AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Draft 2024 Forecasting Assumptions Update

December 2023

Draft report for consultation

For use in the 2024 National Electricity Market Reliability Forecast

Important notice

Purpose

AEMO publishes this Draft 2024 Forecasting Assumptions Update pursuant to National Electricity Rules (NER) 4A.B.1(e) and in accordance with the Australian Energy Regulator's Forecasting Best Practice Guidelines (FBPG). This report includes information on updated assumptions to apply in the Reliability Forecast (or other publications, as named in this report, for the National Electricity Market (NEM).

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AEMO has made reasonable efforts to ensure the quality of the information in this publication but cannot guarantee that information, forecasts and assumptions are accurate, complete or appropriate for your circumstances.

Modelling work performed as part of preparing this publication inherently requires assumptions about future behaviours and market interactions, which may result in forecasts that deviate from future conditions. There will usually be differences between estimated and actual results, because events and circumstances frequently do not occur as expected, and those differences may be material.

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Version control

Version	Release date	Changes
1.0	21/12/2023	Initial release

AEMO acknowledges the Traditional Owners of country throughout Australia and recognises their continuing connection to land, waters and culture. We pay respect to Elders past and present.

Contents

Tables

Figures

Executive summary

AEMO delivers a range of forecasting and planning publications for the National Electricity Market (NEM), including the *Integrated System Plan* (ISP). Key inputs and assumptions for the ISP are published at least biennially as part of the *Inputs, Assumptions and Scenarios Report* (IASR). The most recent IASR, used in support of the Draft 2024 ISP, is the 2023 IASR.

This report therefore complements the 2023 IASR, and uses the latest information available to update assumptions specifically relevant to near-term demand forecasting for the 2024 *Electricity Statement of Opportunities* (ESOO) for the NEM. It also includes updates from CSIRO's annual draft GenCost publication to allow for consultation on proposed updates in technology cost trajectories to inform that publication.

When finalised, this report will update a selection of the 2023 IASR inputs and assumptions set to incorporate updates in market data and associated forecasts relevant to the development of the 2024 ESOO.

Notice of Consultation: Invitation for written submissions

Consultation on these updated inputs is following the single stage consultation process in accordance with Appendix B of the Australian Energy Regulator's (AER's) Forecasting Best Practice Guidelines.

Stakeholders are invited to provide a written submission to the questions outlined in this draft 2024 Forecasting Assumptions Update (Assumptions Update), and on any other matter related to the updated assumptions. Submissions need not address every question posed and are not limited to the specific consultation questions contained in each chapter.

Submissions should be sent via email to forecasting.planning@aemo.com.au and are required to be submitted by 9 February 2024. AEMO is not obliged to consider any submissions received after the closing date. AEMO requests that, where possible, submissions should provide evidence that support any views or claims that are put forward.

The 2024 forecasting scenarios

As outlined in the 2023 IASR, AEMO uses a scenario planning approach to its primary forecasting and planning functions, including for the ESOO. The current planning scenarios represent three distinct and internally consistent futures that explore a range of plausible future conditions affecting the NEM and Australia's east coast gas system, including on key energy sector inputs such as the growth in demand for electricity, and in decentralisation as business and household consumers progressively transition to managing their own energy. The scenarios are *Green Energy Exports*, *Step Change*, and *Progressive Change*.

All of the scenarios consider various energy policies that:

- are (or are anticipated to be) sufficiently progressed to meet the requirements within the National Electricity Rules (NER) for consideration in the 2024 ISP; and/or
- are listed in the Australian Energy Market Commissions's (AEMC's) *Emissions Targets Statement*.

The details of these policies are contained within the 2023 IASR and the rationale for their inclusion is further detailed in the Addendum to the IASR (section 2).

The following Table 1 acknowledges policy developments since the 2023 IASR, and notes where they may influence the 2024 ESOO.

Table 1 New policies implemented or considered since the 2023 IASR

Policy	Brief description	Status	Influence on 2024 ESOO
Victoria's Gas Substitution Roadmap[A]	New homes requiring a planning permit will be required to be all-electric from 1 January 2024. This means new homes and residential subdivisions that require a planning permit cannot connect to the gas network.	Policy included in the AEMC's Emissions Targets Statement[B]	Electrification forecast
National Electric Vehicle Strategy and Fuel efficiency standard[C]	Implementing initiatives from the Strategy will make it easier to charge an electric vehicle (EV), reduce emissions and make EVs more affordable for Australians. Initiatives also focus on reducing the costs to Australians running their vehicles and expand EV availability and choice with a larger range of EVs.	Consultation and submissions in progress	Electric vehicle forecast

A. See https://www.energy.vic.gov.au/renewable-energy/victorias-gas-substitution-roadmap.
B. See Section 2: Targets likely to contribute to reducing Australia's greenhouse gas emissions, at https://www.aemc.gov.au/sites/default/files/2023-09/AEMC%20Emissions%20targets%20statement%20-%20final%20guide%20September%202023.pdf.
C. See https://www.dcceew.gov.au/about/news/australias-first-national-electric-vehicle-strategy and https://www.dcceew.gov.au/about/news/australians-support-new-fuel-efficiency-standards.

Summary of updated assumptions

This draft Assumptions Update and associated draft 2024 *Forecasting Assumptions Update Workbook* (the Updated Assumptions Book) incorporates updates in data and forecasts, with particular focus on inputs of relevance to AEMO's 2024 reliability forecasts.

It confirms the status and update process of some forecast components that use the latest actual data prior to applying scenario-based assumptions. Updated data inputs have provided for minor updates affecting distributed photovoltaics (PV), distributed battery storage, participation in Virtual Power Plants (VPP), and Electric Vehicles (EVs).

It also provides updated assumptions for generation technology costs (as incorporated in the draft 2023-24 GenCost report, led by CSIRO).

Next steps

Details on how to get involved in the consultation process are provided on AEMO's website[1].

AEMO may identify engagement opportunities for stakeholders during the consultation period. Following the receipt of submissions by **9 February 2024**, there will be opportunities for engagement on inputs and assumptions, outlined throughout this report.

[1] At https://aemo.com.au/consultations/current-and-closed-consultations/2024-consultation-on-forecasting-assumptions-update.

1 Introduction

AEMO produces several publications that use a detailed set of inputs, assumptions and scenarios that are detailed in *the Inputs, Assumptions and Scenarios Report* (IASR). These publications include the *Electricity Statement of Opportunities* (ESOO), the *Gas Statement of Opportunities* (GSOO), and the *Integrated System Plan* (ISP). These publications complement each other, providing reliability and adequacy assessments of the electricity and gas systems, as well as a broader roadmap for the energy transition in the National Electricity Market (NEM) for secure, reliable and affordable energy, and to achieve net-zero emissions targets .

AEMO uses a scenario planning approach to investigate various uncertainties facing the energy sector, to assess supply adequacy, and to identify the economically efficient level of infrastructure investment necessary to support the future energy needs of consumers in presence of uncertainty, and the risks of over- or under-investment. The assumptions within the scenarios are updated in two publications. The first is the IASR, most recently published in July 2023. It informs the development of the draft and final 2024 ISP, and the 2024 GSOO.

The second document, this draft 2024 *Forecasting Assumptions Update* (Assumptions Update), outlines several updated inputs to be applied in the reliability forecast in the 2024 ESOO. This update meets AEMO's requirements to disclose and consult on basic inputs, and assumptions that underpin the reliability forecasts for the ESOO, in accordance with the principles of the Australian Energy Regulator's (AER's) Forecasting Best Practice Guidelines (FBPG).

The information in this report is supported by the draft 2024 *Forecasting Assumptions Update Workbook* (the Updated Assumptions Book)[2], which provides more granular detail for the inputs and assumptions that have changed since the 2023 IASR.

1.1 Forecast components

Table 2 below lists the forecasting components relevant to the 2024 ESOO, and their stakeholder engagement opportunities. AEMO will use the Forecasting Reference Group (FRG)[3] primarily for additional engagement opportunities; if any other engagement activities are scheduled, these will be identified in the Draft Assumptions Update consultation page[4].

The FRG is an open, monthly forum with AEMO and industry's forecasting specialists that is used to validate assumptions, share expertise and explore new approaches to addressing the challenges of forecasting in a rapidly changing energy industry. Stakeholder engagement in this forum provides the opportunity to receive feedback. (Note dates and topic may change).

Table 2 Forecasting components relevant for the 2024 ESOO, and their engagement opportunities

Forecasting component	Engagement opportunity	When
Consumer energy resources (CER), consisting of:	This draft Assumptions Update	February 2024

[2] See https://aemo.com.au/consultations/current-and-closed-consultations/2024-forecasting-assumptions-update-consultation.

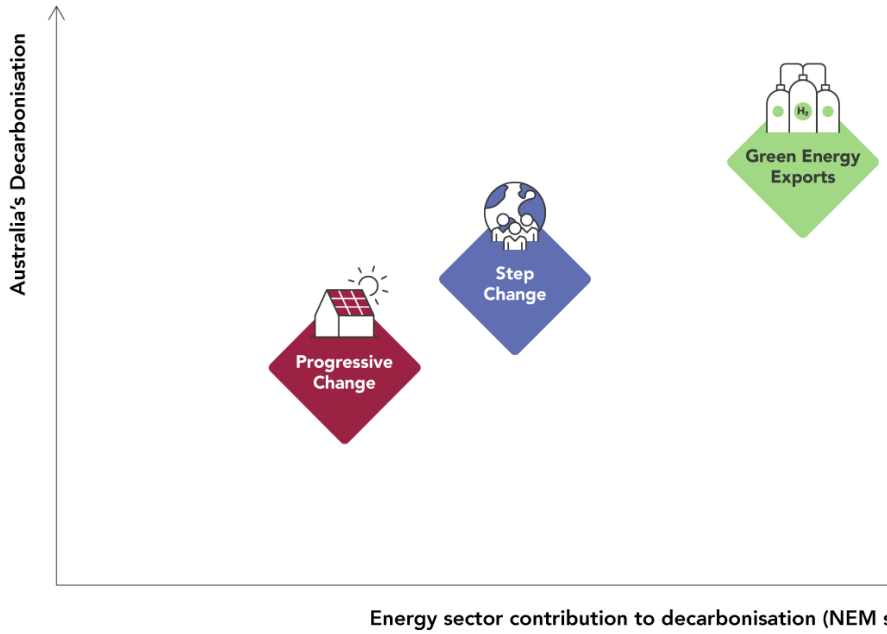
[3] More information on this forum is here: https://aemo.com.au/en/consultations/industry-forums-and-working-groups/list-of-industry-forums-and-working-groups/forecasting-reference-group-frg. Visit this page to register for updates.

[4] At https://aemo.com.au/consultations/current-and-closed-consultations/2024-consultation-on-forecasting-assumptions-update.

Forecasting component	Engagement opportunity	When
• Distributed PV (rooftop PV systems and larger systems, referred to as 'PVNSG'). • Customer batteries (including those orchestrated via a virtual power plant (VPP). • Electric vehicles (EVs).		
Economic and population forecasts	FRG engagement	March 2024
Large industrial loads	FRG engagement	May 2024
Electrification (non EV)	FRG engagement	May 2024
Electricity price indices	FRG engagement	May 2024
Demand Side Participation	FRG engagement	May 2024
Energy Efficiency Forecast	FRG engagement	May 2024
Appliance uptake forecast	FRG engagement	May 2024
Households and connections forecasts	FRG engagement	May 2024

1.2 2023 IASR scenarios

Figure 1 2023-24 scenarios



This draft Assumptions Update inherits the scenarios defined in the 2023 IASR, which are:

- ***Green Energy Exports*** – this scenario reflects very strong decarbonisation activities domestically and globally to limit temperature increase to 1.5°C, resulting in rapid transformation of Australia's energy sectors, including a strong use of electrification, green hydrogen and biomethane.
- ***Step Change*** – this scenario is centred around achieving a scale of energy transformation that supports Australia's contribution to limiting global temperature rise to below 2°C compared to pre-industrial levels (and may be compatible with 1.5°C pathways for the NEM as well, depending on actions taken by other sectors of Australia's economy). This scenario relies on a very strong contribution from consumers in the transformation, with rapid and significant continued investments in CER which are highly orchestrated through aggregators or

other providers with the benefits passed on to consumers. There is also strong transport electrification, as well as opportunities for Australia's larger industries to electrify to reduce emissions, or use developing hydrogen production opportunities or other low emissions alternatives to support domestic industrial loads.

- ***Progressive Change*** – this scenario explores the challenges of meeting Australia's current Paris Agreement commitment of 43% emissions reduction by 2030 and net zero emissions by 2050. In this scenario, transformational energy sector investments continue, but economic and international factors place industrial loads at greater risk. Higher technology costs and supply chain challenges relative to other scenarios slow the pace of change compared to other scenarios.

1.3 Alignment with update cycles for key inputs

AEMO utilises the following input and assumptions classifications to distinguish between values near final and those that had not yet been updated through an annual update cycle:

- **Interim** – an input that has not been updated since the previous IASR (released in July) but is intended to be updated before the release of the final IASR.
- **Draft** – an input that is considered final unless AEMO receives sufficient evidence to change it as part of the consultation.
- **Current view** – an input or assumption which is regularly updated in a standardised and objective process to reflect the most up-to-date observations: for example, metered demand data, the continued development of new generation projects that are included within AEMO's Generation Information data set, or environmental and energy policies that meet the NER requirements for inclusion in the ISP and/or are included in the AEMC's Emissions Targets Statement.

Regarding the incorporation of limited forecasting components in this draft Assumptions Update:

- AEMO acknowledges that the development of the draft ISP and its subsequent stakeholder consultation period is concurrent with the development of this draft Assumptions Update and its stakeholder consultation period.
- Some forecasting components rely on inputs that are at fixed points in time (such as market participant surveys of DSP and forced outage rates), or have been scheduled so as to benefit from the latest viewpoints (such as economic forecasts).

For these reasons, AEMO plans to engage on the remaining forecast components at more opportune times, as detailed above in Table 2.

All other inputs, as reported in the 2023 IASR, are considered "draft" for the purpose of this consultation; that is, they are considered final and will not be updated prior to preparing the 2024 ESOO reliability forecasts unless AEMO receives sufficient evidence to change as part of this consultation. In the rare situation where interim values have been used in this draft 2024 Forecasting Assumptions Update, they have been clearly identified.

1.4 Consultation process

Table 3 below summarises the consultation activities undertaken thus far for this draft Assumptions Update.

Table 3 Stakeholder engagement on the draft Assumptions Update

Activity	Date
Draft CER forecast (focusing on distributed PV and battery uptake)	25 October 2023
Draft EV forecast	25 October 2023

The publication of this draft Assumptions Update commences the process of formal consultation on several of the inputs appropriate for the reliability forecast in the 2024 ESOO, and stakeholders are invited to submit written feedback on any matters related to this draft Assumptions Update, or other components listed above that are not included within this draft Assumptions Update, but are expected to influence the 2024 ESOO. Such feedback may influence future engagement on these issues or opportunities.

Stakeholders are invited to provide input through a written submission to the questions outlined in this report. Submission should be sent via email to forecasting.planning@aemo.com.au and are required to be submitted by **Friday 9 February 2024**.

AEMO asks that submissions provide evidence that support any views or claims that are put forward.

Stakeholders should identify any parts of their submissions that they wish to remain confidential, and explain why the information provided is confidential. AEMO may still publish that information if it is otherwise authorised to do so, for example if the information is found to be available in the public domain, but will advise the stakeholder before doing so.

Following the completion of the consultation submission period, AEMO will publish a summary of the matters raised across the submissions and outline how feedback is being, or has been, addressed, as well as publishing a final version of the Assumptions Update ahead of, or with, the publication of the 2024 ESOO.

A more comprehensive consultation to update the biennial IASR will commence in 2024, with a draft 2025 IASR expected to be published in December 2024.

1.5 Supporting material

In addition to the draft Assumptions Update Workbook, Table 4 documents additional information related to AEMO's inputs and assumptions.

Table 4 Additional information and data sources

Organisation	Document/source	Link
Aurecon	2023 Cost and Technical Parameter Review	https://aemo.com.au/consultations/current-and-closed-consultations/2024-forecasting-assumptions-update-consultation
CSIRO	Draft GenCost 2023-24	
CSIRO	Electric Vehicle projections 2023: update to the 2022 projections report	
GEM	Projections for distributed energy resources – solar PV and stationary energy battery systems	

2 Updated assumptions

2.1 Consumer energy resources

Input classification	Draft
Input vintage	November 2023
Source	• Green Energy Markets, informed by updated market data from: – Clean Energy Regulator – Victorian Energy Saving Scheme – AEMO's DER register
Updates since 2023 IASR	• Updated by new consultant forecast, November 2023

Consumer energy resources (CER) predominantly describes consumer-owned devices that can generate or store electricity as individual units and which may have the 'smarts' to actively manage energy import and export. CER can also refer to consumer-shared devices, such as community batteries and other resources that enable greater demand flexibility.

The forecasting component generally refers to components including distributed PV systems (which includes PV non-scheduled generation, known as PVNSG), battery storage, and Electric Vehicles (EVs).

As outlined in the 2023 IASR, AEMO engaged two consultants to inform the 2023 IASR CER forecasts. For distributed PV and battery forecasts, this was provided by CSIRO and Green Energy Markets (GEM). With two forecasts, using two independent models but aligned to the same assumptions and scenario narratives, AEMO considers that the accuracy of the forecasts are improved over a single view. For EVs, a single forecast was sourced from CSIRO only.

In this 2024 FAU, AEMO has obtained updated forecasts from a single consultant for each component, due to practical difficulties for both consultants to repeat their analysis from the 2023 IASR. GEM provided updated forecasts for the distributed PV and battery components. CSIRO provided an updated forecast for the EV component.

The acquisition of a single forecast does not intend to imply that that consultant forecast is the single version of the component forecast for the 2024 ESOO. Rather, AEMO has proposed in this Draft Assumptions Update the means by which insights provided by one consultant may inform and uplift the other, thereby retaining the scenario spread for those affected components.

For example, if this draft Assumptions Update for rooftop PV systems (provided by GEM) were to increase uptake of that component by 5% relative to the 2023 IASR forecast, then AEMO proposes to escalate the CSIRO forecast by 5% as well. This technique attempts to maintain the spread of scenario forecasts, by retaining the breadth of drivers provided by the two consultants, while ensuring these updated forecasts reflect new insights and information.

Table 5 below summarises the proposed CER forecast components, and relevant proposed consultant 'blends'. In the table, average means the average of the current GEM forecast, and the previous CSIRO forecast escalated by the GEM forecast.

Table 5 Forecast blendings of consultant forecasts for key CER components, by scenario

Forecast	*Green Energy Exports*	*Step Change*	*Progressive Change*
Rooftop PV	GEM	Average	CSIRO escalated per *Step Change*
PVNSG	GEM	GEM	CSIRO escalated per *Step Change*
Battery storage	Average	Average	Escalated CSIRO
EV	CSIRO	CSIRO	CSIRO

2.1.1 Distributed PV

This section comprises of rooftop PV and PV non-scheduled generation (larger PV systems between 100 kilowatts (kW) and 30 megawatts (MW), referred to as PVNSG) forecasts, which together make up total distributed PV at the end of the section.

Rooftop PV and PVNSG current installed capacity estimates are from the Clean Energy Regulator, with AEMO's DER Register available as a comparison. The forecasts may be rebased to reflect the latest actual installation data before the 2024 ESOO is finalised.

The forecasting approach by the consultants may differ, but fundamentally uses the same scenario definitions, and the same primary inputs such as technology cost and population trends. The consultant reports provide details on individual PV forecasting components within their reports, as well as their methodologies. For this updated forecast, relevant component updates include updated installation data, the consultant's views on forward retail prices and tariff options, and the consumer's investment appetite and capabilities. Key components including technology costs and economic outcomes and population trends remain unchanged from the 2023 IASR components.

Distribution network service provider (DNSP) hosting of CER is considered in the rooftop PV section below, and further described in a call out section further below in Section 2.1.3, which provides an update on the relevance of Dynamic Operating Envelopes to PV forecasts.

Rooftop PV

The rooftop PV forecasts include inputs from the 2022-23 GenCost[5] and retail price trends, and the forecasts also use PV installation size data from the Clean Energy Regulator[6].

Details on GEM's forecasting approach and outlook can be found in its report[7]. Key insights include:

- The Clean Energy Regulator data reveals ongoing increases in average installation size.
- *Green Energy Exports* and *Step Change* have lowered uptake due to increased overall costs relative to the 2023 IASR forecast. Note that GEM considers 'fully installed costs' which include various overhead costs associated with retail sales and marketing, installation costs, and retail margin.

The above points are now expanded on in the sub-headings below.

[5] See https://doi.org/10.25919/zmvj-tj87

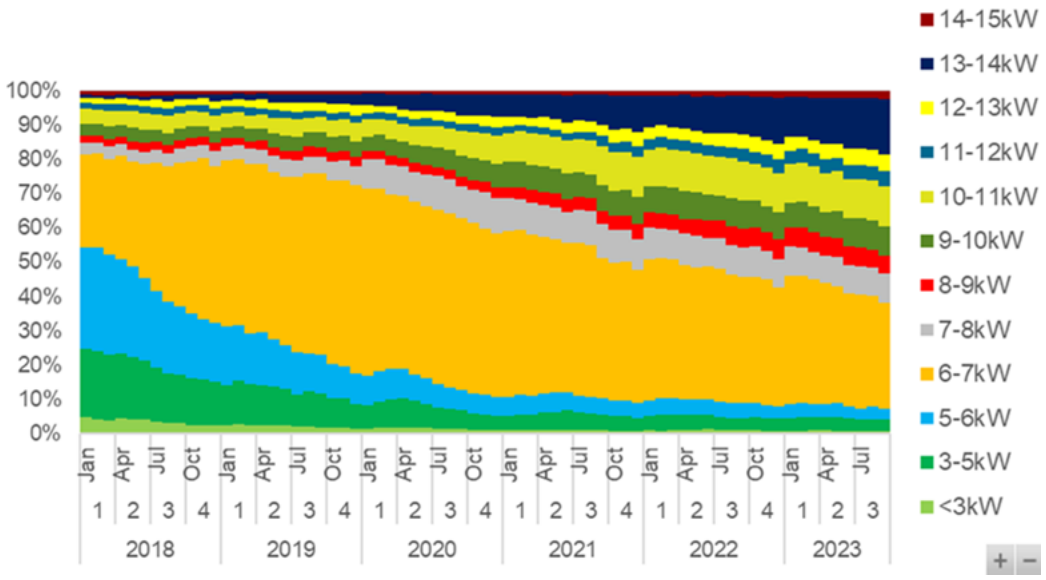
[6] See Figure 1-16 of GEM's report 'Share of residential solar capacity installed by system size band'.

[7] At https://aemo.com.au/consultations/current-and-closed-consultations/2024-forecasting-assumptions-update-consultation.

Average PV system size

The Clean Energy Regulator data in Figure 2 below shows ongoing increases in average system size, and this has previously been used to support projections in average system size. It is observed that systems in the 10kW and above range are growing at the expense of systems in the 6-7kW range.

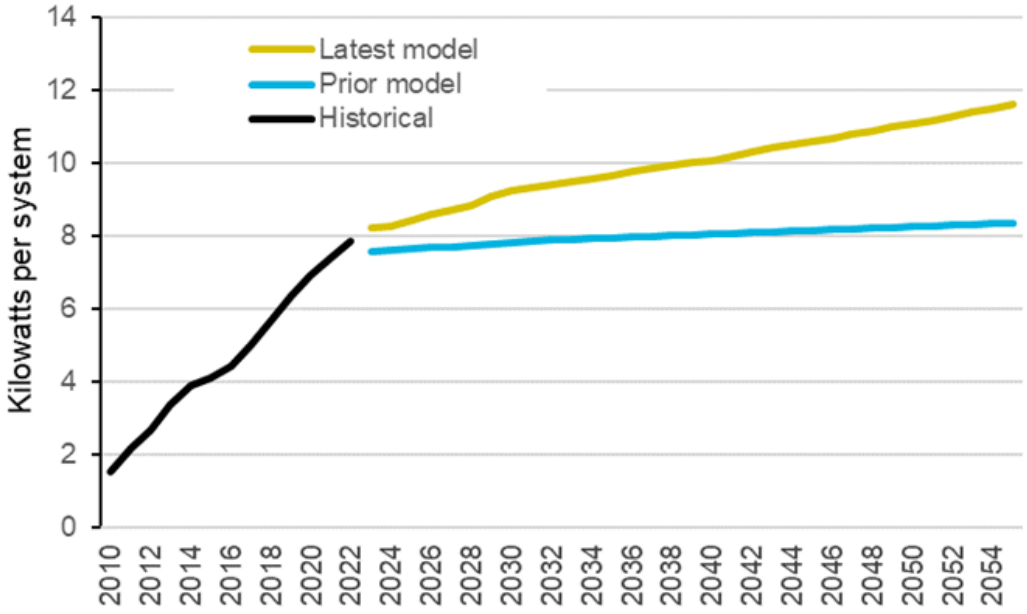
Figure 2 Share of new residential PV installations by system size band



Source: Clean Energy Regulator, via GEM

As the latest data continues to show increases, it has prompted an updated system size projection as shown in Figure 3 below.

Figure 3 Actual and forecast average system size of new PV installations



In considering the above projection of PV system size, AEMO notes:

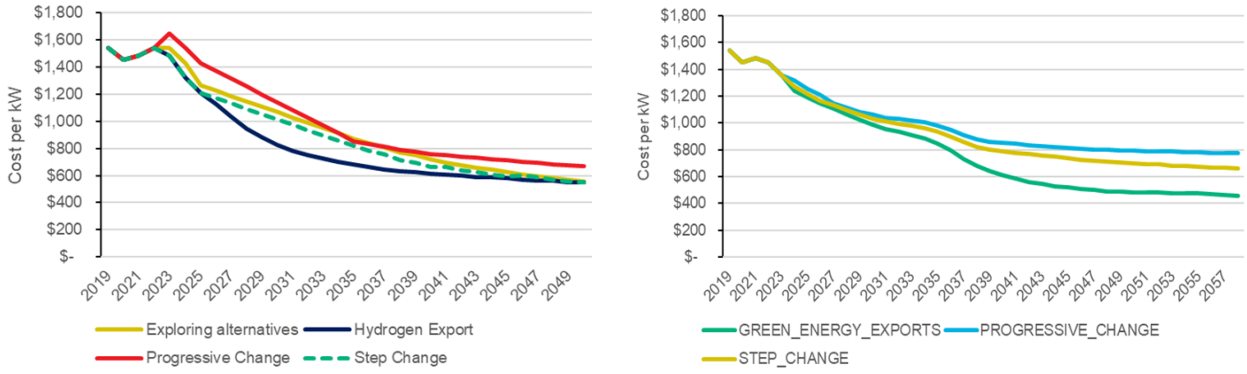
- The declining outlook for solar feed in tariffs is accounted for in the payback calculations and associated uptake, rather than the system size.
- As consumers increase their consumption needs with EVs and/or electric heating, it is expected that more value may be obtained, or perceived when making a purchase decision, with a larger PV system.

GEM's report Section 1.3.2 provides more commentary on PV system size.

PV system costs

PV system costs are forecast by GEM, considering the most recently finalised GenCost publication (2022-23, rather than the draft 2023-24 forecast[8] included in Section 2.3) and its forecasts of rooftop PV and distributed battery systems, as well as its own market research. These costs include installation costs and various forms of retail overheads. Figure 4 below shows changes in such overhead costs.

Figure 4 GEM view on fully installed residential PV system costs 2023 IASR (left), Draft 2024 FAU (right)



Both graphs exclude government support such as Small Technology Certificates (STC).

GEM's report Section 1.3.1 provides more detail, including re-evaluation of the impact of labour costs in the medium and long term trajectory.

Additionally, the forecast has greater regard in this updated forecast of the price feedback effect, whereby as PV volumes rise, the value of daytime energy falls, which diminishes PV payback and limits further uptake.

Green Energy Exports and *Step Change* attain similar forecast values, but due to different dynamics. *Step Change* has higher wholesale prices but also higher PV system costs. *Green Energy Exports* has lower wholesale prices but also lower PV system costs. While the wholesale price outlook remains unchanged from the last forecast, the levels, and relativities of fully installed costs for the two scenarios have changed.

DNSP hosting

AEMO notes stakeholder interest in how distribution network hosting capacity limitations might limit further growth of PV. The 'latest model' series in Figure 3 allows for a reduced rate of system growth relevant to recent history, with that line reflecting both DNSP considerations and the impact of reduced Small Scale Renewable Energy

[8] The draft 2023-24 GenCost forecast costs were not available to the consultant in a timely enough fashion to apply the updated costs, however the change from 2022-23 GenCost to 2023-24 is minor, and only represents a draft forecast rather than a final forecast. As such, AEMO considers this to be a reasonable baseline for this input.

Scheme certificates. AEMO notes DNSP strategies to accommodate further PV growth, and describes how this influences forecasts further below in the *Network curtailment risks and impacts on distributed PV forecast* box at the end of this section.

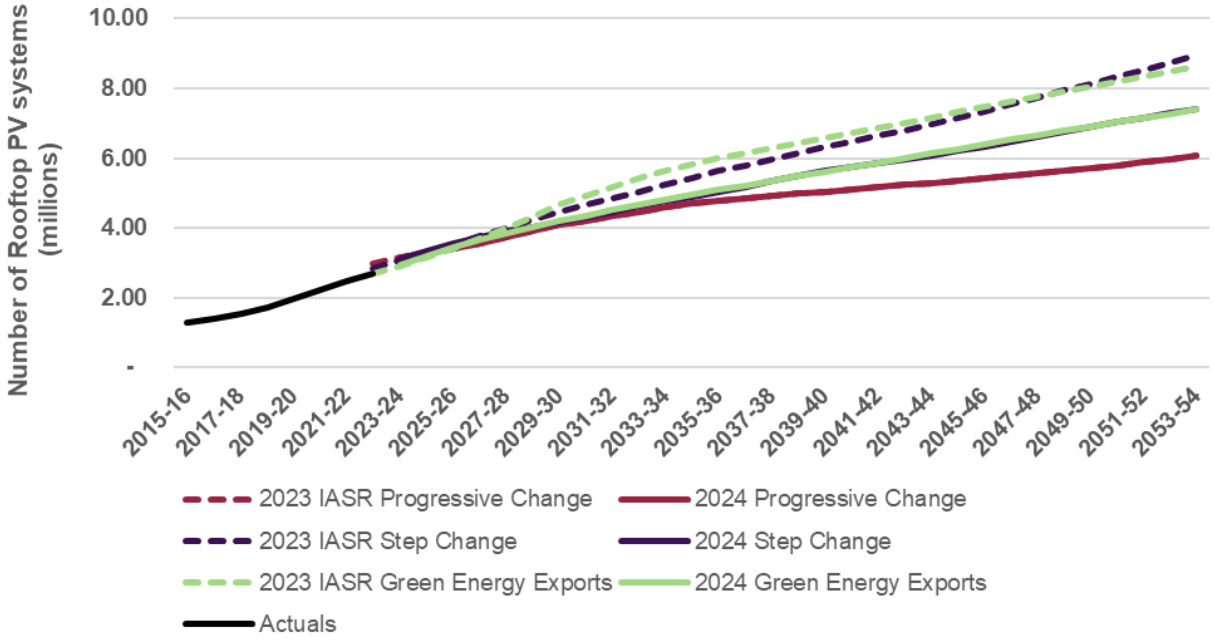
Rooftop PV systems and capacity forecast results

In considering all of the above, AEMO proposes to retain:

- GEM's forecast as the foundation for the *Green Energy Exports* scenario. This results in a modest rooftop PV capacity increase compared to the 2023 IASR. While PV numbers decrease, ongoing system size growth outweighs the reduced number of PV systems.
- An average of GEM's forecast, and an escalated CSIRO forecast, for the *Step Change* scenario. This results in a modest increase to rooftop PV capacity forecast for *Step Change* compared to the 2023 IASR, due to the expectation of ongoing system size growth outweighing the reduced number of PV systems.
- The 2023 IASR CSIRO *Progressive Change* forecast, escalated by GEM's view of changes to its *Step Change* forecast. AEMO proposes to retain CSIRO's *Progressive Change* forecast after considering GEM's, but considered that the large increases narrowed the forecasting range too much, and that there remains reasonable uncertainty regarding the expected rate of PV system size growth that validates the retention of the milder CSIRO forecast in this regard.

Figure 5 below shows the resulting system counts.

Figure 5 Number of rooftop PV systems

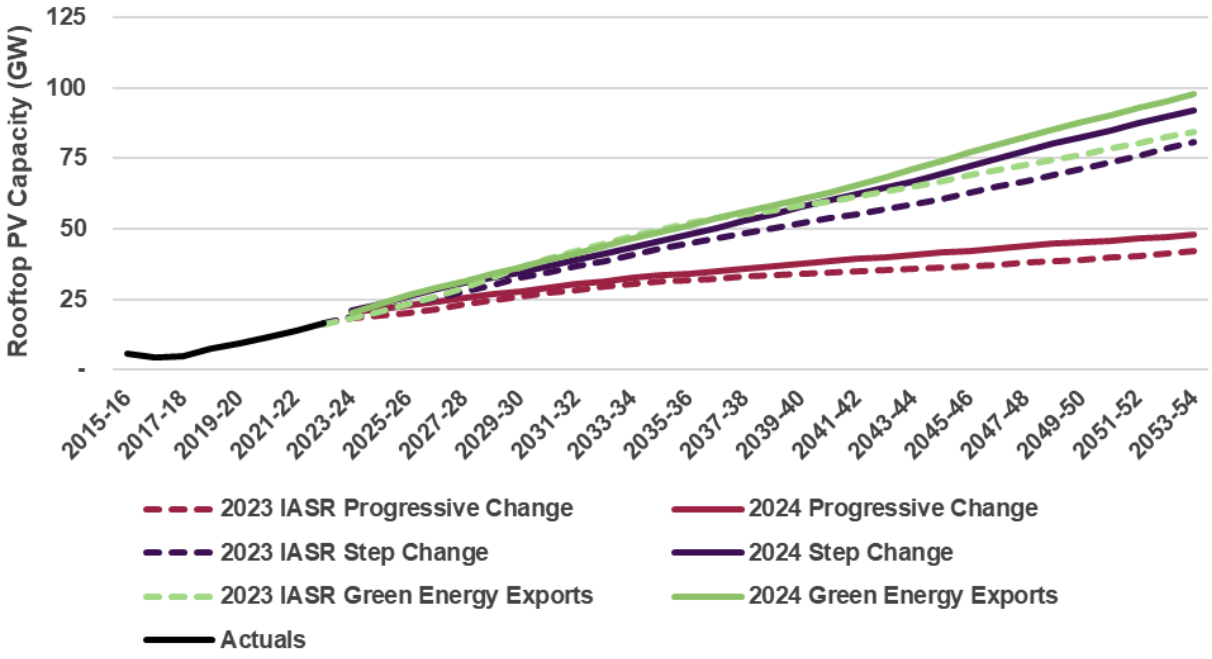


Note: the 2023 and 2024 *Progressive Change* lines are on top of each other.

Green Energy Exports and *Step Change* attain similar system count forecast values, but due to different dynamics. *Step Change* has higher wholesale prices but also higher PV system costs. *Green Energy Exports* has lower wholesale prices but also lower PV system costs. While the wholesale price outlook remains unchanged from the last forecast, the levels and relativities of fully installed costs for the two scenarios have changed to produce this result.

Figure 6 shows the resulting forecast PV capacity.

Figure 6 Actual and forecast NEM rooftop PV installed capacity by scenario, 2016 to 2054



PVNSG

The uptake of PVNSG systems (between 100 kW and 30 MW that are either rooftop or ground-mounted, installed by larger energy consumers or by market developers) reflects scenario-specific revenue and capital cost dynamics over the forecast horizon:

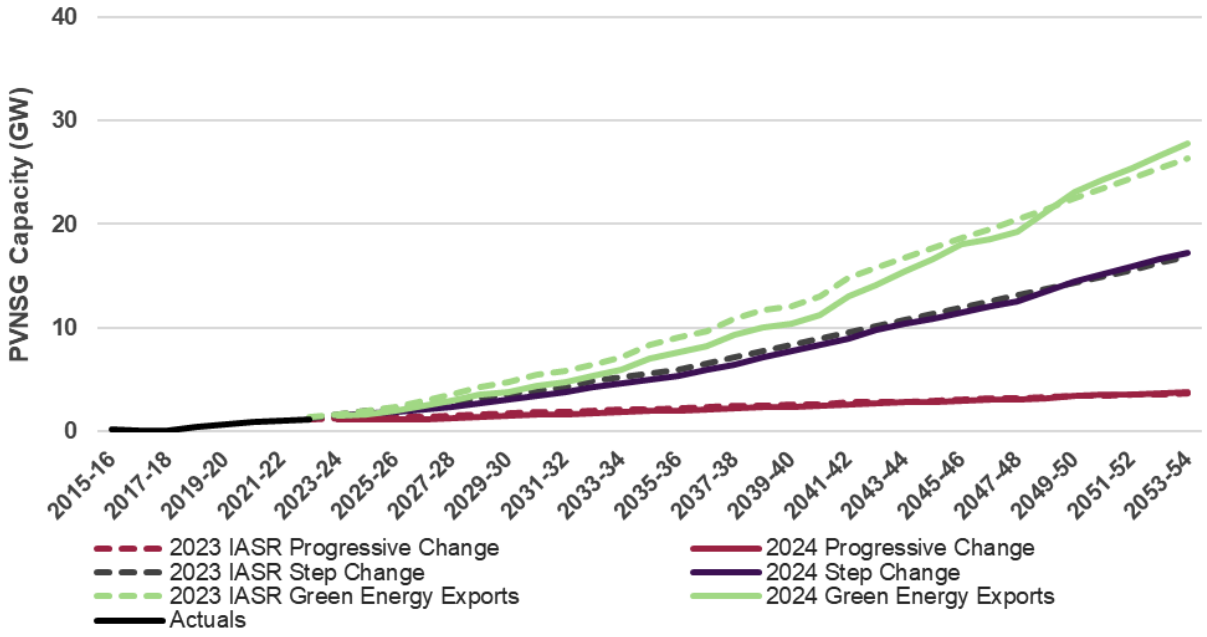
- Across all scenarios, revenue from PVNSG systems are expected to decline over the 2020s before stabilising around the mid 2030s. This reflects the completion of the Large-scale Generation Certificates (LGCs) scheme in 2030.
- Under the *Green Energy Exports* scenario, capital costs decline faster, and a supportive environment for solar encourages faster emission reductions. This outpaces the fall in revenues, and results in continued growth in PVNSG installations over the remainder of the 2020s. Growth continues through the 2030s due to ongoing capital cost reductions, while revenue remains stable.
- The *Step Change* scenario shows almost no change in uptake as system cost changes and revenue outlook changes are at a comparable scale, in effect balancing each other out.
- Across all scenarios, the 2040s rate of annual additions stabilises due to slowing capital cost reductions, and an expected degree of maturation/saturation in the PVNSG market.

AEMO considers it prudent to retain the same blending of consultant forecasts as used in the 2023 IASR (see Table 5).

For *Progressive Change*, AEMO notes that GEM forecast slower growth in the 2020s and then higher growth in the 2030s due to its scenario-specific system cost outlook. Applying this approach, even when averaged with the escalated CSIRO forecast as described previously, would uplift this scenario's forecast materially, and AEMO

considered that the breadth of the scenario collection did not warrant narrowing at this time, therefore the same relative adjustment to *Step Change* has been applied. This has been reflected in Figure 7 below.

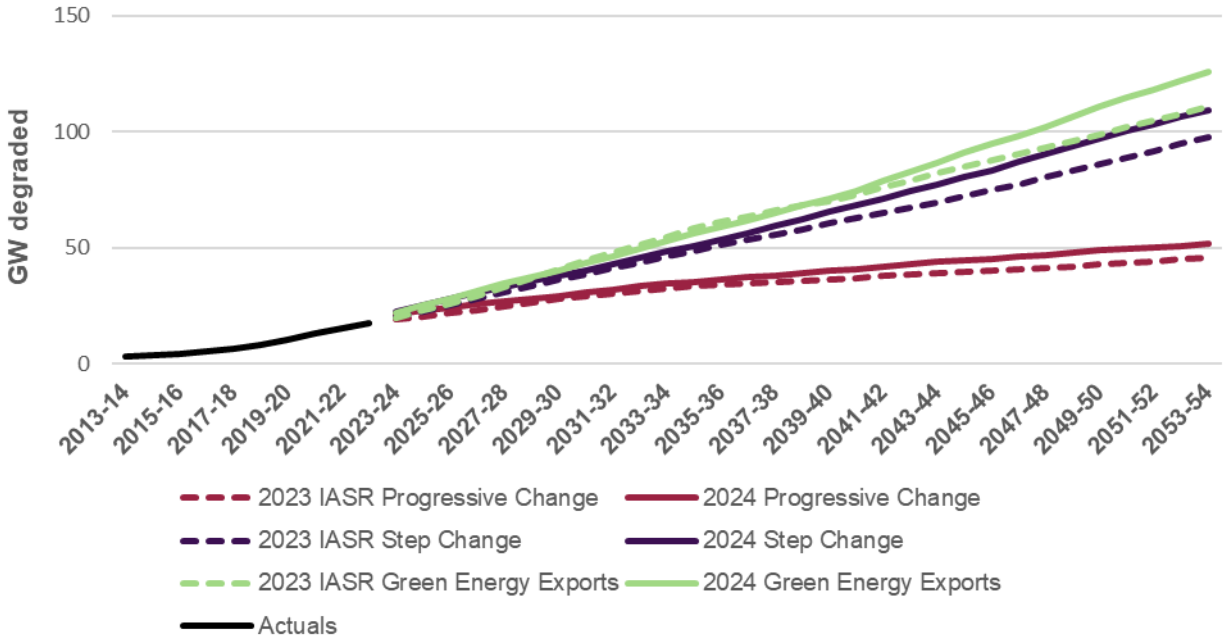
Figure 7 PVNSG capacity in the NEM by scenario



Distributed PV - totals

Figure 8 below aggregates the larger rooftop PV component, and the PVNSG component, to construct the total distributed PV forecast:

Figure 8 Actual and forecast NEM distributed PV installed capacity (degraded) by scenario, 2014 to 2054



Network curtailment risks and impacts on distributed PV forecast

Regarding DNSPs' PV hosting capability, page 72 of the 2023 IASR summarises AEMO and DNSP positions as at the IASR publication date of July 2023. At that time, AEMO noted the DNSPs' commitment and action plans were documented in their Distribution Annual Planning Reports. The plans included reference to Dynamic Operating Envelopes (DOEs). This technology avoids the curtailing imposed by historical static export limits, such as 5 kW export limits per phase.

Since then, AEMO notes DNSPs are continuing to develop DOE capabilities. In South Australia, SA Power Networks (SAPN) has mandated that from July 2023 all new solar installations must have DOE functionality and that all consumers will have the option to enter a dynamic connection agreement with SAPN from the same date, with the aim to have DOE rolled out state-wide by mid-2024[9]. In Queensland, Energex and Ergon Energy have recently released a standard for dynamic connection of small inverter energy systems which sets DOE implementation requirements for new connections[10]. In Victoria, DNSPs will be using CSIP-Aus technology[11] to implement emergency backstop capabilities[12] for systems equal to and less than 200 kW from 1 July 2024 and this technology has the potential to enable DOE[13]. All DNSPs are planning for DOE implementations, with most in the trial stage. Nine out of 13 NEM DNSPs have plans to offer a DOE option to all customers within the next three years[14]. Recent DNSP revenue proposals to the AER have also proposed network expenditure to increase low voltage visibility for system upgrades to manage their networks more dynamically[15].

AEMO considers that DOE technology retains the vast majority of opportunities to export energy for the consumer, while minimising grid impact in extreme circumstances. Thus, AEMO considers that the revised PV system size projections included in the forecasts above suitably accommodate the limited extent to which DNSP hosting limitations might impact PV growth.

Matters for consultation

- Do stakeholders with knowledge of DOE or other approaches to support high consumer PV penetration have additional insights to offer?
- Is AEMO's blending of current and escalated historical forecasts a suitable approach for distributed PV?
- Is the forecast similarity of distributed PV levels across *Step Change* and *Green Energy Exports* credible, and is it sufficiently justified by the commentary on complementary supply/demand dynamics?

[9] See https://www.sapowernetworks.com.au/data/315274/attention-update-issued-on-sa-s-dynamic-export-requirements/.

[10] See https://www.ergon.com.au/__data/assets/pdf_file/0008/1072592/STNW3510-Dynamic-Standard-for-Small-IES-Connections.pdf.

[11] Common Smart Inverter Profile Australia (Australian implementation of the IEEE 2030.5 standard that has been mandated for inverter-based resources in California (USA), to support the deployment, monitoring and active management of CERs. For more details, see https://arena.gov.au/knowledge-bank/common-smart-inverter-profile-australia/.

[12] Capacity of network service providers to remotely turn down or switch off rooftop solar systems during an energy supply emergency to support system security and avoid blackouts, as directed by AEMO.

[13] Click here to download pdf of Victoria's Emergency Backstop Mechanism: Consultation Outcomes Report.

[14] See https://arena.gov.au/assets/2022/07/review-of-dynamic-operating-envelopes-from-dnsps.pdf.

[15] See https://www.aer.gov.au/system/files/2023-11/Draft%20export%20limit%20interim%20guidance%20note%20-%20November%202023.pdf.

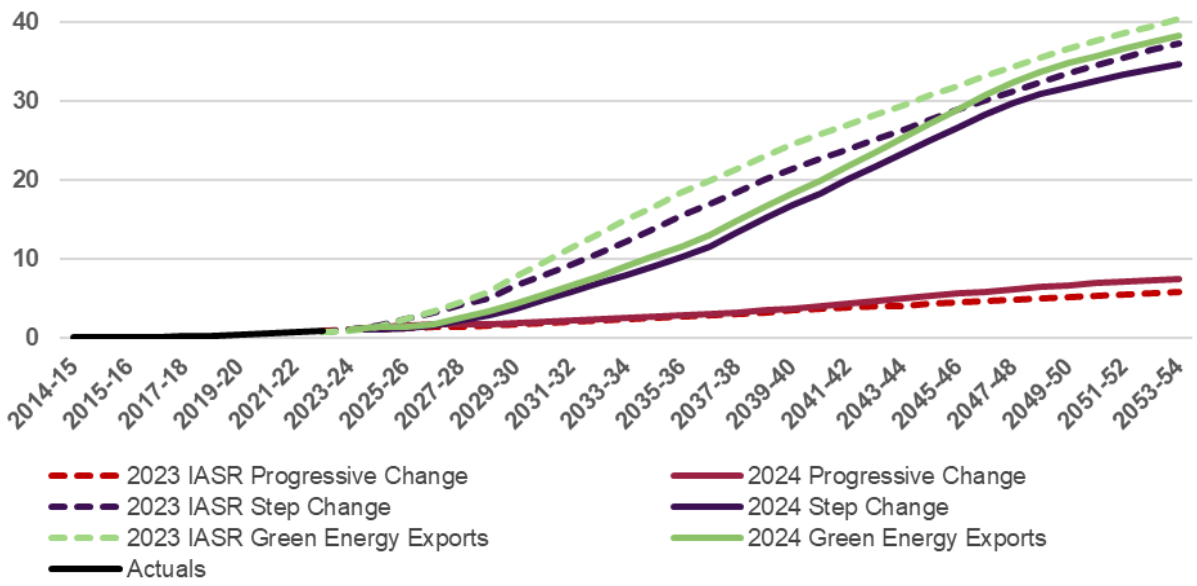
2.1.2 Embedded energy storage

The outlook for distributed batteries takes into account:

- Recent slower than anticipated battery sales.
- The forecast reduction in the number of PV installations.
- An anticipated reduction in battery capital costs, consistent with the trends of the most recently finalised GenCost publication (2022-23, rather than the draft 2023-24 forecast[16] included in Section 2.3), adjusted by GEM to consider small-scale battery influences and expected retail costs. The forecast reflects near-term battery cost reductions that are faster than those expected in the longer term.

The above points lead to a slightly lower battery uptake in the *Step Change* and *Green Energy Exports* forecast. In contrast, recent battery sales, although slow, uplift the lower *Progressive Change* forecast in the short term. In the longer term, the scenario-specific energy price outlook drives the energy saving (and thus uptake) for the *Progressive Change* forecast.

Figure 9 Distributed battery forecast for the NEM



AEMO recognises that consumers will have choices regarding using EVs as battery storage, and/or the uptake of distributed batteries. A number of marketplace interactions are conceivable, including synergistic (additive) and competing (subtractive) interactions. While there is an absence of data on consumer preferences, it is clear that EVs will not capture the rooftop PV energy of consumers who drive away from home during the day. While AEMO notes the apparent change to travel behaviours and work location (see EV section further below), it is still true for most consumers that EVs are not seen as an alternative to a home battery. Thus for this publication, AEMO assumes the growth of EVs does not materially impact the outlook for distributed batteries. This assumption will be reviewed in future publications.

[16] The draft 2023-24 GenCost forecast costs were not available to the consultant in a timely enough fashion to apply the updated costs, however the change from 2022-23 GenCost to 2023-24 is minor, and only represents a draft forecast rather than a final forecast. As such, AEMO considers this to be a reasonable baseline for this input.

Matters for consultation

- Are the battery outlooks plausible given the emerging popularity of EVs, or is there evidence to support a view that EV growth helps or hinders investment in home batteries?
- Is the forecast for the low end scenario, *Progressive Change,* suitable, or does it underestimate the potential for distributed batteries?

Virtual power plants (VPPs)

A VPP broadly refers to the involvement of an aggregator to orchestrate CER via software and communications technology, to deliver energy services similar to large-scale inverter-based generation and storage developments. This is in contrast to typical household battery installations which are configured to offset household energy costs by reducing the volume of grid supplied energy and increase self-consumption of complementary PV generation.

The role of orchestrating CER to provide energy for the power system at large will be a significant influence on the scale of network and utility scale investments needed to maintain reliability, security and affordability through the energy transition. Consumer resources that increase load flexibility and provide reliable capacity to meet system peaks will offset other investments.

AEMO incorporates VPPs with a slightly different approach to other CER, as the concept of a VPP effectively converts them to a pseudo-dispatchable supply resource. For other CER devices, AEMO adapts the demand forecast to increase or decrease the effect on electricity consumption and/or the demand profile across the day. For VPPs, consumption and demand are forecast gross of the effect of the use of these devices, and the capacity is then captured as an alternative and controllable supply source in AEMO's forecasting and planning models. Depending on the objective of the modelling, the methodology and treatment of VPPs therefore can change. For reliability assessments, AEMO's 2023 ESOO and associated Reliability Forecasting Guidelines excluded VPPs that were not committed or anticipated, bringing it into line with other transmission, generation and storage projects. For the ISP, VPP growth is adopted, but the contribution of the technology to regional reserves is reduced. See the relevant methodology documents of each publication for more information. ***Note that this Assumptions Update is seeking stakeholder feedback on the magnitude of the forecast component, rather than feedback on the treatment of the forecast component in forecasting and planning models.***

New evidence reinforces the view of the technical practicality and economic advantages of VPP programs. Project Symphony[17] successfully orchestrated approximately 900 CER (including rooftop solar, batteries and large appliances) across 500 homes and businesses in Western Australia.

The cost benefit analysis from the three-year-long Project EDGE demonstrated feasible end-to-end technical capabilities, finding an estimated $6 billion in future cost savings for NEM electricity consumers, plus $3 billion further societal benefits through emissions reduction[18]. The project involved substantial collaboration between a range of agencies, including a DNSP (Ausnet Services), Mondo acting as an aggregator, retailers AGL and Discover Energy, and Rheem as a technology provider.

[17] See https://aemo.com.au/en/initiatives/major-programs/wa-der-program/project-symphony.

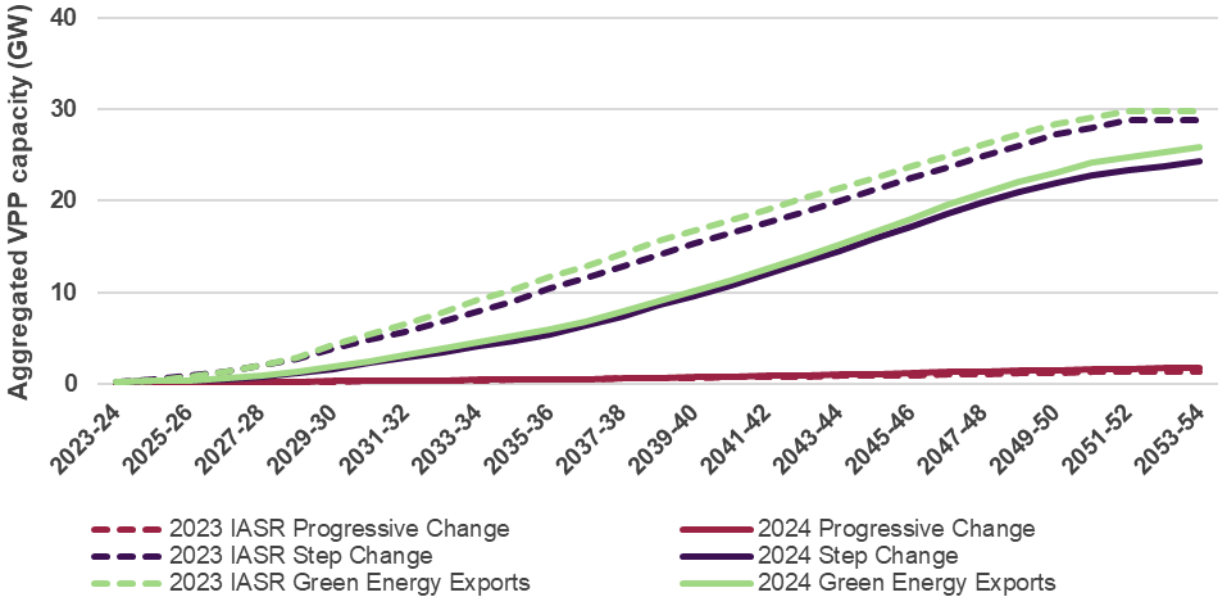
[18] See https://aemo.com.au/en/initiatives/major-programs/nem-distributed-energy-resources-der-program/der-demonstrations/project-edge.

South Australia has at least seven market participants offering VPPs there. The AEMC lists a wide range of VPP programs and their details[19]. AEMO considers that the long-term potential of VPPs remains of keen interest to retailers, particularly gentailers with legacy coal generators, who are particularly motivated to harness consumer investments to transition their business to renewable sources.

Despite that long-term potential, the marketing of VPP products to date has been modest, as retailers evolve their VPP offerings and communications to increase VPP popularity.

Overall, AEMO proposes to retain the participation rate for VPPs (the proportion of battery owners signed up to VPP) unchanged since the 2023 IASR. The downtick in distributed battery numbers passes through to a downtick in VPP capacity.

Figure 10 Aggregation trajectories for VPP forecasts



Matters for consultation

- Do the proposed VPP forecasts sufficiently reflect a spread of outcomes, considering the potential for a range of consumer acceptance, and the emerging market for VPP?

2.1.3 Electric vehicles

Input classification	Draft
Input vintage	Reforecast since the 2023 IASR
Source	CSIRO
Updates since 2023 IASR	EV model rebased with updated EV sales

[19] See https://www.aemc.gov.au/news-centre/data-portal/retail-energy-competition-review-2020/vpp-offers-available.

This document uses electric vehicles (EVs) as the collective term for battery electric vehicles (BEV) and plug-in hybrid vehicles (PHEV). The EV uptake forecast has been updated as a result of:

- The latest actual sales figures of BEV and PHEV.
- Stakeholder feedback on PHEV.
- Policy changes since the 2023 IASR, including the proposed fuel efficiency standard.
- Recognition of vehicle utilisation changes (kilometres travelled per vehicle).

These points are elaborated below, before describing overall EV uptake, energy use and charging profiles.

Latest actual EV sales figures (including PHEV)

Updated vehicle sales figures are available quarterly, and recent EV sales figures have exceeded the previous 2023 IASR *Step Change* forecast[20]. As a result, AEMO's forecasts include increases in the short term. This uplift, in response to sales data, most strongly effects the *Progressive Change* scenario forecast, as its previously forecast low uptake rates appear increasingly unlikely[21].

PHEV modelling

AEMO's forecasts use scrapping rates to reflect the rate at which vehicles are withdrawn from use. Examples of scrapping include vehicles written-off after accidents, and vehicles no longer economic to register (perhaps due to the cost of replacement parts). The previous forecast used constant annual scrapping rates, which was satisfactory for BEVs enjoying high sales rates, but resulted in an unrealistic early reduction in PHEV numbers because the scrapping rate exceeded the low PHEV sales rate. Introducing vintage-specific scrapping rates has substantial impacts to modelling design and performance, so the new forecast simply uses a close to zero PHEV scrapping rate for the first five years, before resuming to a normal scrapping rate. It has had the effect of maintaining the size of the PHEV longer in the forecast.

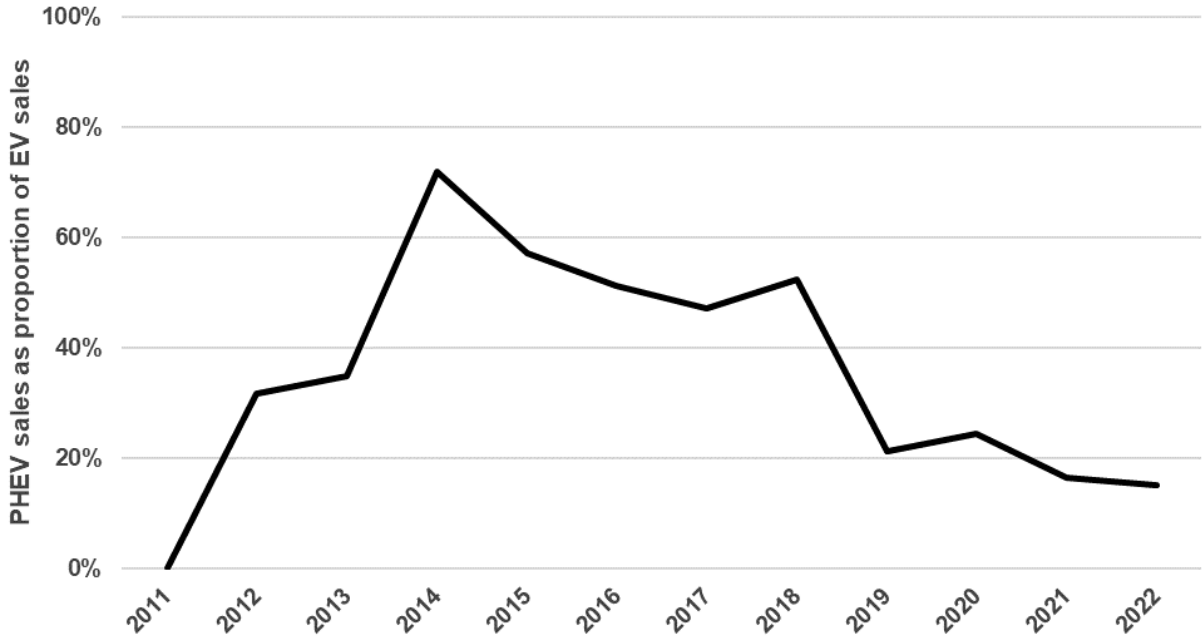
AEMO notes feedback from FRG stakeholders on the value of retaining the dual drivetrain of a PHEV for some communities that have geographical barriers to BEV adoption – that is, that long distances, or unaddressed need for public charging infrastructure, preclude acceptance of full EVs if that materially impacted the driver's ability to use the vehicle for its intended purpose of transportation.

AEMO notes the longer-term decline in PHEV sales as a percentage of EV sales, as shown in Figure 11. Recent changes such as the inclusion of PHEV into tax exemptions, removing fringe benefit tax payable vehicles purchased under novated leases under the *EV Discount Act*, and uplifts to exemptions on the Luxury Car Tax, may lift PHEV uptake. However, these benefits are generally temporary within those policy frameworks, and are expected to exclude PHEV much earlier than they will expire for BEV. On balance, AEMO considers that the impact of the updated scrapping rates addresses the feedback. Overall, the current forecast reflects that PHEV are most likely a transitional rather than long-term technology for most consumers.

[20] See CSIRO Executive Summary, page v: https://aemo.com.au/consultations/current-and-closed-consultations/2024-forecasting-assumptions-update-consultation.

[21] See CSIRO Section 4.2: https://aemo.com.au/consultations/current-and-closed-consultations/2024-forecasting-assumptions-update-consultation.

Figure 11 Actual PHEV sales as a proportion of EV sales



Note: see page 62, https://electricvehiclecouncil.com.au/wp-content/uploads/2023/07/State-of-EVs_July-2023_.pdf.

Fuel efficiency standard forecast impacts

AEMO notes progress in the Commonwealth Government's consideration of a new vehicle Fuel Efficiency Standard[22]. Following conclusion of public submissions in May 2023, it has been revealed that the majority of submissions supported the introduction of an efficiency standard, and the government is now undertaking an impact analysis. The relationship between a likely efficiency standard and EV sales is complex – a standard does not uniformly boost sales across all scenarios. The impact depends on the level of fuel efficiency required, and the implementation rules and timeframe. An efficiency standard may stimulate a minimum uptake of EVs, if it effectively requires early scrapping of existing vehicles, but in the absence of clarity on the potential magnitude of the efficiency standard, the high EV sales forecasts are expected to be higher than any efficiency standard impact, particularly in the medium and high trajectories.

Vehicle utilisation changes

Figure 12 shows vehicle utilisation rates sourced from BITRE Road Statistics[23] with forecasting assumptions overlaid. It reveals a decrease in the vehicle utilisation rate of medium passenger vehicles (accounting for more than 80% of total EVs) in New South Wales, from 2018-19 to 2021-22. While COVID-19 induced restrictions influence these figures, insurance data on road travel suggests that the decline is part of a longer-term trend from at least the year 2010[24]. The lower assumed utilisation rate per vehicle helps drive a higher number of vehicles in the new forecast.

[22] At https://www.infrastructure.gov.au/department/media/publications/fuel-efficiency-standard-cleaner-cheaper-run-cars-australia-consultation-paper.

[23] See https://www.bitre.gov.au/statistics/road.

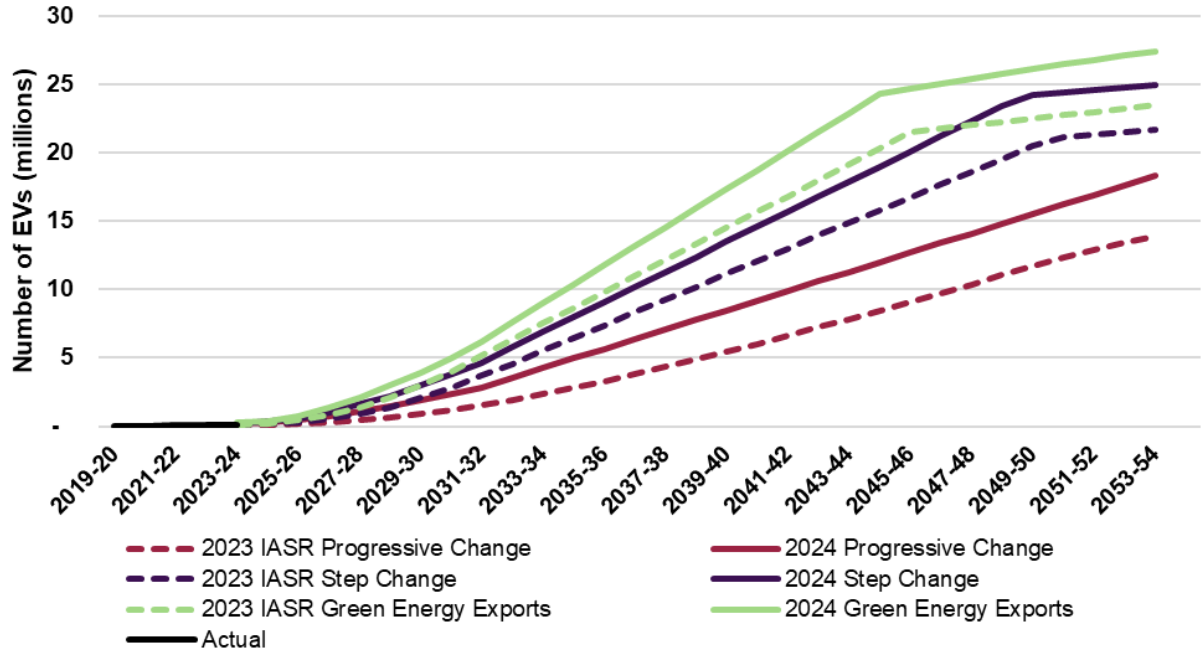
[24] See Section 1, Average Kilometres Driven in Australia - Budget Direct, at https://www.budgetdirect.com.au/car-insurance/research/average-kilometers-driven.html#30-average-kilometres-travelled-2020-ref-number2.

Figure 12 Vehicle utilisation rate of New South Wales passenger cars, 2018-30

In summary, the EV uptakes in Figure 13 are forecast to increase because of:

- Recent strong sales, above all 2023 IASR scenarios.
- An updated approach to PHEV forecasts which has resulted in an uplift for that vehicle category.
- The consideration and likelihood of a potential fuel efficiency standard. The nature of this policy is that it boosts lower end forecasts.
- Recognition of lower vehicle utilisation.

Figure 13 Projected BEV and PHEV fleet size by scenario, 2020 to 2054

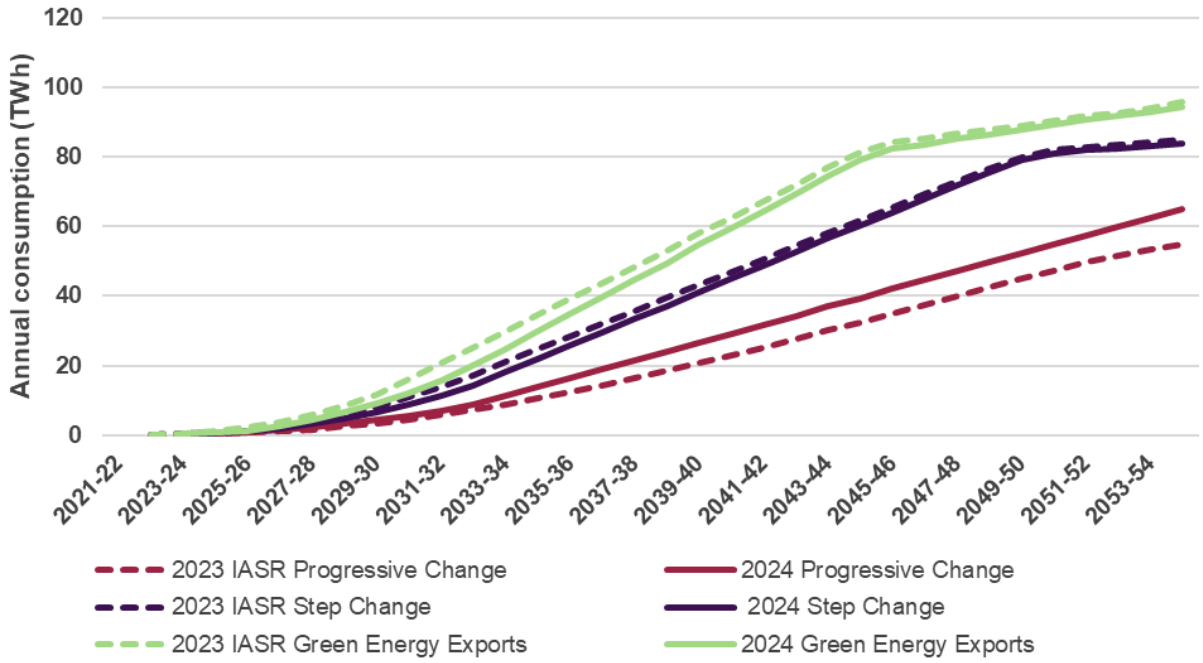


Energy use associated with electric vehicles

The total energy use associated with EVs has remained mostly unchanged despite the increase in EV vehicle projections. This reflects the fact that total demand for road transport has not significantly changed since the last projection. This demand is being met with more vehicles, with each vehicle providing a lower relative utilisation (kilometres driven) based on an updated understanding of vehicle ownership and utilisation.

Figure 14 shows that for *Step Change* and *Green Energy Exports*, the effects of vehicle sales and vehicle utilisation offset each other. In contrast, *Progressive Change* shows stronger growth as its fleet size increases (driven by recent sales, and prospect of a Fuel Efficiency Standard) outpace the impact of lower utilisation.

Figure 14 BEV and PHEV electricity consumption by scenario



EV charging profiles

For the 2023 IASR, a range of half-hourly charging profiles were developed to reflect the link between various EV driver charging behaviours and the time-specific load on the power system. The profiles varied over vehicle type, time (months, years), geography (NEM regions) and day 'types' (weekdays/weekends).

The latest charging profiles have revised names and descriptions (see 0), with the change providing greater transparency on how tariffs relate to charge behaviour. Average after-diversity charging profiles are explicitly presented, with the three scenarios showing different utilisation of abundant solar energy, and different demand outcomes.

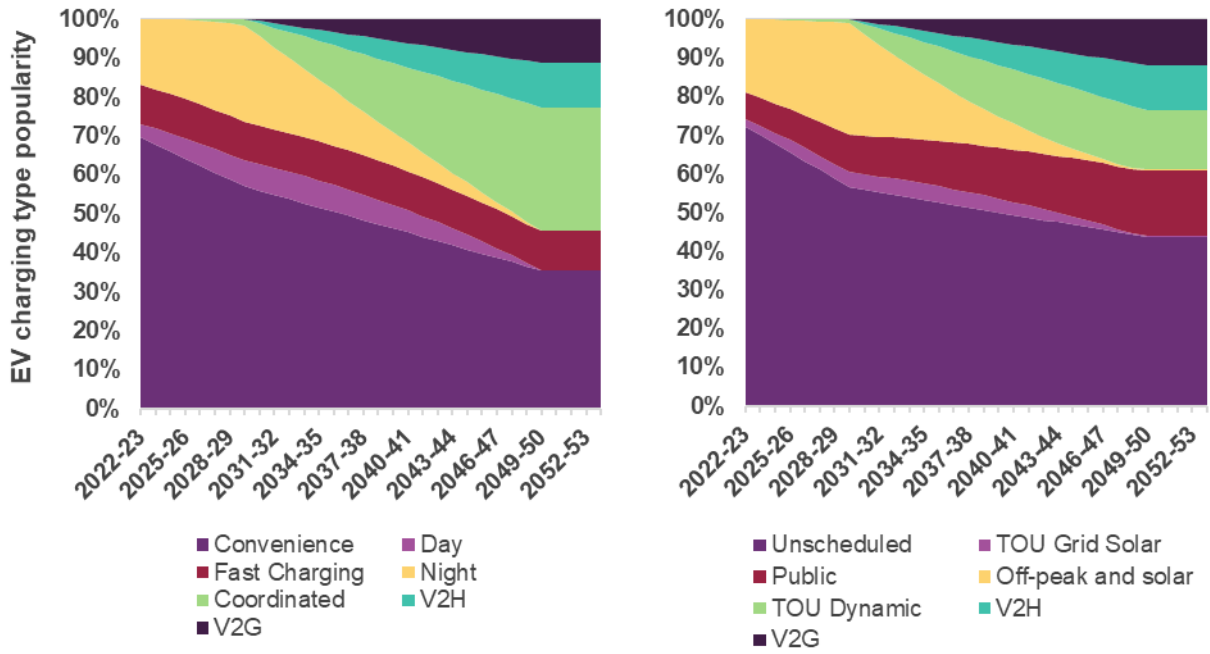
Table 6 EV charging profiles

Charging profile name	Previous name	Description
Unscheduled	Convenience	Unscheduled home charging that occurs on a flat tariff
Off-peak and solar	Night	Traditional time of use (TOU) tariff without day incentives, other than use of home solar
TOU Grid solar	Day	Where a TOU tariff includes day charging incentives, and even customers without solar are incentivised to use abundant low cost solar via the grid
TOU Dynamic	Coordinated	TOU tariff, but dynamically priced to reflect solar energy availability. Used for charging only – does not include vehicle-to-home (V2H) and vehicle-to-grid (V2G) power flows
Public	Fast/Highway (FHWY)	Public L2 and fast charge
V2G/V2H	V2G/V2H	Vehicle to home/grid (dynamic system-controlled charging)

Relative to the 2023 IASR forecast, the new forecast better recognises the important role of public charging, both for managing vehicle range and travel needs, and for those drivers who cannot charge their EV at home or work. The 'public' EV charging profile (previously called Fast/Highway) has been updated with new projections for the share of use of public and private chargers.

Figure 15 below, shows the result of CSIRO and AEMO modelling of charging types over time. It considers various trial data referred to in CSIRO's report, stakeholder feedback, and the anticipated evolution of Time Of Use (TOU) tariffs:

Figure 15 Split of charging types for medium residential vehicles: 2023 IASR (left), Draft 2024 FAU (right)



Note: figure shows values for New South Wales under the *Step Change* scenario.

It shows:

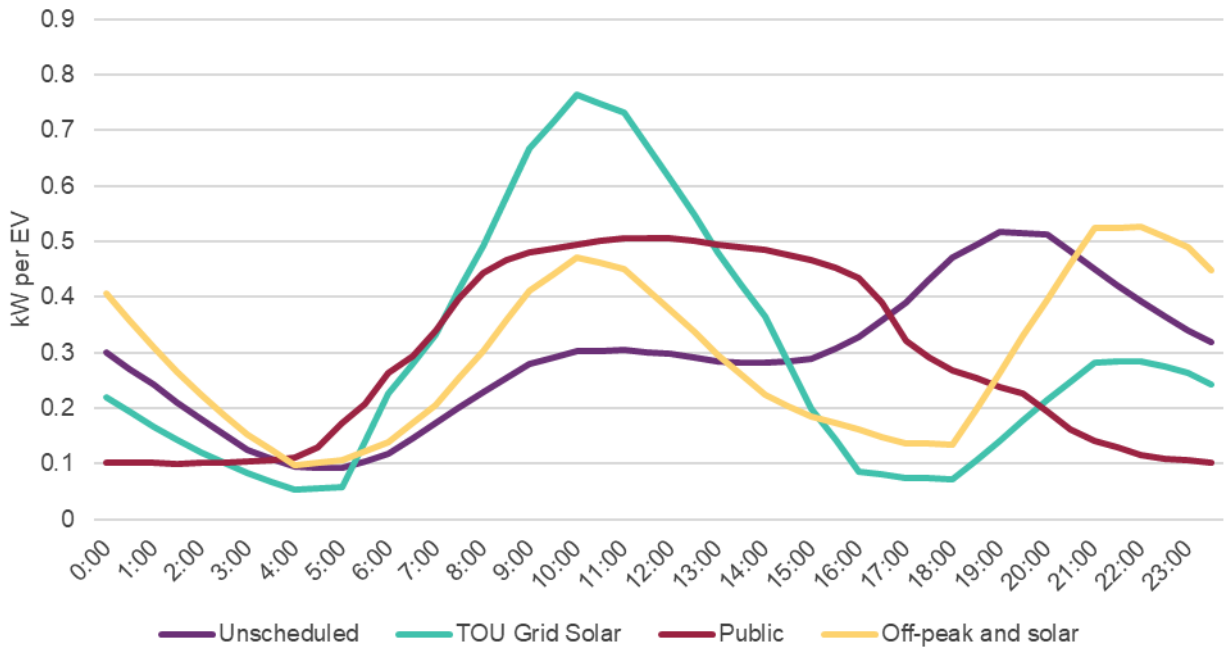
- Initially, EV drivers use Off-peak and solar, which is based on traditional TOU with peak/shoulder/off-peak periods. The peak price is late afternoon and evening, the shoulder price is morning to mid-afternoon (and possibly late evening), and the off-peak price occurs around midnight to early morning. EV drivers on that tariff

are incentivised to charge during overnight off-peak, or to charge from their rooftop PV if applicable. This traditional TOU tariff does not fully incentivise EV drivers to make use of the abundant low cost solar available.

- TOU Grid Solar evolves in response to its predecessor's limitation, with pricing that better reflects daytime solar abundance. The lower daytime price is available to everyone, including those without rooftop PV. While solar is generally available in the daytime, the tariff does not cater for daily weather variations. Thus, EV drivers would still be incentivised to charge, even on a day when a large region may be cloud-covered.
- TOU Dynamic is similar to TOU Grid Solar, but includes a dynamic weather sensitive element to best contribute to managing the power system needs. For example, if cloud cover suddenly appeared in the mid-afternoon, then the price would quickly change from very low (to encourage solar soaking) to a moderate value to encourage those who can charge later to do so. The TOU Dynamic charging type becomes the most popular as it offers the greatest incentives to charge at times when solar power is abundant.

Figure 16 represents the updated half-hourly charging profiles of all the static charging types. The profiles below are shown for a typical January weekday in New South Wales, under the *Step Change* scenario.

Figure 16 Static charging profiles of different EV charging types for medium residential vehicles in New South Wales normalised to 7 kilowatt hours (kWh)/day



Matters for consultation

- What alternative views are there on how a likely the Fuel Efficiency Scheme would impact EV sales?
- Is the increased prominence of PHEVs in the short-term forecast suitable? Is there a case for PHEVs sales beyond the short term?
- Do the updated EV charging profile descriptions clarify their design and application in energy forecasts?

2.2 Existing generators and transmission

AEMO uses a range of data to describe the existing generators in its models. Some of this data is updated through established processes and documented methodologies as outlined in Table 7 below.

Table 7 Status and update process for key inputs and assumptions for existing generation and transmission

Input	Current Status	Forward plan for updating inputs and assumptions
Generation Information data	Current view	Updated quarterly based on AEMO's Generation Information survey and is published on AEMO's Generation Information website[A]. This data is collected and published in accordance with the Generation Information Guidelines[B].
Transmission Augmentation Information data	Current view	Updated as required based on information advised by relevant Transmission Network Service Providers and is published on AEMO's Transmission Augmentation Information website[C].
Scheduled generator unplanned outage rates	Interim view	The interim view will be updated based on historical and forward-looking unplanned outage rates to be provided by registered participants in accordance with AEMO's ESOO and Reliability Forecast Methodology[D]. The data is collected in April 2024 and thus accounts for generator performance over the 2023-24 summer. Based on the methodology outlined in the ESOO and Reliability Forecast methodology, AEMO will calculate new generator forced outage rates for all scheduled production units. The unplanned outage rates are scheduled for FRG consultation in June 2024.
Unplanned outages affecting inter-regional power transfers	Interim view	AEMO will collate and develop projections of inter-regional transmission unplanned outage rates consistent with the ESOO and Reliability Forecast Methodology. The unplanned outage rates are scheduled for FRG consultation in June 2024.

A. See https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information.
B. See https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information.
C. See https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/transmission-augmentation-information.
D. See https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-essooE.

2.3 Technology costs (Draft 2023-24 GenCost)

GenCost is an annual collaboration between AEMO and CSIRO to provide updated cost projections for electricity generation, storage and hydrogen technologies. The GenCost 2023-24 Consultation draft is the sixth update to the inaugural report in 2018. It represents Australia's most comprehensive assessment of future electricity generation costs.

A key input to the GenCost method is to provide updated current capital cost estimates. These for 2023-24 have again been provided by Aurecon in its *2023 Cost and Technical Parameters Review*. The GenCost 2023-24 Consultation draft [25] and Draft 2023 Cost and Technical Parameters Review[26] were released with this Assumptions Update, for consultation. Key generation costs are summarised below.

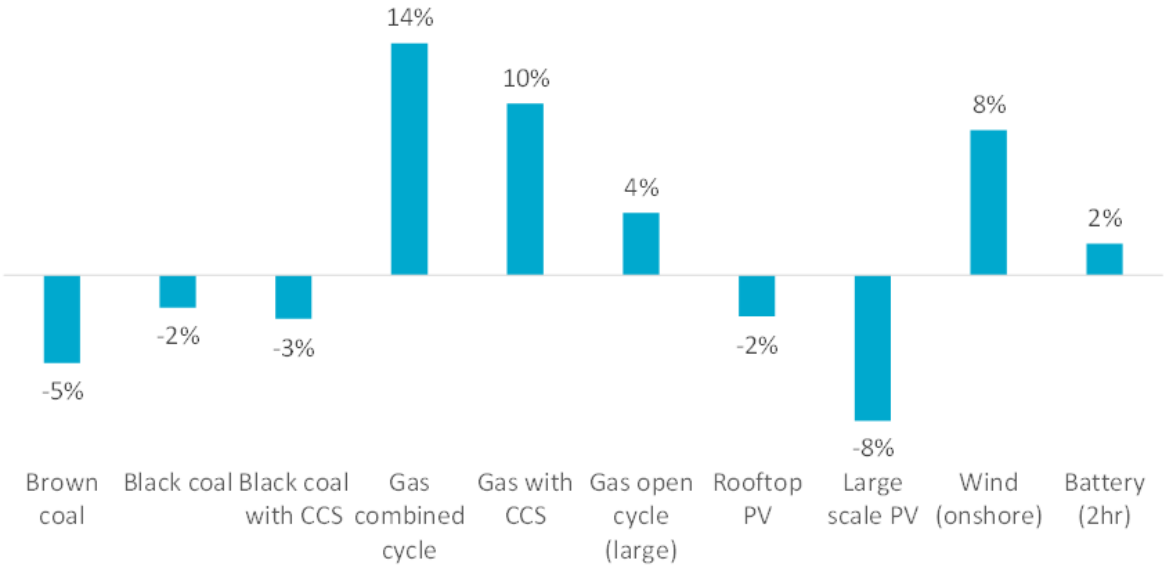
[25] See CSIRO GenCost 2023-24 report at https://aemo.com.au/consultations/current-and-closed-consultations/2024-forecasting-assumptions-update-consultation.

[26] See Aurecon Draft 2023 Cost and Technical Parameters Review at https://aemo.com.au/consultations/current-and-closed-consultations/2024-forecasting-assumptions-update-consultation.

2.3.1 Current capital costs

Changes to current capital costs of generation technologies relative to GenCost 2022-23, as outlined in the Aurecon report, are highlighted in Figure 17 below.

Figure 17 Change in current capital costs of selected technologies relative to GenCost 2022-23



Note: summary figure from Draft 2023-24 GenCost report. Other technologies such as offshore wind and pumped hydro are detailed elsewhere in the GenCost report.

Notable increases are seen in combined-cycle gas turbines, gas with carbon capture and storage (CCS) and onshore wind, with a decrease in large-scale PV. The range of outcomes is due to the different material inputs and supply chains that are required for each technology. These changes represent an easing in global inflationary pressures which saw an average increase in technology costs of around 20% from 2021-22 to 2022-23.

Pumped hydro energy storage (PHES) costs have also increased, varying by storage depth, with a higher relative increase for shallower solutions, implying the power equipment and installation costs have increased by more than the storage reservoir.

CSIRO uses the updated current capital cost estimates in the GALLM model to produce capital cost forecasts that are a function of global and local technology deployment. GenCost estimates include consideration of global demand for each technology, which relates to, among other things, international climate policy and the renewable and fossil resources available to each region. While long-term cost changes remain a focus, consideration of current supply-chain pressures has been an increasingly important factor shaping the forecasts. The forecasts assume that it will take between four to seven years for technology costs to return to their expected trajectory prior to the global disruption to supply chains. Even after this period, and consistent with the approach to transmission costs, GenCost assumes that increase in land costs will have an ongoing impact on technology costs. The cost trajectory for each technology relative to the forecast in the previous reports is available in the GenCost 2023-24 report[27].

[27] See CSIRO GenCost 2023-24 report at https://aemo.com.au/consultations/current-and-closed-consultations/2024-forecasting-assumptions-update-consultation.

2.3.2 Capital cost trajectories

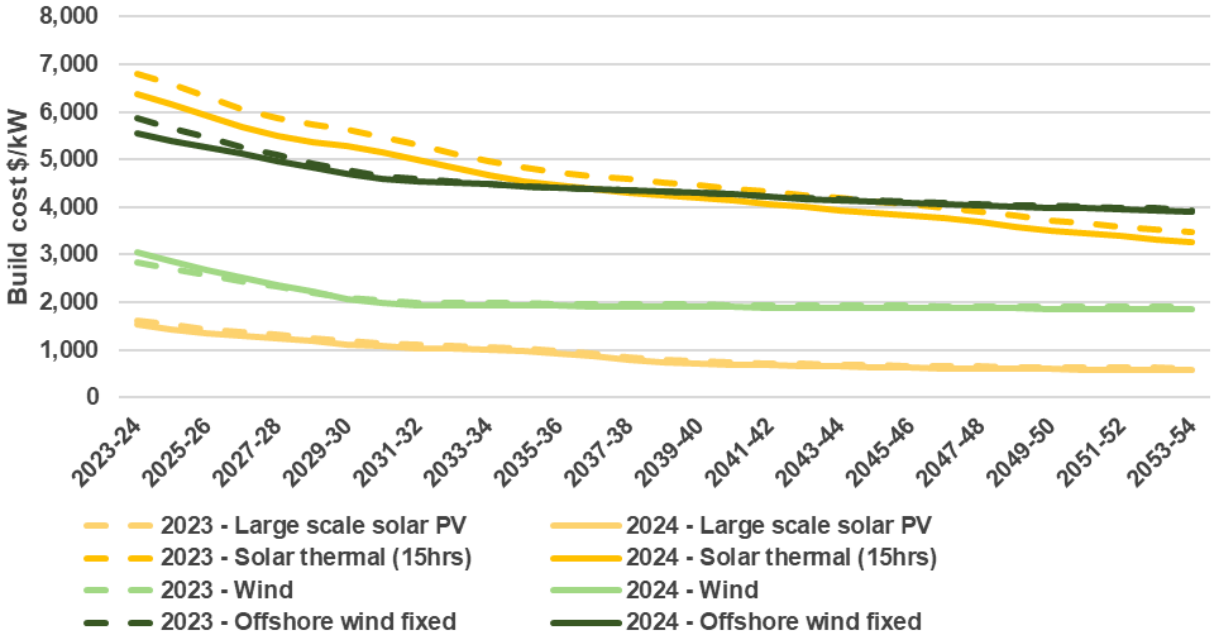
GenCost produces build costs for three scenarios ("Global NZE by 2050", "Global NZE post 2050" and "Current policies"). These scenarios are described in greater detail in CSIRO's GenCost report, and are then mapped by AEMO to the 2023 IASR scenarios, as shown in Table 8.

Table 8 Mapping AEMO scenario themes to the GenCost scenarios

AEMO scenario	GenCost scenario
Progressive Change	Current Policies
Step Change	GenCost Global NZE post 2050
Green Energy Exports	GenCost Global NZE by 2050

The figures below present a comparison of the build costs for major technologies. They show the Draft 2023-24 GenCost against the GenCost 2022-23 Final report data for the Global NZE post 2050 scenario, based on construction in Melbourne and excluding connection costs. More detailed cost projections are provided in the CSIRO data tables[28].

Figure 18 Draft 2023-24 vs Final 2022-23 Global NZE post 2050, for wind and solar



[28] See CSIRO GenCost 2023-24 data tables at https://aemo.com.au/consultations/current-and-closed-consultations/2024-forecasting-assumptions-update-consultation.

Figure 19 Draft 2023-24 vs Final 2022-23 Global NZE post 2050, for gas

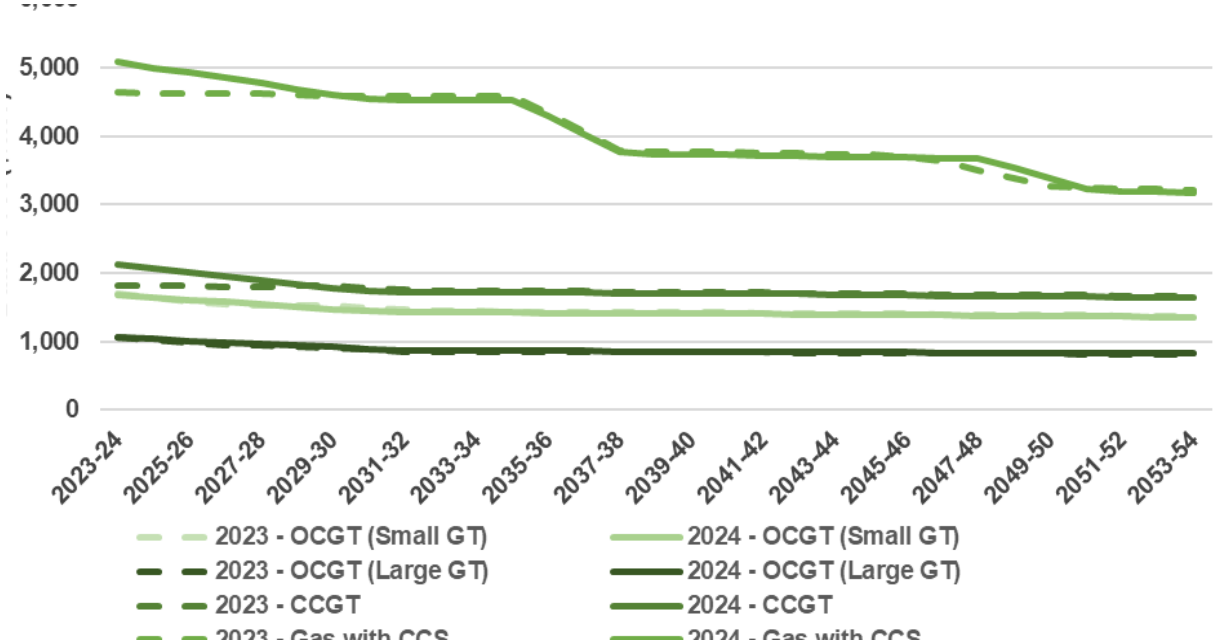
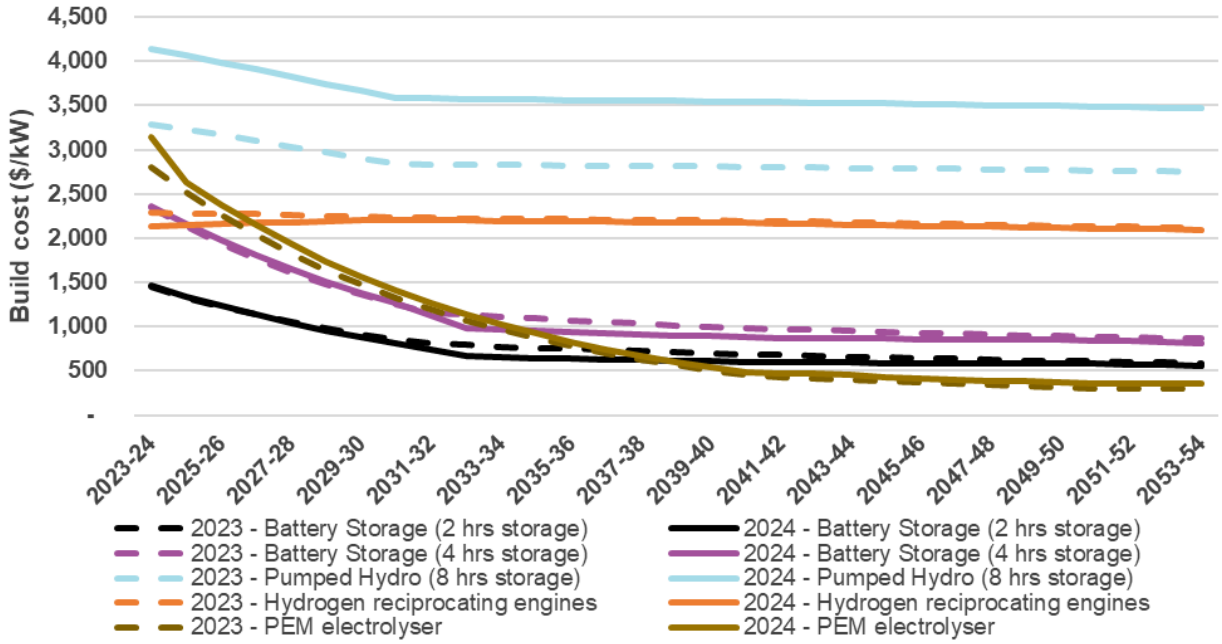


Figure 20 Draft 2023-24 vs Final 2022-23 Global NZE post 2050, for selected storage, hydrogen



Note that the two-hour battery costs show approximately 1% change in 2023, compared to CSIRO's quoted 2% change, due to a small difference in the assumed inflation rate from 2022 to 2023.

2.3.3 Technical and other cost parameters (new entrants)

Technical and other cost parameters for new entrant generation and storage technologies include:

- Unit size and auxiliary load.

- Seasonal ratings.
- Heat rate.
- Scope 1 emissions factors.
- Minimum stable load.
- Fixed and variable operating and maintenance costs.
- Maintenance rates and reliability settings.
- Lead time, economic life, and technical life.
- Storage parameters (including cyclic efficiency and maximum and minimum state of charge).

These parameters for new entrant technologies are updated as part of the annual GenCost scope of work to reflect the current trends and estimates of future cost and performance data of new technologies. These are published in the supporting material from Aurecon[29].

[29] See Aurecon Cost and Technical Parameters review at https://aemo.com.au/consultations/current-and-closed-consultations/2024-forecasting-assumptions-update-consultation.