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CONSULT AUSTRALIA
Member Firm

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Submission on the

2022 Draft AEMO Integrated System Plan

11th February 2022

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Disclaimer

1 Introduction

1.1 Electric Power Consulting Pty Ltd (EPC) welcomes the opportunity to participate in the consultation on the Draft 2022 Integrated Systems Plan (ISP). The ISP outlines a set of ambitious scenario pathways for the energy transition to Net Zero by 2050.

1.2 EPC acknowledges the scale and complexity of the task at hand. The Draft 2022 ISP addresses issues that will have a large bearing on the future development and prosperity of Australia. For this reason, we are keen to contribute to making the ISP a better plan.

2 About Electric Power Consulting Pty Ltd

2.1 Electric Power Consulting Pty Ltd is a consulting electrical engineering firm that was formed in 1990 by its owner and Director Dr Robert Barr. Dr Barr is a visiting professorial fellow at the University of Wollongong. EPC has special skills in electric power system analysis and has been providing consulting services to Network Service Providers, high voltage (HV) customers, large low voltage (LV) customers, universities and governments across Australia and overseas for over 30 years.

2.2 Of special interest to EPC is the topic of Distribution Network Planning. EPC provides a full 13 week Distribution Network Planning module for the University of Wollongong in the "Master of Power Engineering" course that has been completed by many post graduate students over the past decade. In preparing this submission we have been able to employ many of the most fundamental principles needed to successfully plan a Power System for the future. These skills include both technical and financial analysis.

2.3 EPC has special modelling tools that allow direct comparison with the ISP modelling. Much of this report is about comparison of AEMO power and energy modelling with EPC modelling.

2.4 We have not addressed issues of system strength, stability or inertia. These issues are very important but are beyond the scope of this report.

3 List of Abbreviations

Abbreviation	Description
AEMO	Australian Energy Market Operator
CF	Capacity Factor - Average generator MW output/generator MW rating
CO_2	Carbon Dioxide
DNSP	Distribution Network Service Provider
EPC	Electric Power Consulting Pty Ltd
GSRSF	Generation/ Storage Resource Scale Factor
ISP	Integrated System Plan
MW	Mega Watt (unit of power)
MWh	Mega Watt Hour (unit of energy)
NEM	National Electricity Market
NPV	Net Present Value
OCG	Open Cycle Gas (generator)
PV	Photo Voltaic
REZ	Renewable Energy Zone
t/MWh	tonnes/MWh (unit of CO_2 emissions)
TNSP	Transmission Network Service Provider
WACC	Weighted Average Cost of Capital

4 Overview of AEMO 2022 Integrated System Plan

4.1 The ISP's prescribed purpose is "… to establish a whole-of-system plan for the efficient development of the power system that achieves power system needs for a planning horizon of at least 20 years for the long-term interests of the consumers of electricity." The key question addressed in this submission by EPC is whether this purpose is achieved and how might the draft ISP be improved to better achieve this purpose.

4.2 In preparing this response to the draft ISP, we have limited our scope to two key areas that go to the heart of purpose of the ISP. These issues are:

a) The technical viability of the mix of transmission, generation and storage specified in each of the scenarios to meet the specified customer loads.

b) The quality of financial analysis and the identification of areas where improvements can be made.

4.3 Our efforts have focused primarily on the AEMO Step Change Scenario because it is the most advocated scenario. However, we do provide a brief assessment of the other scenarios.

5 The Planning Process

5.1 As with all network and system planning, the AEMO planning strategy involves many assumptions. Many of these are explicit and documented in the ISP materials, while others are implicit and are incorporated in the AEMO analysis and are not necessarily visible to the readers of the ISP. In some cases, some of the implicit assumptions made by AEMO may be so ingrained that they may not even be recognised as assumptions by AEMO itself.

5.2 The planning process by its very nature is iterative. It is always difficult to look even a few years forward, let alone 28 years forward to 2050. The net zero requirement dictated by various government policies is obviously a key constraint as the NEM plan evolves. We do not expect perfection, we know that is not possible. We do however expect the ISP to:

a) incorporate the basic engineering condition of generation/load balance at all times.

b) provide comparisons of delivered energy costs to customers on at least an annual basis from now through to 2050 for each scenario.

c) allow a comparison of delivered energy costs between scenarios.

d) provide sufficient detail of each scenario for third parties like EPC to fully understand both the engineering and the financial inputs and outputs of all the scenarios.

e) provide for reasonable ranges of random variability in renewable energy output, especially wind and solar PV, including:

   i. periods of wind drought and low solar radiance (dunkelflaute events).
   ii. random variability in combinations of wind and solar PV outputs.

f) provide a reasonable safety margin between generation and load at all times. This will include:

   i. adequate reserves of dispatchable generation; and
   ii. adequate reserves of stored energy.

5.3 In our view the existing draft ISP has not delivered what is needed in these key areas. Each of these key points are addressed in this submission.

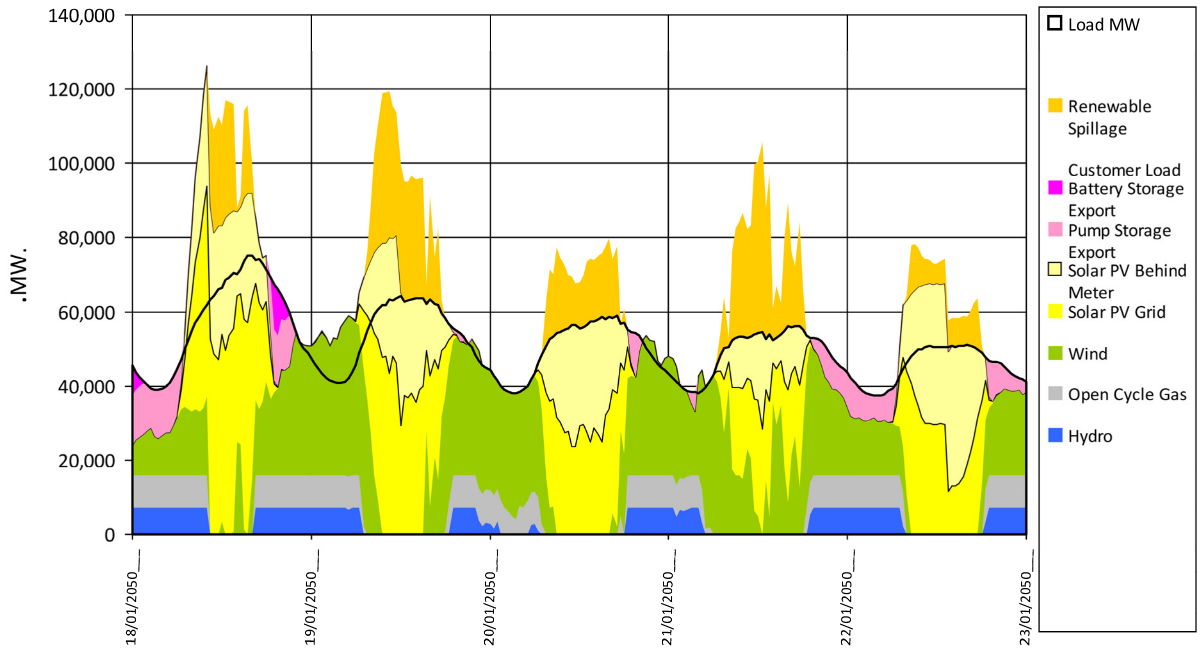
6 The Step Change Scenario

6.1 Typical Generation Profiles

6.1.1 As planners, when we look at network or system plans like the ISP, we are attracted to the end year which in this case 2050. The transmission build, generation mix, the energy storage mix is the input to the plan that delivers the nominated 2050 load at the required level of carbon emissions, reliability and cost. All the preceding years of the plan are stepping stones on how the plan is executed.

6.1.2 The 2050 generation mix and nominated MWh load/generation output was entered into the EPC NEM model to review its performance and characteristics. The load profile shape, MW wind patterns, and MW solar PV patterns were based on historical performance of the NEM from the years 2017, 2018 and 2019. Figure 1 shows EPC NEM model dispatch of generation, pump storage and battery storage for a period in January 2050. With abundant solar PV, wind and storage the dispatch is successful in fully meeting the needs of all customer loads. A high level of renewable spillage is evident. This renewable spillage is potential generation from wind and solar PV that cannot be utilised because it exceeds the ability of the system load and the storages to absorb it.

Figure 1 – Step Change Scenario – EPC Model of January 2050 Generation Profile



6.1.3 Figure 2 shows the EPC NEM model dispatch during part of June 2050 during a credible low in solar PV availability (winter and overcast) and a wind drought across SE Australia. These modelled conditions are based on actual conditions that occurred in June 2017. What is evident here is that the NEM's stored energy reserves have been exhausted and over 20,000 MW of load has been shed. This is an unacceptable reliability outcome showing that the EPC modelled NEM has insufficient generation and storage. Table 1 shows that 1.41% of the customer load remains unsupplied in the year 2050. Major supply outages were experienced across 52 days of the year. In addition, the carbon emissions of 0.12 t/MWh were inconsistent with a Net Zero requirement and were significantly higher than the 0.01 t/MWh modelled by AEMO. The contrast between the EPC NEM modelling and the AEMO ISP modelling is very stark.

Figure 2 – Step Change Scenario – EPC Model of June 2050 Generation Profile Showing Unsupplied Load

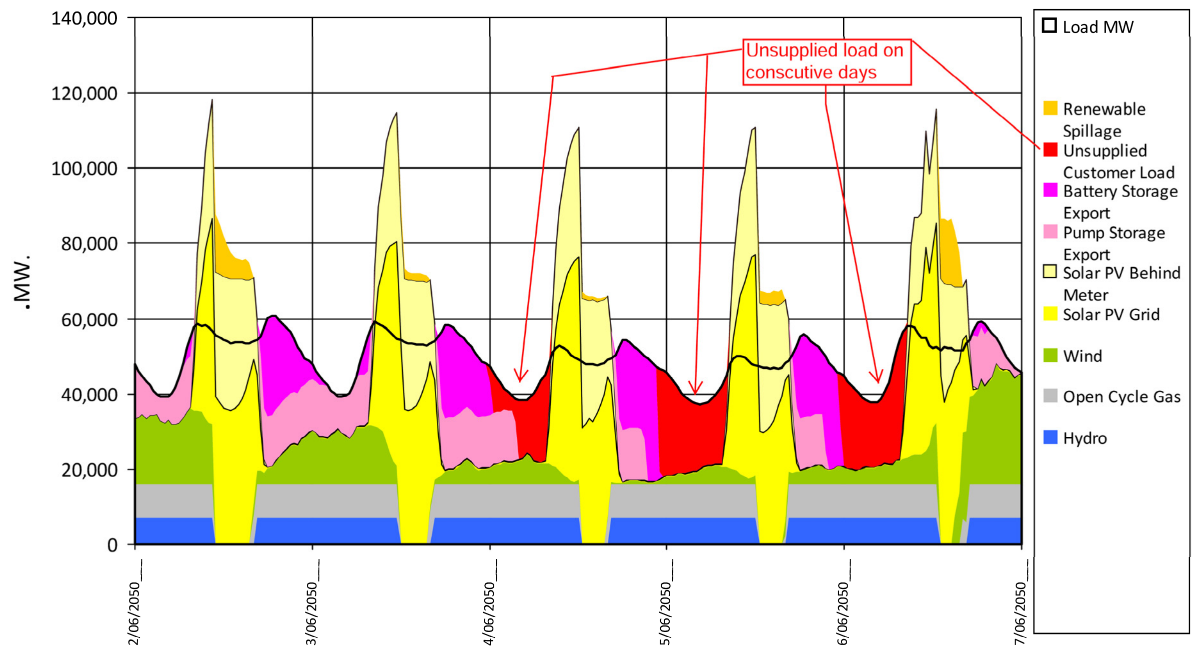


Table 1 – Statistical Measures of Performance – 2050 Step Change Scenario

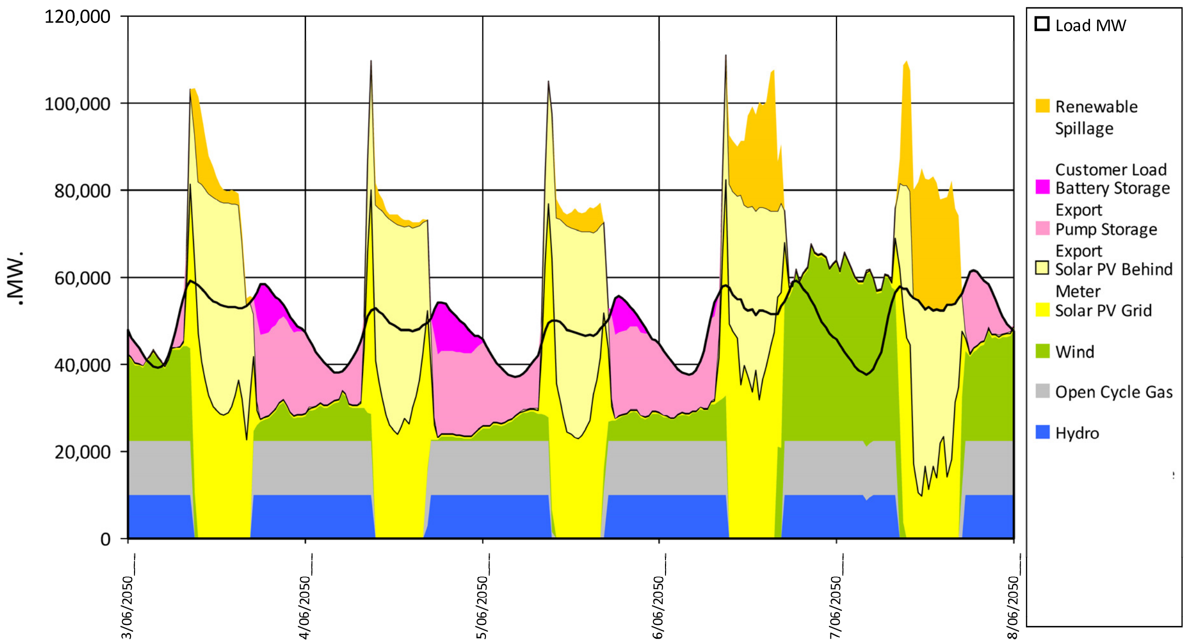
AEMO Data from Step Change Scenario		Carbon Emissions		Unsupplied Load - % of total load MWhs		EPC Model Results	
Year	Generation - Load Energy TWh	AEMO Model t/MWh	EPC Model Emissions t/MWh	AEMO ISP Model	EPC NEM Model	Supplied Load - % of Load MWhs	Days/year Impacted by Unsupplied Load
2050	416.37	0.01	0.12	0.0%	1.41%	98.592%	52

6.1.4 In contrast to the AEMO ISP modelling, it should be noted that EPC modelling takes into account embodied emissions in all generation and storage devices including solar PV, wind, pump storage and batteries when assessing carbon emissions.

6.2 Impact of Installing Extra Generation and Storage Resources

6.2.1 The question then addressed by the EPC modelling was how much extra generation and storage is required to be able to match supply and demand over the full 2050 year. Figure 3 and Table 2 show that the generation and storage inputs of the AEMO Step Change scenario in 2050 needs to be increased by 40%. Note that a 40% increase is represented by a "Generation and Storage Resource Scale Factor" (GSRSF) of 1.4. That is, all generator MW ratings are scaled up by a factor of 1.4 and all storages have both their MW and MWh ratings scaled up by a factor of 1.4.

Figure 3 – Step Change Scenario – EPC Model of June 2050 - EPC Model Generation and Storage Resource Scale Factor at 1.4

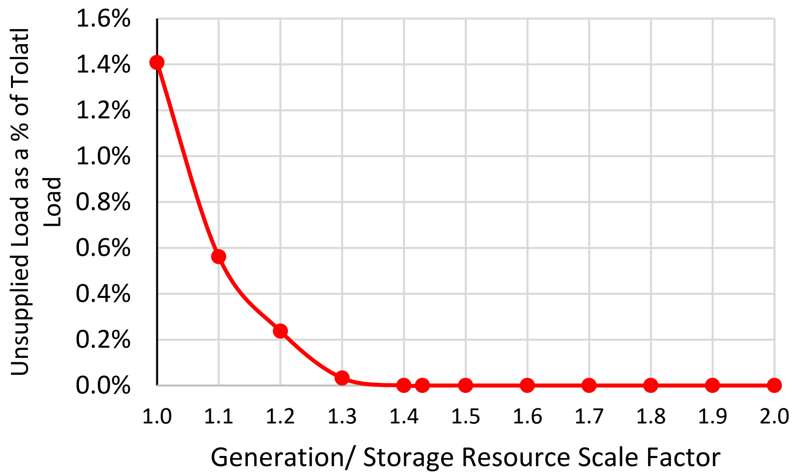


6.2.2 Figure 4 shows that as the GSRSF factor increases from 1 to 1.4 the level of unsupplied load for 2050 is driven down to zero. That is a 40% increase in generation/storage resources is required to supply the last and most difficult to supply 1.4% of load energy. This graph illustrates that when the NEM is dominated by Variable Renewable Generation and Storage, it is difficult and very expensive to supply that last component of load during the most severe wind drought and low solar PV output conditions. When we study the ISP scenarios, we see no evidence of the ISP addressing this issue.

Table 2 – Application of GSRSF Factors to the Step Change Scenario

Year	## Generation and Storage Resource Scale Factor (GSRSF)	Emissions t/MWh	Capacity Factor OCG	Unsupplied Load - % of Load MWhs	Supplied Load - % of Load MWhs	Days/year Experiencing Unsupplied Load
2050	1.0	0.117	59.4%	1.41%	98.592%	52
2050	1.1	0.112	51.3%	0.56%	99.438%	20
2050	1.2	0.107	44.4%	0.24%	99.763%	8
2050	1.3	0.102	38.7%	0.03%	99.968%	3
2050	1.4	0.098	34.1%	0.00%	100.000%	0
2050	1.4	0.066	18.7%	0.00%	100.000%	0
2050	1.5	0.062	16.1%	0.00%	100.000%	0
2050	1.6	0.040	5.8%	0.00%	100.000%	0
2050	1.7	0.034	3.4%	0.00%	100.000%	0
2050	1.8	0.029	1.3%	0.00%	100.000%	0
2050	1.9	0.027	0.6%	0.00%	100.000%	0
2050	2.0	0.026	0.4%	0.00%	100.000%	0

Figure 4 – Step Change Scenario – EPC Model 2050 Unsupplied Load over a Range of Generation and Storage Resource Scale Factors

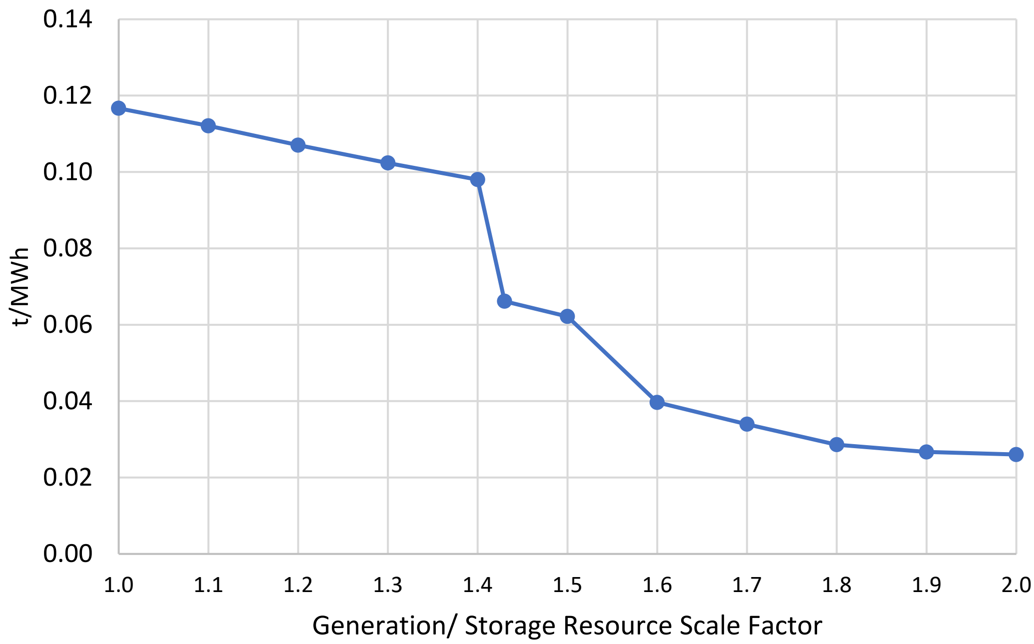


6.2.3 Figure 5 shows that as the GSRSF factor increases from 1 to 2, CO_2 emissions fall towards near zero levels. The decline is slow in the range of 1 to 1.4 because the prime purpose of the EPC model dispatch algorithm is to try and minimise the unsupplied load. After the load requirement is met at a GSRSF of 1.4, the

EPC model algorithm then directs more of the storage resources toward minimising CO_2 emissions by reducing the use of Open Cycle Gas (OCG) generation. As the GSRSF increases past 1.4, CO_2 emissions continue to fall until a minimum is reached at about a GSRSF level of 2.0.

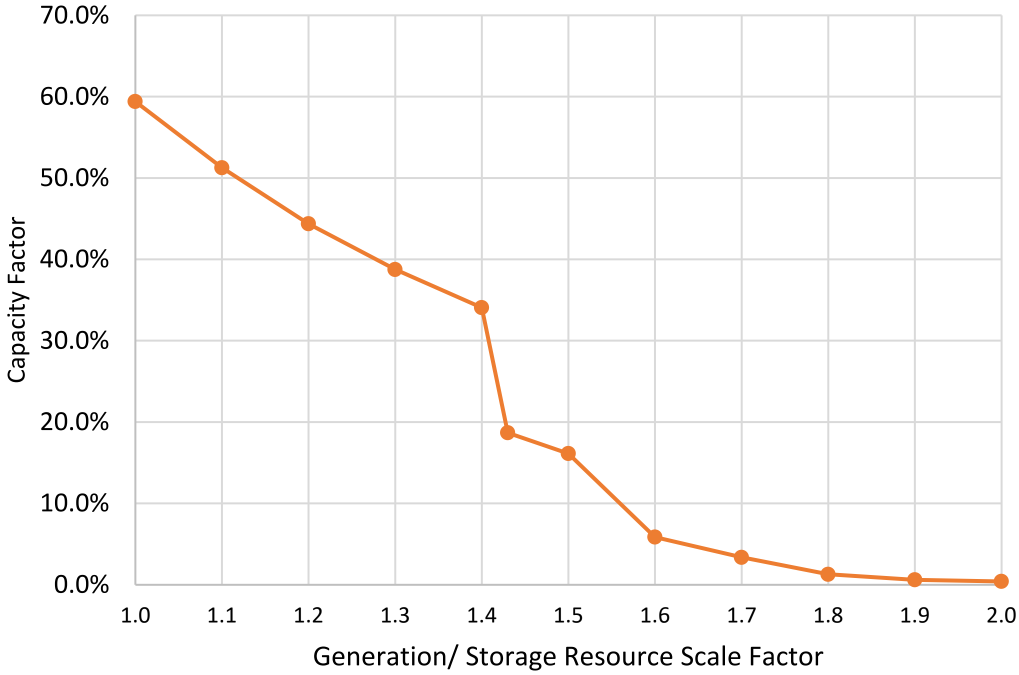
6.2.4 This analysis illustrates that to reach net zero emissions with high levels of variable renewable generation and storage, very large levels of resources are required, most of which will be held back in reserve and rarely used. EPC is not the first organisation to discover this phenomenon with variable renewable generation. Our conclusions are consistent with findings reached in the Massachusetts Institute of Technology Publication "The Future of Nuclear Energy in a Carbon Constrained World". When we study the AEMO ISP scenarios, we see no evidence of the ISP addressing this issue.

Figure 5 – Step Change Scenario – EPC Model of 2050 CO_2 Emissions over a Range of Generation and Storage Resource Scale Factors



6.2.5 Figure 6 shows the Capacity Factor of the OCG Generation. The curve has a shape very similar to that shown in Figure 5. This graph illustrates that the as the GSRSF factor increases from 1 to 2, CO_2 emissions fall. The reduced emissions are being driven by the diminished need to operate the OCG generation.

Figure 6 – Step Change Scenario – EPC Model of 2050 OCG Generator Capacity Factors over a Range of Generation and Storage Resource Scale Factors



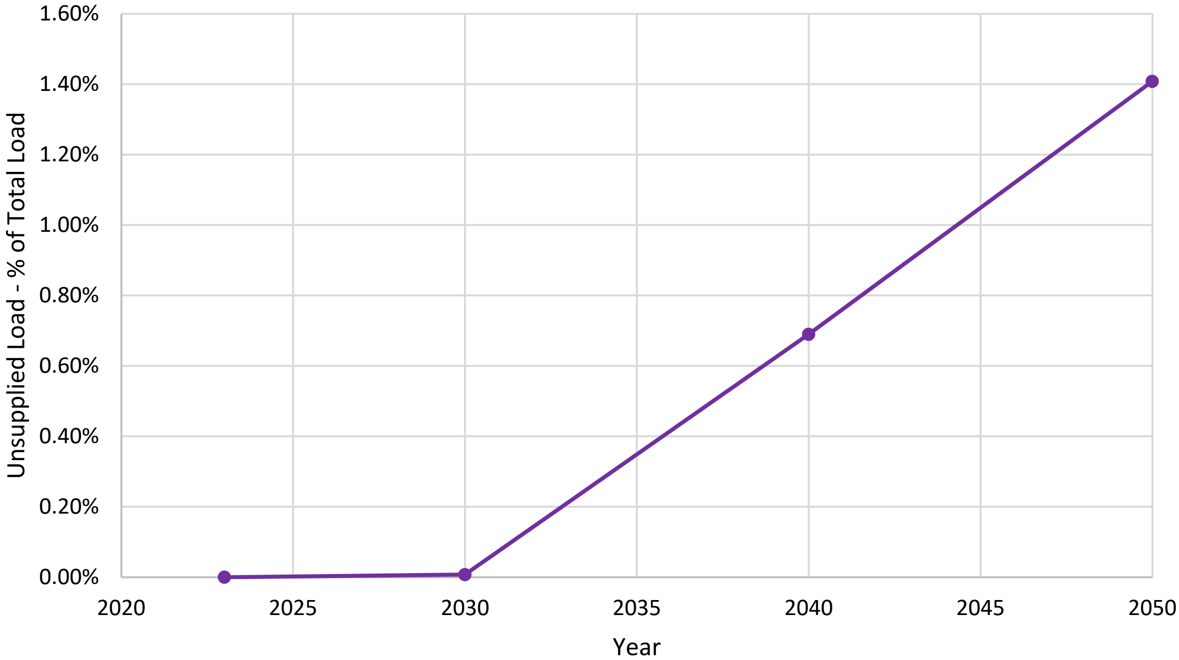
6.3 Development of the ISP Step Change Scenario from 2023 through to 2050

6.3.1 While it has not been possible for EPC to model each successive year through to 2050, we have been able to look at a sample of years 2023, 2030, 2040 and 2050 to see how the AEMO plan evolves in comparison to the EPC Modelling.

6.3.2 Figure 7 shows that the EPC modelled scenario has unsupplied customer loads beginning at about 2030 that tends to increase toward 2050. It should be noted that while the EPC model has been used to estimate the position of the dot points, the lines that join the points are for illustrative purposes only. The actual line will have many ups and downs as the generation mix and loads change each year.

6.3.3 Table 3 shows a comparison of generator capacity factors between the AEMO ISP Step Change model and the corresponding EPC Modelling. The comparison provides some insight into where the models are deviating as we move toward 2050. In 2023 both the AEMO and EPC modelling is in general alignment on the assessment of generator capacity factors. However, as we move toward 2050 the EPC model becomes much more reliant on OCG generation than the AEMO model. Also, the capacity factor for wind is about 33% for both the AEMO model and the EPC model. By 2050 the AEMO model maintains a similar level while the EPC model has the wind capacity factor reducing to about 24%. This is illustrated in Figure 8.

Figure 7 – Step Change Scenario – EPC Model of Unsupplied Load 2023 through to 2050

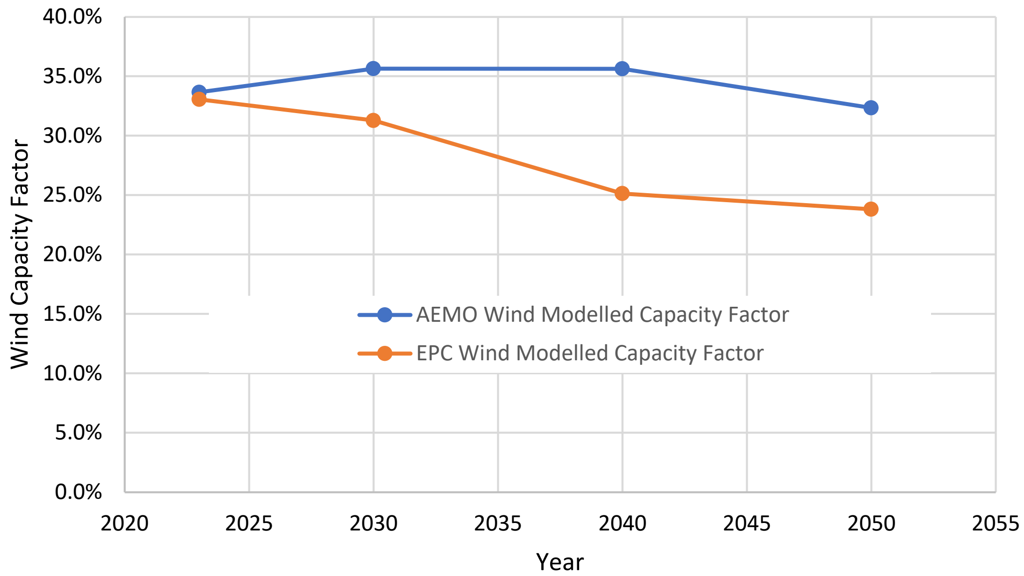


Note: Model samples taken only at 2023, 2030, 2040 and 2050 - line between points for illustration

Table 3 – ISP and EPC Model – Step Change - Comparison of Generation capacity Factors

Generation Source	2023 Capacity Factor		2030 Capacity Factor		2040 Capacity Factor		2050 Capacity Factor	
	AEMO Data	EPC Model	AEMO Data	EPC Model	AEMO Data	EPC Model	AEMO Data	EPC Model
Black Coal	64.17%	58.51%	63.36%	52.74%	65.98%	66.77%	N/A	N/A
Brown Coal	83.40%	82.35%	71.42%	60.26%	N/A	N/A	N/A	N/A
Mid-merit Gas (CCG)	5.30%	27.17%	15.44%	42.55%	32.95%	65.94%	N/A	N/A
Peaking Gas+Liquids (OCG)	0.17%	2.13%	1.08%	16.04%	4.83%	57.47%	9.19%	59.40%
Hydro	21.24%	13.25%	23.39%	22.62%	20.71%	28.58%	15.32%	28.64%
Utility-scale Storage (Pump Storage)	7.35%	1.54%	20.44%	17.45%	22.30%	18.21%	21.63%	25.48%
Wind	33.65%	33.06%	35.64%	31.28%	35.63%	25.12%	32.34%	23.81%
Utility-scale Solar	22.78%	26.12%	24.59%	26.09%	24.18%	21.99%	21.92%	20.36%
Distributed PV	13.88%	14.89%	14.65%	14.89%	15.21%	14.89%	15.52%	14.89%
Battery	3.67%	0.12%	5.17%	0.73%	6.27%	1.22%	7.89%	3.15%

Figure 8 – Step Change Scenario – Comparison of AEMO and EPC Modelled Capacity Factors 2023 through to 2050



6.3.4 The EPC modelled reduction in Wind Capacity Factor over time shown in Figure 8 is the direct result of congestion and renewable spillage. This is not traditional transmission congestion, but storage congestion related to the MW and MWh limits on storage. By comparison the AEMO wind capacity factor increases from 2023 to 2040 despite the congestion issues. Changes in renewable generation capacity factor over time is an underlying part of the main differences between the AEMO and EPC models.

6.4 Conclusions on the ISP Step Change Scenario

6.4.1 Differences in modelling outcomes between the AEMO modelling and the EPC modelling of the Step Change Scenario are very significant. While the AEMO modelling presents a smooth transition to net zero emissions with no unsupplied load issues, the EPC modelling points to major reliability problems and emissions levels well above what is being expected by governments.

7 Brief Review of the Other ISP Scenarios

7.1 Due to time constraints, it has not been possible to review the Slow Change Scenario, the Progressive Change Scenario or the Hydrogen Superpower Scenario in the same detail as the Step Change Scenario. However, we have been able to examine a simple model run of each of these plans for the year 2050. A summary of the results is shown in Table 4.

Table 4 – AEMO and EPC Model Comparisons – All ISP Scenarios

Year	AEMO Scenario	Generation - Load Energy TWh	Carbon Emissions		Unsupplied Load - % of total load MWhs		EPC Model Results	
			AEMO Model t/MWh	EPC Model t/MWh	AEMO Model	EPC Model	Supplied Load - % of Load MWhs	Days/year impacted by Unsupplied Load
2050	Step Change	416.37	0.01	0.12	0.0%	1.408%	98.592%	52
2050	Slow Change	223.67	0.05	0.16	0.0%	0.501%	99.499%	17
2050	Progressive Change	447.64	0.04	0.17	0.0%	0.561%	99.439%	22
2050	H_2 Superpower	1343.64	0.00	? ##	0.0%	3.183%	96.817%	? ##

Note: Unable to make an EPC Model estimate

7.2 Table 4 is showing that unsupplied load issues previously identified in the Step Change Scenario in 2050 are recurring in all the scenarios. The EPC modelling shows higher than expected CO_2 emissions are occurring in all the scenarios with the possible exception of the Hydrogen Superpower Scenario which the EPC model cannot evaluate.

7.3 Our conclusions are that AEMO/EPC modelling outcome differences identified in the Step Change Scenario are present in the other three scenarios in the key areas of reliability and emissions.

8 Review of the Economic Evaluation Methodology in the ISP Scenarios

8.1 We have reviewed in detail the economic analysis provided in the spreadsheet "2022 Draft ISP results workbook - Step Change Working.xlsx". We understand the use of the annuitised capital costs cashflow over an asset's economic life and the general methodology being used.

8.2 The ISP NPV costing of scenarios provided is useful for comparing variations in generation mixes and transmission development pathways within the confines of a set of load and other constraints defined by the particular scenario. Because each scenario has a different set of constraints, individual scenario NPV values are not comparable between scenarios This in our view is a major weakness that needs to be addressed in the final ISP.

8.3 The ISP financial methodology and results are very poor in conveying to industry, government and customers the impact on future delivered electricity costs.

8.4 Email advice received from AEMO that behind the meter costs of solar PV and battery storage do not form part of the ISP NPV analysis is a clear indication of the limitation of the existing ISP scenario financial analysis. If the aim is only to examine transmission options and HV connected generation mixes, this approach may be reasonable. However, in our view the ISP can do much more and be much more useful to its stakeholders.

8.5 It is our view the costs associated with augmentation of LV systems, MV systems and subtransmission systems need to be addressed. The focus of the draft ISP needs to extend to include all costs, including behind the meter Solar PV and Battery costs because they form such an integral part of the ISP scenarios. A direct consequence of this approach is that the NPVs calculated for each of the scenarios in the existing draft ISP are not comparable with each other and hence they provide no guidance on which scenario might provide the best outcome for customers.

8.6 It is our view that the ISP financial analysis needs to go beyond what has been provided in the draft ISP. The ISP aim should be to minimise the total cost of electricity supply to customers, not just to minimise the NPV cost of transmission, HV generation and grid storage. The scope of the electricity costs needs to include:

- Grid connected generation (both DNSP and TNSP).
- Transmission.
- Grid connected storage (both DNSP and TNSP).
- All subtransmission (both conventional load and REZ developments).
- All LV and MV distribution.
- All behind the meter generation and battery storage.
- Retail and metering

8.7 The ISP needs to become more customer focused and show comparable HV and LV customer delivered costs in $/MWh for each year through to 2050 for all the scenarios. These costs could be based on 2022 prices with a nominated WACC of say 6% or similar. All scenario costs and NPVs need to be on a common base so that they can be directly compared. Without this detail the ISP is delivering only part of what it is capable of, and the public is not getting value for the investment made in building the plan.

8.8 Most of the data needed to complete this task is readily available from the work already undertaken on the draft ISP. The balance of information needed is available in the public domain or via the AER. EPC can provide assistance in defining a suitable methodology if requested.

8.9 In the NEM, electricity supply costs are driven by investments by generators, TNSPs, DNSPs, Retailers, Meter Service Providers and customers. For customers, the supply cost contribution is mostly by way of rooftop solar PV and small-scale battery storage. The aim should be to build ISP scenarios to assess and minimise the ongoing delivered costs of energy. Small scale behind the meter solar PV and battery storage needs to be treated as just another NEM resource. If AEMO can achieve this objective, it will have provided a very valuable community service.

8.10 The use of this methodology is unlikely to change the rankings of existing transmission recommendations made in the ISP. It will however open up a new informed conversation on the best way forward having regard to all the NEM scenarios put forward.

9 Request for Additional Scenario Data

9.1 To demonstrate the credibility of each of the scenarios, it is recommended that the additional information covering customer energy use, capacity factors, storage performance, environmental performance and reliability of supply as detailed in Appendix 1 be included in the ISP spreadsheets.

9.2 To build the costing methodology described in section 8, it is recommended that the additional information covering financial performance as detailed in Appendix 1 be included in the ISP spreadsheets.

10 Conclusions

10.1 Differences in all the scenario outcomes between the AEMO modelling and the EPC modelling are very significant and cannot be ignored. While the AEMO modelling presents a smooth transition to net zero emissions with no unsupplied load issues, the EPC modelling points to major reliability problems and emission levels well above what is expected by governments.

10.2 The differences in modelling outcomes will come down to the underlying assumptions, model inputs and methodologies. It is our view that there is much to be gained for the Australian community if the causes of the differences in modelling outcomes can be identified. Identifying these differences is the key to building a stronger more robust plan for the future.

10.3 Extreme periods of wind drought and low solar radiance (dunkelflaute events) need to be very well understood because they a key driver in determining the required investment levels in power systems dominated by variable renewables.

10.4 The existing ISP NPV financial analysis is very transmission centric and would benefit from being broadened to include amongst many other categories, behind the meter generation and battery storage assets. There is a large need to make the ISP more customer focused.

11 Recommendations

11.1 It is recommended that:

a) AEMO study the EPC results provided in this report to gain an understanding of the EPC NEM modelling.

b) AEMO and EPC work closely in collaboration to identify the underlying causes of the differences in outcomes between the AEMO ISP models and the EPC models.

c) The ISP scenarios address and report on their responses to the most extreme periods of wind drought and low solar radiance (dunkelflaute events).

d) The ISP financial reporting be enhanced to include all electricity supply costs including behind the meter solar PV and batteries, LV networks, MV networks and subtransmission systems.

e) The ISP financial reporting be enhanced to include HV and LV customer delivered costs in units of $/MWh for each scenario and for each year through to 2050.

f) Additional data be provided in the scenario spreadsheets as detailed in Appendix 1.

Appendix 1 – Request for Additional Data

In the interests of providing greater credibility to the ISP scenarios and providing enhanced financial reporting it is recommended that the following measures be incorporated into the spreadsheet attachments to the ISP.

Scenario Characteristics

Energy to Customers	2023-24	2024-25	>>>>>	2049-50
Delivered Energy to HV Customers (GWh)	??	??		??
Delivered Energy to LV Customers (GWh)	??	??		??
Delivered Energy to all Customers (GWh)	??	??		??
Renewable Spillage (GWh)	??	??		??
Network Losses (GWh)	??	??		??
Storage Losses (GWh)	??	??		??
Total Losses (GWh)	??	??		??

Customer Demand

Maximum Demand NEM (MW)	??	??		??
Maximum Demand TAS (MW)	??	??		??
Maximum Demand SA (MW)	??	??		??
Maximum Demand NSW (MW)	??	??		??
Maximum Demand VIC (MW)	??	??		??
Maximum Demand QLD (MW)	??	??		??
Minimum Demand NEM (MW)				
Minimum Demand TAS (MW)	??	??		??
Minimum Demand SA (MW)	??	??		??
Minimum Demand NSW (MW)	??	??		??
Minimum Demand VIC (MW)	??	??		??
Minimum Demand QLD (MW)	??	??		??
Annual Load Factor NEM %	??	??		??
Annual Load Factor TAS %	??	??		??
Annual Load Factor SA %	??	??		??
Annual Load Factor NSW %	??	??		??
Annual Load Factor VIC %	??	??		??
Annual Load Factor QLD %	??	??		??

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Financial Performance	2023-24	2024-25	>>>>>	2049-50
assets)	??	??		??
$ Weighted Average Asset Life (years - all assets)	??	??		??
Effective Asset Age (years - all assets)	??	??		??
Depreciation Charge $B/year - (2022 dollars)	??	??		??
Depreciated Value of all assets $B (2022 dollars)	??	??		??
System Operation and Maintenance $B/year - (2022 dollars)	??	??		??
Average Cost of Supply to HV Customers $/MWh (2022 dollars - 6% WACC)	??	??		??
Average Cost of Supply to LV Customers $/MWh (2022 dollars - 6% WACC)	??	??		??
Average Cost of Supply to all Customers $/MWh (2022 dollars - 6% WACC)	??	??		??
Capacity Factors				
Black Coal Capacity Factor %	??	??		??
Brown Coal Capacity Factor %	??	??		??
Mid-merit Gas Capacity Factor %	??	??		??
Peaking Gas+Liquids Capacity Factor %	??	??		??
Hydro Capacity Factor %	??	??		??
Offshore Wind Capacity factor %	??	??		??
Wind Capacity factor %	??	??		??
Utility-scale Solar Capacity factor %	??	??		??
Distributed PV Capacity factor %	??	??		??
Storage Performance				
Utility-scale Storage (Discharge Cycles per Year)	??	??		??
Coordinated DER Storage (Discharge Cycles per Year)	??	??		??
Distributed Storage (Discharge Cycles per Year)	??	??		??
Environmental Performance				
Carbon Emissions Intensity t/MWh	??	??		??
Security of Supply				
Minimum Generation Margin Over Demand during year TAS (MW)	??	??		??
Minimum Generation Margin Over Demand during year SA (MW)	??	??		??
Minimum Generation Margin Over Demand during year NSW (MW)	??	??		??
Minimum Generation Margin Over Demand during year VIC (MW)	??	??		??
Minimum Generation Margin Over Demand during year QLD (MW)	??	??		??