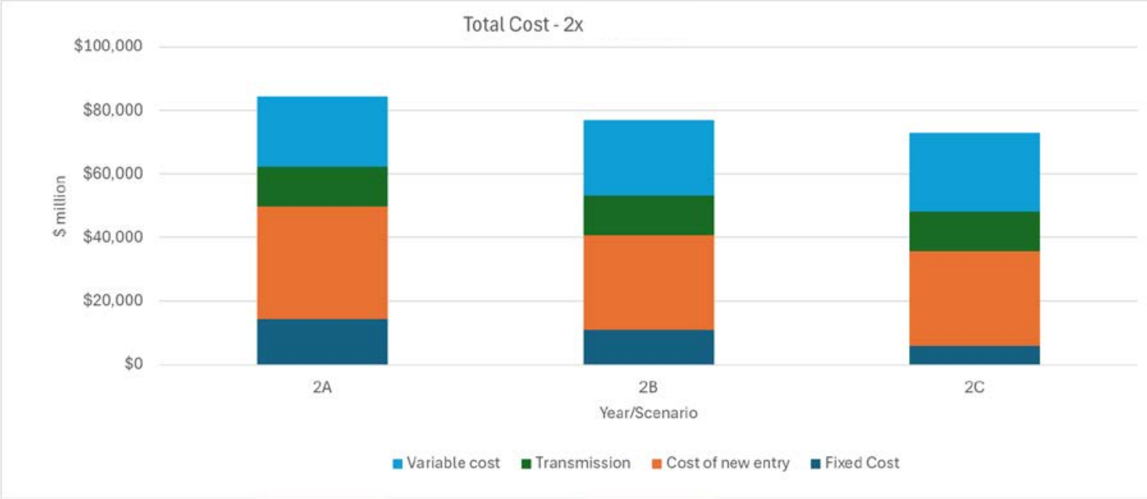


6. Overall costs

Total cost

- Scenario nC has overall cost around 17% less than scenario nA including capacity build to 2050, and operational costs for the six years modelled
- The total cost of 2x is less than 1x because of higher wind build.
- System-wide capacity procurement provides substantial savings when compared to current practices of self procurement
- Scenario nB indicates that a large centralised balancing service would bring substantial savings when compared to self-procurement
- In later years, generation costs are slightly higher with system-wide capacity procurement, but this is outweighed by the reduced capacity investment cost





Modelling outcomes

Modelling indicates that:

- High renewable penetrations are achievable once transmission investment unlocks access to renewable energy zones
- With high penetration of variable renewables:
    - The current approach to assessing system reliability will no longer be effective
    - Generation volatility means ancillary services must be revisited
    - Electricity users in the Pilbara will see significant cost efficiencies from more integrated operations
- Changes can be delivered incrementally rather than a completely new paradigm

The Pilbara Network Rules need to start describing requirements and obligations for a power system with more participants and more contracting between parties, to give confidence that all parties will meet their obligations to maintain power system security and reliability

Implications for the PNR

The largest benefits come from:

- Having more centralised services – starting with balancing, and potentially moving to full merit-order dispatch later
- Applying reliability standards on a whole-of-system basis, where individual network owners still have the option to build or contract dedicated capacity

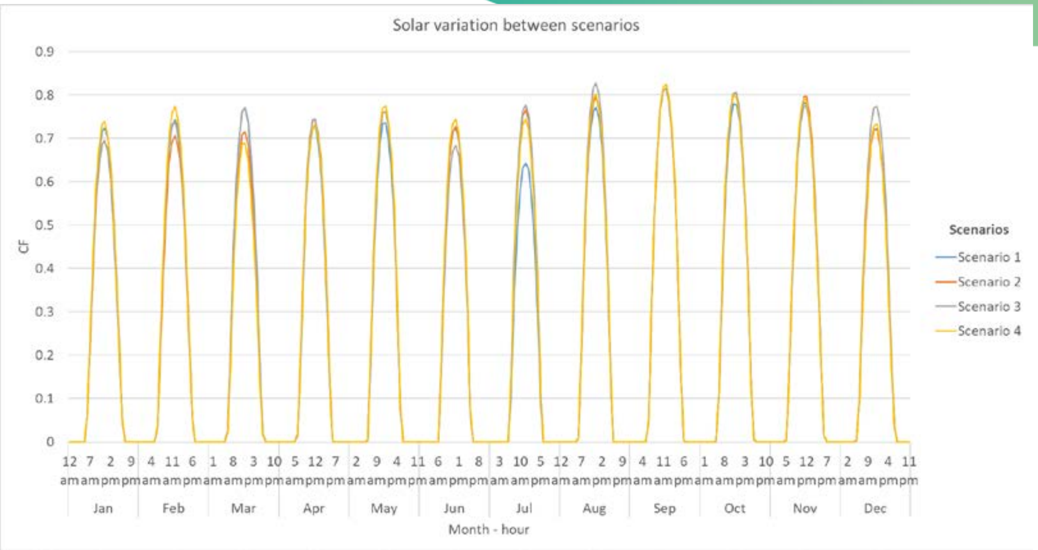
To unlock these benefits, the PNR need to:

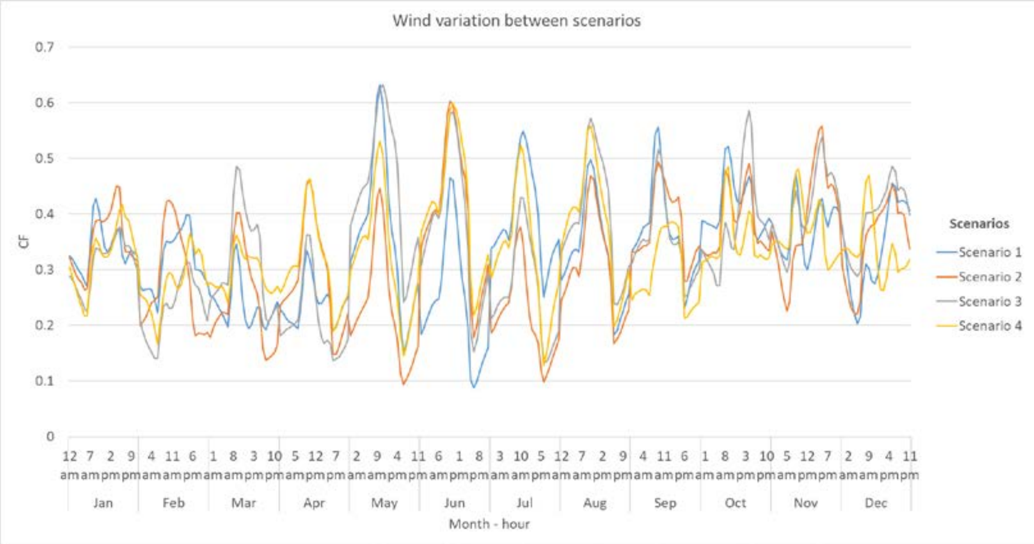
1. Provide a mechanism for greater operational integration, timed to commence alongside the transmission investment that enables renewable investment. This includes:
    - Monitoring and intervention power for the ISO
    - Amended load following rules
    - Adjustments to ESS definitions to manage reduced load-following requirements and increased renewable energy penetration
2. Include a formal reliability definition and target (whether for individual networks or for the system as a whole)
3. Provide a transparent mechanism for collaborative long-term planning

7. Sensitivity Analysis

Sensitivity 1 – Intermittent variation

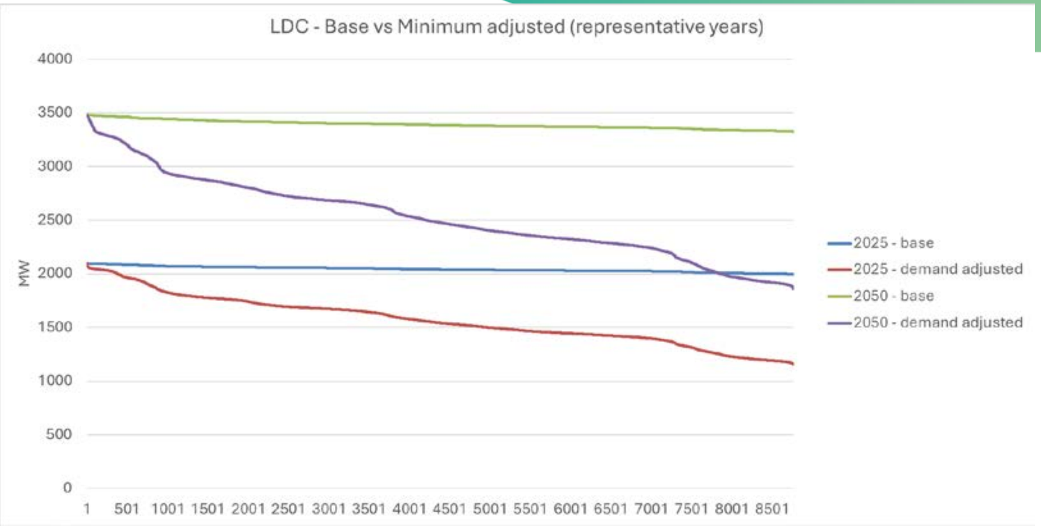
- Based on the data provided, the intermittent pattern cycles every four years to account for the El Nina phenomenon.
- This sensitivity run is to analyse the effects of variation in the intermittent pattern (the base model – 1A uses the average).
- There is very little variation in the solar profile, but wind is more widely dispersed.
- Since the capacity of wind in the fleet is much lesser compared to solar, the capacity needed to meet in the demand in each of the scenarios do not make a substantial difference.

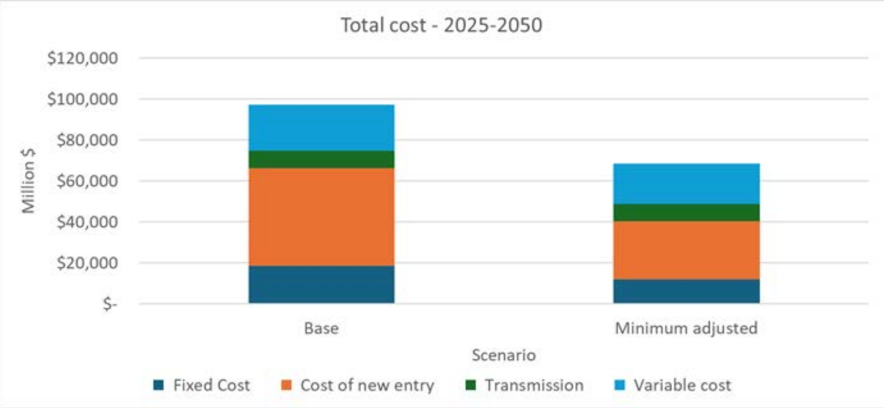


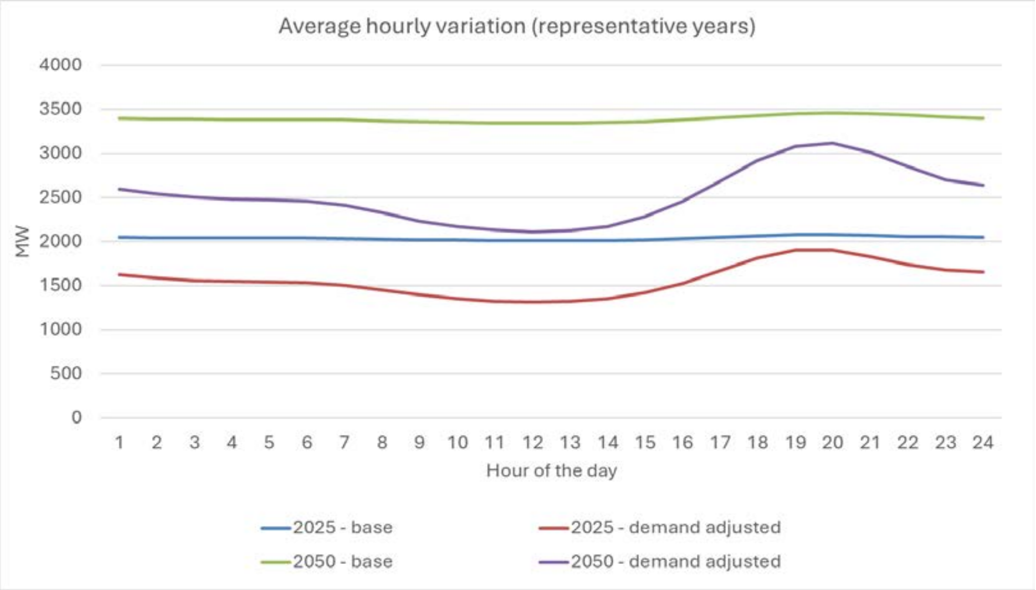


Sensitivity 2 – Demand variation

- The base demand (1A) profile is flat because most of the load is industrial.
- This sensitivity explores load profile with more variation in the load. The minimum demand is adjusted to be around 50% of the maximum demand for every year modelled.
- The capacity required to meet demand is much lower than the base case because of the drop in demand (mainly during off peak hours) when batteries are needed.
- The total cost reduces by 30% when the demand drops.







Sensitivity 3 – Emissions limits

- This sensitivity explores effect on the total cost if more stringent emission targets are imposed. The targets remain the same until 2030 and the revised target gradually reduces to 20% of the base by 2050.
- This limits the use of gas and diesel in the market necessitating the requirement of more alternative sources.
- The comparison provides two observations:
    - the system makes efficient use of batteries but still requires more solar and wind to charge up the batteries to make up for the lost gas capacity.
    - The variable cost drops because of less gas usage.
- The total cost increases by 5% when the targets are tighter because of higher installed capacity.