Network of Illawarra Consumers of Energy

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Submission in response to AEMO's Draft 2022 Forecasting Assumptions Update

January 2022

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Summary

This submission is made by the Network of Illawarra Consumers of Energy (NICE), a recently formed entity advocating for the energy transition to a net-zero carbon future to be managed with the interests of consumers at heart.

Our focus in the submission is on the purpose of the ISP and the use of scenarios to fulfil that purpose. We submit that the current use of scenarios inadequately reflects the inherent uncertainties in system planning, with particular attention to policy uncertainty.

We distinguish the use of scenarios in forecasting and scenario planning as a variety of strategic management. We also highlight the value of scenario planning in overcoming natural human biases that constrain thinking about possible futures.

We support the development of a low-emissions gas scenario; on the proviso, the endpoint is still a zero-emissions (not net zero-emissions) energy system by 2050.

Contents

Glossary

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
COAG	Council of Australian Governments – an entity that existed from the 1991 recession until the 2020 recession
DER	Distributed Energy Resources which includes generation, storage and loads that can respond to price or non-price signals.
Draft	AEMO's *Draft 2022 Forecasting Assumptions Update* of November 2021
EC	COAG Energy Council
ECA	Energy Consumers Australia
ESB	Energy Security Board
ESOO	Electricity Statement of Opportunities
Finkel Review	*Independent Review into the Future Security of the National Electricity Market: Blueprint for the future* chaired by Alan Finkel that reported to COAG leaders in 2017.
FRG	Forecasting Reference Group
GSOO	Gas Statement of Opportunities
Guideline	*Cost Benefit Analysis Guidelines* required under NER 5.22.5
IASR	Inputs Assumptions and Scenarios Report prepared by AEMO
ISP	Integrated System Plan – a recommendation of the Finkel Review designed to be more than a transmission plan on steroids.
NEM	The (misnamed) National Electricity Market. The term is used both to refer to the bulk power market operated by AEMO and to the integrated electricity system including regulated networks and competitive retail markets.
NER	National Electricity Rules
NICE	Network of Illawarra Consumers of Energy
PV	Photovoltaic – a shorthand for solar panels located on consumer premises
RRO	Retailer Reliability Obligation
ToR	Terms of Reference
TUNA	Turbulence, uncertainty, novelty, and ambiguity – a term from Ramirez, R & Wilkinson, A 2016, Strategic reframing: The Oxford scenario planning approach, Oxford University Press

Introduction

NICE

The Network of Illawarra Consumers of Energy (NICE) is a recently formed informal network advocating for the energy transition to a net-zero carbon future to be managed with the interests of consumers at heart.[1] This necessary transition needs to occur at least cost to consumers while maintaining reliability and security of energy services, appropriate consumer protections for essential services and a just transition for affected workforces.

We believe there is a role for regionally based advocacy within the context of nationally consistent energy policy. The choice and options for energy supply do differ by geographic region regarding different climatic conditions affecting demand and supply options and different risk factors impacting resilience planning. David Havyatt is the sole author of this submission.[2]

This submission

We appreciate the opportunity to comment on the Australian Energy Market Operator's (AEMO) *Draft 2022 Forecasting Assumptions Update* (the Draft) of November 2021. This submission was motivated by a discussion on the 2023 Inputs Assumptions and Scenarios Report (IASR) process kick-off and engagement planning at the January Forecasting Reference Group (FRG) meeting.

The submission does not primarily engage with the consultation questions included in the Draft. Instead, it focuses more generally on the use of scenarios in AEMO's planning activities.

Currently, and appropriately, the Electricity Statement of Opportunities (ESOO), the Gas Statement of Opportunities (GSOO) and the Integrated System Plan (ISP) use the same set of scenarios. However, as the ESOO and GSOO both focus on shorter-term outcomes, the impact of the scenarios is less than in the ISP.

While the Draft is subtitled 'For use in the 2022 National Electricity Market Reliability Forecast, ' any changes to the forecasting assumptions will flow through to other processes. The Draft seeks views on whether an additional scenario – dubbed the 'low-emissions gas-focused scenario' – should be included. Rather than merely addressing the narrow question, we recanvas our concerns about the choice and use of scenarios in all the AEMO planning documents.

While the ESOO can result in significant extra costs to consumers through any invocation of the Retailer Reliability Obligation (RRO), the ISP has a greater impact overall on both prices and quality of service for future customers. Accordingly, we start the submission with a discussion on the role of the ISP. We note that AEMO will significantly recast the scenarios for the next ISP. However, we want to raise these issues now to ensure AEMO adequately plans future scenario

[1] The network has not yet started actively recruiting participants.
[2] Mr Havyatt was employed as Senior Economist at Energy Consumers Australia from October 2015 to August 2020. For the avoidance of doubt, nothing in this submission is the position of Energy Consumers Australia.

development. Our extensive commentary about the ISP provides our reason for our response to the specific question of the low-emissions gas scenario.

Our discussion of the role of the ISP attempts to delineate the difference between the ISP and the National Transmission Network Development Plan (NTNDP) that it replaced. We assert that ISP has been introduced to provide a broader service than merely transmission planning. We note that in making the actionable ISP rules, the Energy Security Board (ESB) assured stakeholders that the ISP could include a range of policy alternatives in developing scenarios.

This is followed by a consideration of scenario planning as a methodology. This draws out the distinction that this is a specific type of planning, not just an approach to other planning methodologies (e.g. forecasting) with the addition of scenarios. In this, we focus on the tendency of humans to include subconscious biases in their analyses based on their prior knowledge. We further draw out the importance of policy as a source of uncertainty that needs to be incorporated into scenarios.

We finally bring the function of the ISP and consideration of scenario planning as a methodology together to deliver a set of recommendations about the choice and use of scenarios by AEMO. We do this by illustrating the inadequacy of the current scenario set in addressing viable future alternatives on the extent of PV generation in distribution networks.

Our first conclusion is that AEMO needs to define scenarios more by the outcomes they reflect rather than by the pathways of the inputs that generate the scenario. Our second conclusion is that AEMO needs to break down the rigid separation between IASR development and system modelling to recognise that the scenarios are only valid if the system modelling of the scenario results in the outcomes included in the scenario specification.

Matters for consultation

We respond to the specific matters for consultation in the Draft as follows.

Would a low-emissions gas-focused scenario complement the existing suite of scenarios for use in some or all of AEMO's forecasting and planning publications?

Yes (see the penultimate section)

What are the key drivers this scenario would incorporate, distinguishing it from the existing scenarios?

No comment

Do you have any feedback on the updated technology cost assumptions relating to new technologies, as described in this report or the referred Draft GenCost 2021-22 report?

No

Do you have any feedback on the assumed gas price trajectory?

No

The Integrated System Plan

Finkel review and recommendation

The *Independent Review into the Future Security of the National Electricity Market*, chaired by Alan Finkel (the Finkel Review), was commissioned by the COAG Energy Council (EC) on 7 October 2016[3]. Following a presentation by Dr Finkel of his preliminary report to the Council of Australian Governments (COAG) meeting held on 9 December 2016, the Meeting Communique[4] recorded:

> *COAG agreed that governments must prioritise energy security, reliability and affordability as the electricity sector transitions to low emissions technologies. As the electricity sector accounts for 35 per cent of Australia's carbon emissions, Leaders agreed it has an important role to play in meeting Australia's commitments under the Paris Agreement. Leaders noted the technical challenges to be overcome to successfully manage this transition and asked the COAG Energy Council to make it easier to expedite changes to frameworks, technical standards and rules that will assist in managing this transition and to accelerate proof of concept projects in relation to new technologies and infrastructure enhancements.* ***Leaders committed to urgently progress work on broader solutions to provide certainty to industry, drawing on the outcomes of Dr Finkel's final review.*** *(emphasis added)*

The proximate cause of the EC decision was the 'system black' event in South Australia, as reflected in the Terms of Reference (ToR - these are included as Appendix 1 as they are difficult to find online). There are two significant consequences of this. The first is that the ToR referred to the AEMO, Australian Energy Market Commission (AEMC) and Australian Energy Regulator (AER) reviews of the system black event and envisioned that the Finkel Review would 'draw together and build on the analysis and findings of the recent and ongoing work streams.' Instead, Finkel reported before any of these were completed.

The second is that the single most significant cause of the system black event was the settings AEMO made for the operation in South Australia, particularly interconnector flows, in the face of a well forecast catastrophic storm.[5] Even though the Finkel review did not have the market body reviews nor recognise that the event had been avoidable by AEMO, the review provided its final report on 9 June 2017. On that day, COAG asked the EC to consider the review and provide advice on which recommendations could be implemented and a timeline for doing so.

The chair of the EC wrote to the Prime Minister with a response on 31 August 2017, which advised that all but one recommendation would be implemented and outlined a three-year program for doing so. While this response would normally have been considered at the next

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[3] https://www.energy.gov.au/government-priorities/energy-markets/independent-review-future-security-national-electricity-market

[4] https://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;query=Id:%22media/pressrel/4985522%22

[5] See Simshauser, P 2019, 'Lessons from Australia's National Electricity Market 1998-2018: the strengths and weaknesses of the reform experience', University of Cambridge Energy Policy Research Group, EPRG Working Paper 1927. Since revised in Simshauser, P 2021, 'Lessons from Australia's National Electricity Market 1998-2018: strengths and weaknesses of the reform experience', in *Handbook on Electricity Markets*, Edward Elgar Publishing.

COAG meeting, there was no reference to it in the communique, and it is the author's understanding that it was simply noted without discussion.

Despite the support given by EC, several recommendations remain outstanding, and many others were slow to occur.[6] However, the recommendation for AEMO to prepare an integrated grid plan was heartily embraced, based on three recommendations:

> *5.1 By mid-2018, the Australian Energy Market Operator, supported by transmission network service providers and relevant stakeholders, should develop an integrated grid plan to facilitate the efficient development and connection of renewable energy zones across the National Electricity Market.*
>
> *5.2 By mid-2019, the Australian Energy Market Operator, in consultation with transmission network service providers and consistent with the integrated grid plan, should develop a list of potential priority projects in each region that governments could support if the market is unable to deliver the investment required to enable the development of renewable energy zones. The Australian Energy Market Commission should develop a rigorous framework to evaluate the priority projects, including guidance for governments on the combination of circumstances that would warrant a government intervention to facilitate specific transmission investments.*
>
> *5.3 The COAG Energy Council, in consultation with the Energy Security Board, should review ways in which the Australian Energy Market Operator's role in national transmission planning can be enhanced.*

The focus of AEMO and Governments has primarily been on the first and last of these recommendations. However, it is the second that we believe has always warranted more attention. The key emphasis in this recommendation is identifying projects that governments could support.

AEMO has identified that integrated system planning (Finkel's section title) required more than an integrated grid plan. AEMO's Consultation Paper for the inaugural ISP stated:

> *AEMO is calling this an Integrated System Plan (ISP), rather than an integrated grid plan, to reflect that over time, the ISP will by necessity consider a wide spectrum of interconnected infrastructure and energy developments including transmission, generation, gas pipelines, and distributed energy resources2. The June 2018 ISP is not the end of the process, but rather the first of many steps, with updates in future years to reflect the dynamically changing nature of the power system and the need to continually innovate and evolve strategies for the future.*[7]

This principle was expanded upon in the 2018 ISP, which said:

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[6] The most notable of all the unactioned is recommendation 7.3 that called for a new Australian Energy Market Agreement by mid-2018 to take a nationally consistent approach to energy policy. A close second is 7.10 which called for a Statement of Policy Principles to provide clarification and guidance on interpreting the NEO, the intent being to require consideration of emissions reduction. Third goes to recommendation 7.14 which called for a data strategy by end-2018; a strategy document was delivered as part of the Post 2025 documentation, but there appears to be no implementation plan.

[7] https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/isp/2017/integrated-system-plan-consultation.pdf?la=en

> *Whenever an industry undergoes the level of transformative change the power industry is experiencing, a level of disruption is to be expected. However, when that change occurs in an essential industry such as energy, neither economic nor physical failure, even for a short time period, is an acceptable outcome. In this circumstance, it is essential to have independent engineering and evidence-based planning around forecastable changes across the spectrum of the supply and demand equation and consumer and investor preferences.*
>
> *By providing a forecast plan of a likely range of outcomes, this ISP helps identify the desirability of proactive policy, regulatory, and market reforms in the public interest. Collectively, these actions can simultaneously identify required and likely investments, provide pathways for orderly retirements and investment in new resources that can best meet established and new policy and economic objectives, and enable broad innovation through the removal of existing and emerging barriers to entry and competition. As a result, the transition can occur in a much more orderly manner, reduce the risk of failure from uncontrollable and unplanned events, and help ensure the public interest in reliable, affordable energy is met, in the context of government energy policies, including emission standards.*[8]

In the Draft 2022 ISP, AEMO has enunciated the same sentiment as:

> *As a rigorous whole-of-system plan, prepared in collaboration with NEM jurisdictional planners and policy-makers, energy consumers, asset owners and operators, and market bodies, the ISP is the most comprehensive analysis of Australia's energy future.*[9]

To put it simply, the ISP is a lot more than just a national transmission plan.

The actionable ISP

That said, the third recommendation and EC's desire to force transmission builds on consumers resulted in the reforms to make the ISP 'actionable.' A consequence of the Ministerial rule changes to deliver this goal was that the use of scenarios became part of the rules.

In particular NER 5.22.6(a)(4) states:

> *An Integrated System Plan must identify the optimal development path which must be based on a quantitative assessment of the costs and benefits of various options across a range of scenarios, in accordance with Cost Benefit Analysis Guidelines.*

NER 5.22.5 requires the AER to publish *Cost Benefit Analysis Guidelines* (the Guidelines), one of the functions of which is that they must "require AEMO to test the robustness of alternative development paths to future uncertainties through the use of scenarios and sensitivities" (5.22.5(d)(2)). However, in developing and publishing the Guideline, the AER must "provide flexibility to AEMO in its approach to scenario development, modelling and selection of the optimal development path" (5.22.5(e)(2)).

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[8] https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/isp/2018/integrated-system-plan-2018_final.pdf?la=en&hash=40A09040B912C8DE0298FDF4D2C02C6C

[9] https://aemo.com.au/-/media/files/major-publications/isp/2022/draft-2022-integrated-system-plan.pdf?la=en

Section 3.2.2 of the AER's Cost Benefit Analysis Guidelines (the Guidelines) specifies the approach to scenarios required by the AER.[10] The AER describes scenarios as "different future external market environments that are used in a CBA to assess and manage uncertainty about how the future will develop. They are based on variations to input variables and parameters that drive supply and demand conditions (for example, population growth, coal and gas prices, etc.)." The requirements it places on AEMO are to consider:

- The major sectoral uncertainties affecting the costs, benefits and need for investment in the NEM, when selecting the input variables and parameters that form part of each scenario.
- Taking the most probable value(s) for each input variable and/or parameter that forms part of the most likely scenario.
- Taking a balanced approach to risk in varying input variables and/or parameters to create reasonable scenarios around the most likely scenario.
- Using internally consistent input variables and parameters for each scenario, such that each scenario represents a plausible market environment.

While noting that AEMO has flexibility in its development of scenarios, the AER recommends the following discretionary principles:

- To explore the impact of major uncertainties, it would be valuable to consult with stakeholders in developing a purpose for each scenario.[11]
- Represent a reasonable range of plausible future market environments informed by stakeholder consultation and should be stretching so as to cover a range of uncertainties, but without being skewed by unrealistic events.
- Consist of inputs that are exogenous to the development paths but relevant to investment decision making. That is, the set of input variables used to construct a scenario should not be influenced by a given development path.

This description of the use of scenarios is consistent with the approach we describe as using in forecasting, which we will shortly distinguish from scenario planning.

Defining scenarios and sensitivities in forecasting

As noted above, the NER requires the ISP to test the robustness of development paths through scenarios and sensitivities. These terms are not otherwise defined. In the Guidelines, the AER defines scenarios as noted above and further notes that AEMO has flexibility over how it undertakes sensitivity testing, but suggests that sensitivity testing should:

[10] https://www.aer.gov.au/system/files/AER%20-%20Cost%20benefit%20analysis%20guidelines%20-%2025%20August%202020.pdf

[11] The Guideline gives as an example of this principle "a 'high distributed energy resource' scenario might explore how a highly distributed grid would affect the costs, benefits and need for investments in an optimal development path."

- Only vary inputs (or underlying assumptions) that are not already varied through scenario analysis.
- Test important inputs such as the discount rate and VCR.
- Test cost estimates against the lower and upper end of their ranges
- Be used to identify the key inputs or assumptions, i.e. those where uncertainty has the greatest impact on outcomes.
- Illustrate 'boundary values' for particular inputs at which the optimal development path changes. AEMO can then discuss the plausibility of that value and evaluate the risk of that development path.

In finance, scenario analysis and sensitivity analysis are distinguished by using the latter term to refer to modelling the impact of varying only one input variable.[12] In integrated resource planning for utilities, one paper distinguishes between scenario analysis (*In scenario analysis, alternative futures are posited, each containing internally consistent combinations of key uncertain factors, such as fuel prices, availability of new and existing generating facilities, environmental regulations and load growth*) and sensitivity analysis (*In sensitivity analysis, a preferred combination of options, often referred to as a plan, is developed. Then, different values are assumed for a number of potentially important factors (e.g., natural gas prices and economic growth), and the performance of the original plan is examined in the face of these changed conditions*.)[13]

This latter version is how the Rules and AEMO interpret the difference between the scenario analysis and the sensitivity analysis. In particular, the ISP sensitivity analysis is applied not to the most likely scenario but the Optimal Development Path.

The purpose of the ISP

The original Finkel recommendation for an Integrated System Plan is clearly intended to be something more than just a revamped NTNDP. It is equally clear that Finkel expected strengthening of AEMO's transmission planning function, which was developed through the actionable ISP rules.

The policy dimension of the ISP was recognised by the inclusion of specific provisions for policy consideration in the plan. When including these Rule provisions, the ESB assured stakeholders that these specific Rules did not limit AEMO's ability to consider other possible policies.

AEMO is required to use scenarios in the ISP. As stated by the AER, these are used to 'assess and manage uncertainty about how the future will develop.' Policy changes are a clear potential uncertainty, but not only can they be assessed, demonstrating the consequences of different policy environments would contribute to managing those uncertainties.

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[12] https://corporatefinanceinstitute.com/resources/knowledge/modeling/scenario-analysis-vs-sensitivity-analysis/#:~:text=The%20difference%20between%20the%20two,variables%20at%20the%20same%20time. https://8020consulting.com/sensitivity-analysis-and-scenario-analysis/

[13] Hirst, E & Schweitzer, M 1989, 'Uncertainty: A critical element of integrated resource planning', *The Electricity Journal*, vol. 2, no. 6, pp. 16-27.

The ISP, to be fulfilling its function, needs to incorporate the uncertainty of future policy environments.

Scenarios and planning

Scenarios in forecasting and strategic management

The use of scenarios in forecasting differs from the approach known as 'scenario planning.' The distinction can be seen in what has been described as the four phases of strategic management.[14] These phases and their associated value systems are:

Phase	Value system
Budget based planning	Meet budget
Forecast based planning	Predict the future
Strategic planning	Think strategically
Strategic management	Create the future

The second two stages are described as 'externally oriented' and reflect that aspects of the external environment also change. Thinking strategically then simply means being dynamic enough to choose between alternative strategies, including decisions on how the organisation can shape the future. Finally, strategic management goes a stage further. It recognises that there are uncertainties beyond the ability of the organisation to influence and integrates planning and management to optimise the ability of the organisation to thrive no matter how those uncertainties evolve.

Scenario planning is best understood as a tool used in strategic management, though it is often described as part of 'long range planning.' The foundational story of scenario planning has been its use by Shell and the specific case of their planning in 1972, a world characterised by continuing and sustained expansion, which included a disruption in oil supplies and a subsequent rise in prices. This scenario materialised in 1974 with the Arab oil embargo and the Yom Kippur War.[15]

The most important (and is often overlooked) aspect of this story is that Shell's scenario wasn't about a Middle East war or an oil embargo; the scenario described a generic supply disruption and price rise without specifying the cause. This is a critical departure from scenarios in forecasting, which are still fundamentally bound to feasible trajectories of inputs.

An excellent starting point for implementing scenario planning is to use Ramirez and Wilkinson's *Strategic reframing: The Oxford scenario planning approach*.[16] Energy Consumers Australia (ECA) adopted this approach in its scenario work leading into the 2020 Foresighting Forum.[17] The title

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[14] Gluck, F, Kaufman, S & Walleck, AS 1982, 'The four phases of strategic management', The Journal of Business Strategy, vol. 2, no. 3, p. 9. and Gluck, FW, Kaufman, SP & Walleck, AS 1980, 'Strategic management for competitive advantage', Harvard Business Review, vol. 58, no. 4, pp. 154-61.
[15] See Cornelius, P, Van de Putte, A & Romani, M 2005, 'Three decades of scenario planning in Shell', *California management review*, vol. 48, no. 1, pp. 92-109. See also Schoemaker, PJH & van der Heijden, CAJM 1992, 'Integrating Scenarios into Strategic Planning at Royal Dutch/Shell', *Planning Review*, vol. 20, no. 3, p. 41. and Wack, P 1985, 'Scenarios: uncharted waters ahead', *Harvard Business Review*, vol. 63, no. 5, pp. 72-89.
[16] Ramirez, R & Wilkinson, A 2016, *Strategic reframing: The Oxford scenario planning approach*, Oxford University Press.
[17] https://energyconsumersaustralia.com.au/news/foresighting-forum-2020-publications-and-resources

of the scenarios – Futures of Heat, Light and Power – immediately demonstrate that the focus was on the delivery of the services provided by energy, not on the inputs themselves.

Ramirez and Wilkinson describe scenario planning as:

> *A methodology that uses the inherent human capacity for imagining futures to better understand the present situation and to identify possibilities for new strategy.*

They position scenario planning as suiting contexts that exhibit turbulence, uncertainty, novelty, and ambiguity (which they dub TUNA). They also identify seven key premises that underlie their approach to scenario planning, being:

1. Many organisations are facing unprecedented TUNA conditions.
2. TUNA conditions require new approaches to strategic and policy planning that seek to balance competitive and collaborative opportunities.
3. An explicit and flexible sense of future is called for in TUNA conditions. It can be enabled by contrasting plausible, alternative future contexts through an iterative process of reframing and reperception.
4. The "aha" moment of impact is only realised once the reframing-reperception cycle has been completed. This can require several iterations.
5. A culture of learning supported by scenario planning can avoid the extremes of groupthink and fragmentation, which are pathologies preventing learning in organisational settings.
6. Reframing strategy is a distinctive capability that enables learners to identify new opportunities and more and better options.
7. Scenario planning can help develop new social capital to renew the license to operate.

TUNA conditions certainly apply to the future of the energy system in Australia. The commitment by governments to net zero emissions by 2050 only moves the locus of the uncertainty from 'what' to 'how.' The Commonwealth Government's *Long-Term Emissions Reduction Plan* largely relies upon achieving a series of 'stretch goals' set out in its *Technology Investment Roadmap*, together with 'global technology trends' and 'further technology breakthroughs.'[18]

Scenarios and strategic reframing

As the title of their book shows, Ramirez and Wilkinson see the benefit of scenario as being 'reframing.' They note:

> *Reframing helps people to become mindful of the frame they have been using to make sense of and intervene in the world, as well as what is left out of this frame… reframing occurs in the process of scenario planning when alternative scenarios describing future contextual environments are contrasted to reveal, test, and redefine the official future (given frame), to generate plausible alternatives, and in effect*

[18] See https://www.innovationaus.com/the-australian-way-all-aboard-for-net-zero-emissions/ for a discussion of the plan.

> *generate new shared knowledge and insights. By rehearsing actions with these alternative frames, new and better options for action can be identified and contribute to a reperception of the present situation.* (p.4)

Their discussion notes the value of reframing as countering what Herbert Simon dubbed 'bounded rationality.' Simon used this term to reflect the tendency of managers to predetermine the boundaries within which solutions to challenges could be found, primarily as a tool for cognitive efficiency. However, as Havyatt[19] has outlined, there are other terms applied in different contexts to describe the same self-limiting behaviour, including:

- Rules, informal institutions (institutional economists – Veblen 1898, "Why is economics not an evolutionary science?', *Cambridge Journal of Economics*, vol. 22, no. 4, pp. 403-14; Hamilton 1919 'The institutional approach to economic theory', *The American Economic Review*, vol. 9, no. 1, pp. 309-18., Crawford & Ostrom 1995, 'A grammar of institutions', *American political science review*, vol. 89, no. 3, pp. 582-600. Ostrom 2000, 'Collective action and the evolution of social norms', *Journal of economic perspectives*, vol. 14, no. 3, pp. 137-58.)
- Bounded rationality (Simon 1942 *Administrative Behaviour*)
- Paradigm (Kuhn 1962 *The structure of scientific revolutions*)
- Conventional wisdom (Galbraith 1962 *The affluent society*)
- Biases and heuristics (behavioural economics – esp Tversky and Kahneman 1974 'Judgment under uncertainty: Heuristics and biases', *science*, vol. 185, no. 4157, pp. 1124-31.)
- Socio-technical regimes (Geels 2002 'Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study', *Research Policy*, vol. 31, no. 8, pp. 1257-74.)

The last of these is probably the least familiar, yet it is the most significant in the context of planning the energy transition. In this approach, Geels borrows from Nelson and Winter[20] the concept of 'technological regimes' to 'understand inertia of established technologies.' Geels then provides the definition used by Rip and Kemp[21] , who have combined economic, technological and sociological concepts so that:

> *A technological regime is the rule-set or grammar embedded in a complex of engineering practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artifacts and persons, ways of defining problems—all of them embedded in institutions and infrastructures. Regimes are intermediaries between specific innovations as these are conceived, developed, and introduced, and overall socio-technical landscapes.*

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[19] Planning the energy transition: A primer for policy makers Paper prepared for the 2nd International Conference on Energy Research and Social Science 'Energy and Society in Transition'. Available from: https://www.researchgate.net/publication/333521248_Planning_the_energy_transition_A_primer_for_policy_makers_Paper_prepared_for_the_2_nd_International_Conference_on_Energy_Research_and_Social_Science_'Energy_and_Society_in_Transition' [accessed Jan 30 2022].
[20] Nelson, R.R., Winter, S.G., 1982. *An Evolutionary Theory of Economic Change*. Bellknap Press, Cambridge, MA.
[21] Rip, A & Kemp, R 1998, 'Technological change', in S Rayner & EL Malone (eds), *Human choice and climate change*, Battelle Press, Columbus, OH, vol. 2, pp. 327-99.

Engineers and economists would both find the idea of a 'technological regime' that would shape their thinking uncomfortable. Both as applied scientists would regard themselves as rational, which they are. But their thinking and rationality are bounded by their experience and their expectation of where to find the solution.

In the context of the ISP, the impact of the technological regime of a hundred and thirty years of the electricity supply industry comes through in the expectation that the system will always require some generators based on heavy spinning resources. A consequence of this is that inertia is always seen as a positive, even though the inertia of resources means frequency must be held within tight limits (system security) as a safety measure.

The Havyatt paper earlier was titled *Planning for the energy transition: A primer for policy-makers.* It made a case for the use of scenarios as a policy tool. Policy-makers are no different from scientists, business executives, and engineers in their limitations in dealing with new types of problems.

Faced with an energy system that must transition to meet the collective goal to avoid catastrophic climate change, appropriately used scenario planning can overcome the use of rules, heuristics and paradigms and overcome the limitations of technological regimes and bounded rationality. This raises an important question about the role of the Integrated System Plan in relation to policy.

In their submission in response to the ESB's Draft Rules to make the ISP actionable, ECA raised two concerns about the guidance provided in the draft rules to AEMO on incorporating policy in the ISP.[22]

The first was in NER 5.22.3(b), whereby AEMO may consider the impact of policy in determining system needs under certain circumstances. ECA's view was that incorporating policy in energy system needs was an error and should be part of the content. The draft rules were not varied in this regard. At the time, the particular concern was that all State and Territory Governments had policies for Net-Zero emissions by 2050. However, they did not all meet the requirement of either being part of an international agreement, legislated, or having materially significant funding. This meant that AEMO could only incorporate net-zero by 2050 as a system need if the MCE instructed them to do so.

The Commonwealth Government has now also committed to Net Zero emissions by 2050. Still, that policy also does not meet the criteria that merely allows AEMO to consider it as a power system need. We are unaware of any instruction by the Collective of Energy Ministers that AEMO may include Net Zero by 2050.

In particular, ECA was concerned that the provision of circumstances under which AEMO may consider a policy as part of power system needs would prohibit AEMO from considering the policy in any other circumstance.

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[22] https://energyconsumersaustralia.com.au/wp-content/uploads/Energy-Consumers-Australia-Response-to-Actionable-ISP-Draft-Rules.pdf

Notwithstanding ECA's concerns about the inclusion of a policy in consideration of power system needs, ECA went on to note that the content of the ISP under NER 5.22.6 distinguished between content that must be included and content that may be included. Under the second category, ECA raised concerns about NER 5.22.6(b)(3) that the ISP may contain sensitivities showing the impacts of a jurisdiction's policies if asked to do so. ECA reiterated its concern that the allowance of consideration of specific policies had the effect of precluding consideration of other policies. Once again, ECA was unsuccessful in persuading the ESB to change the draft rules.

At the public forum conducted by the ESB, the author (then representing ECA) raised these concerns in a forthright and robust fashion. The responses from the ESB representatives were effectively that ECA was misrepresenting the Rules, and they wouldn't constrain AEMO from considering other policies as part of scenarios. The ECA response was to suggest that if this was indeed the case, there should be no difficulty in adding the standard form of words that the Rule did not limit the ability of AEMO to consider the consequences of alternative policies in developing the plan[23].

In its submission, ECA noted:

> *Consistent with our principles that the ISP be an independent, integrated whole-of-system plan, we believe it is important that AEMO is able to include any policy option that supports the achievement of the National Electricity Objective and promotes the long-term interests of consumers. In particular we note that the planning horizon that AEMO is working to (twenty years plus) is far longer than the electoral cycle and so future policy options considered are not pre-empting the decisions of current governments or parliaments.*
>
> *In addition, we note that no other body has the resources and modelling capability to consider the impact of policy decisions. Consequently, we think it desirable that AEMO can be required to include sensitivities of policy options to inform the decision making process. Future policy is a significant factor in determining 'least regret' options for the power system.*

To give an example of a policy decision, we can consider the extent of PV generating capability in the distribution network. As a matter of history, the initial take-up was heavily driven by jurisdictional policies on premium feed-in tariffs and Commonwealth subsidies. In the current ISP, AEMO is forecasting take up of PV generation based on assumptions of cost and economic circumstances. This approach of merely forecasting rooftop PV results in no scenario having more than 27% of underlying demand supplied by distributed resources in 2050. That is far lower than the total potential from distributed PV, especially given the increasing efficiency of panels and the capacity available from commercial rooftops. Expanding distributed generation would require additional investment in distribution networks, but the scenario may obviate the need for forecast transmission investments.

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[23] This was the point at which, by recollection, I largely went beyond a civil exchange. A member of the AEMO legal team sought out the ECA representative after the meeting to state that they took exception to the approach and would take steps to protect AEMO staff. Not long after I was initially rejected from an AEMO review panel.

To achieve a higher penetration would require something to be different from the assumptions used by AEMO's consultants in developing the DER forecasts. One area in which change could occur to increase distributed resource take-up is policy. The ISP is the only long-range planning process sufficiently detailed to inform this policy question. Further, this is an option that needs to be considered as a scenario; it is not merely an issue of sensitivity analysis on the optimal development path.

The scenario planning approach inherent in the ISP needs to be harnessed to identify areas where alternative policies could deliver better outcomes for consumers. The AEMO approach is not currently realising this opportunity. As the ESB assured participants in the rule change forum that the Rules do not limit AEMO's ability in this regard, AEMO needs to develop bolder scenarios that encompass futures that might require alternative policies to be realised.

Scenario planning methods

Ramirez and Wilkinson identify eight generic types of scenario planning methods that appear most frequently in the literature and could be used consistent with their objective of opening a space for reframing and reperceiving the situation facing the scenario planner:

1. Deductive method. This method involves identifying key uncertain factors in the contextual environment and how these might plausibly interact and impact on the environment in the planning time horizon. These uncertain factors are then termed 'key drivers' of change (that is, driving changes in the transactional environment).
2. Inductive method. This also starts with identifying novel and uncertain factors in the contextual environment, which might be in the form of weak signals, emerging issues, or trend analysis. These are then combined either through the development of story snippets and/or by converting them into a set of drivers of change that describe their combined impact on the transactional environment in the time horizon under consideration.
3. Abductive method. This method iterates between the inductive and deductive approaches mentioned above. Ultimately one approach is used to generate scenarios, and they are then refined using the other approach. The AEMO process looks like the abductive method, except that AEMO's approach begins with the deductive, considers the inductive, and cycles back to the deductive.
4. Normative method. In this method, the starting point in developing the scenarios is to articulate a preferred future—a vision of a system of concern. AEMO in the 2020 process attempted this approach to generate the scenario that became known as Step Change, but in the final ISP that scenario failed to deliver the normative outcome of its premise (net-zero emissions by 2050).
5. Incremental method. The starting point in the incremental method is what can be described as the "official future" and then subjecting it to a series of 'What if' questions.
6. Alternative futures method. This method bases scenarios around four archetypal narratives of systems change; "Continued Growth," "Societal Collapse," "A Conserver Society," and "A Transformational Society".

7. Critical scenarios method. This approach considers how a scenario planning intervention reflects and/or reinforces power relations, then asks how the intervention can instead attempt to redress some of the power imbalances in the system in which it operates.
8. Perspectives-based approach. This uses scenarios to reveal and navigate between differing worldviews and within worldviews to reveal their assumptions and help those who hold them to accommodate different perspectives.

The ECA exercise primarily used the latter approach and was constructed by building scenarios around COAG Energy Council as a strategic decision-maker, identifying driving forces that affected Council's interactors. The context was assumed to be an objective of net zero emissions by 2050 in providing heat, light and power. The scenarios were iterated by workshop participants twice with further refinement by ECA.

The methods above can be combined in generating scenarios. The normative method can be used to specify desired end states (e.g. net-zero emissions). The perspectives-based approach can be used to generate some initial narratives from different worldviews on how to achieve that objective. An example of this approach would be to start with the end-state objective, then around that list all the stakeholders involved in or affected by achieving that objective. Next, you list the issues of concern to each stakeholder.

From this list of issues of concern, groups (commonly four but not necessarily) drawn from different stakeholder classes choose four or five views covering multiple stakeholders and then develop a narrative for achieving the goal consistent with that set of views.

Summary

Scenarios can be used in planning processes in both forecasting ad strategic management approaches. However, a drawback of scenarios in forecasting is that the forecaster's current knowledge constrains the ability of forecasters to consider different futures. This framing by the technological regime, alternatively bounded rationality, means that the planner includes a constrained set and range of uncertainties.

However, planners can use scenario planning can as a tool to overcome their biases. Because these are not conscious biases, the planner is not applying them intentionally, but they will result in an inadequate set of scenarios and only reconfirm those biases. Of the methods identified, the normative, alternative futures, critical scenarios and perspective based are the most likely to free the scenarios from those biases.

Scenarios and the ISP

Scenarios and the purpose of the ISP

As outlined above, the ISP should be more than an exercise in forecasting; it is a tool in the strategic management of the energy supply system. Therefore, scenario planning, rather than scenarios as a forecasting tool, is the appropriate way to consider scenarios to achieve the ISP's purpose.

As scenarios deal with future uncertainties, all uncertainties need to be included. Despite the welcome decision by the Commonwealth to join the States and Territories in committing to net-zero emissions by 2050, plenty of policy uncertainties remain. There are two ways to include policy uncertainty in scenarios. The first and least productive is to hypothesise different policies. The second is to simply describe outcomes that might require different policies to achieve them.

An example is the vexed question of modelling DER uptake in the ISP. AEMO has incorporated DER by assuming certain economic characteristics for each scenario and then using consultants to forecast DER uptake within those scenarios. The outcomes can be compared to a 2018 estimate of the total rooftop PV potential in Australia of 245 TWh[24]. This results in the following outcomes in 2050 across the four scenarios.

Scenario	Distributed PV Generation (TWh)	Underlying Consumption met by DER (%)	Proportion of 2018 potential (%)
Slow Change	58	27	24
Progressive Change	80	19	33
Step Change	93	24	38
Hydrogen Superpower	112	9	46

An alternative way to develop a scenario, which could be called the High DER scenario[25], is to choose a value for Distributed PV Generation in 2050 as a scenario input. Given that Step Change is now regarded as the most likely scenario, a more aggressive DER scenario is appropriate. To develop that target, it is appropriate to remodel the PV potential, including the increase in available roofspace by 2050 and the greater efficiency of solar panels that can be expected. Across the various scenarios, the number of residential connections is forecast to increase by between 42 and 53 per cent[26]. Since there could be an increase in density, this increase won't translate fully into an increase in roofspace. However, this brief analysis suggests the forecasts of PV generation across all scenarios are probably inadequate and certainly don't capture a high DER scenario.

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[24] https://www.cefc.com.au/media/rcalz41c/isf-rooftop-solar-potential-report-final_.pdf
[25] This was used as the name of a plan in the 2020 ISP. It is our understanding that the High DER scenario was dropped because it wasn't sufficiently distinct from Step Change. However, this was a consequence of the forecasting approach to DER uptake.
[26] See http://forecasting.aemo.com.au/Electricity/AnnualConsumption/Operational click on inputs to download.

The iteration of scenarios

Fundamentally there is a flaw in the AEMO methodology in using scenarios. This flaw is the choice of scenarios associated with narratives that are then converted into forecasts of inputs without checking whether the final modelled outcome of the scenario remains true to the narrative.

This was a particular problem with the 2020 ISP, where none of the scenarios developed a trajectory to meet net-zero emissions by 2050, even the Step Change scenario that started as that specific narrative. In the 2022 draft ISP, the same issue occurs where no scenario achieves a zero-emissions NEM. The assumption of the availability of offsets to meet a small residual level of emissions is inconsistent with the remaining decarbonisation challenges in agriculture and industry.

The idea that there is a rigid sequence of IASR being finalised and then followed by a draft ISP, at which point scenarios cannot be challenged, is an inadequate approach to planning. Rather than using scenarios to highlight the challenges in the transition, it perpetuates the thinking of the technological regime.

Molecular energy carriers

AEMO should construct a low emissions gas scenario. However, this needs to be a bold strategy that identifies a pathway for combining non-traditional sources of methane (biogas) with green hydrogen, with the concentration of green hydrogen increasing over time.

Many people already decry any of the discussions of hydrogen as being fanciful because they cannot see today the developments that will make it viable. However, as Havyatt recently observed, there are risks in technological forecasting. In a 1953 paper, Professor Harry Messel claimed that efficiently harnessing solar power was centuries away. Yet, scientists at Bell Labs made the silicon solar cell breakthrough just one year later.[27] Even that development only generated 6% efficiency and solar cells that were most useful in spacecraft. The development of the PERC cells at UNSW further advanced developments, but the substantial cost decreases are primarily due to the experience effect of cumulative production spurred by subsidies.

While we support this extra scenario, we believe its value is primarily in modelling a significant increase in biogas. For the scenario to provide maximum value as an alternative, it needs to perpetuate gas use in residential and small commercial settings commensurate with current usage.[28] It also needs to result in a zero-emissions gas system by 2050.

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[27] https://www.innovationaus.com/nuclear-power-an-industry-whose-glory-years-never-arrived/

[28] Without going into detail, there are a number of studies on the cultural difficulties of converting households in India and surrounding countries from fuel burning cooking to cleaner forms. There is a similar cultural issue regarding the use of gas and various Asian cooking styles common in Australia.

Conclusion

This submission has focussed on the general question of scenario development rather than specific consultation questions. It has been made at this time in response to a suggestion by AEMO at the January 2022 FRG meeting.

We have argued that AEMO needs to incorporate a wider range of possible futures by defining scenarios more by the outcomes they reflect rather than by the pathways of the inputs that generate the scenario. Moreover, this wider set of outcomes needs to model both technological and policy uncertainty.

We have further argued that AEMO needs to break down the rigid separation between IASR development and system modelling to recognise that the scenarios are only valid if the system modelling of the scenario results in the outcomes included in the scenario specification.

We support the inclusion of a low-emissions gas scenario with zero-emissions gas as an endpoint.

Appendices

Appendix 1 – Finkel Review Terms of Reference from 7 October 2016 COAG EC Communique

COAG Energy Council

BLUEPRINT FOR ENERGY SECURITY IN THE NATIONAL ELECTRICITY MARKET

INDEPENDENT REVIEW

The Australian electricity market is undergoing a significant transition, including due to rapid technological change, the increasing penetration of renewable energy, a more decentralised generation system, withdrawal of traditional baseload generation and changing consumer demand.

Energy security is the paramount responsibility of governments. Recent events have once again highlighted the importance of ensuring the security and reliability of the National Electricity Market (NEM).

The COAG Energy Council has initiated a number of processes and work programs to properly understand the causes of these specific events as well as to examine and advise on the broaderissues facing the system due to the increasing penetration of intermittent generation. These include:

- Reviews into the South Australian 'system black' event by AEMO, AER and the AEMC
- Detailed analysis and reports by AEMO and the AEMC into future power system securityand market frameworks
- Analysis by AEMO and the AEMC into the impact of carbon mitigation policies at both theFederal and State level on energy markets
- A review of governance arrangements (Vertigan review)
- National Gas market reforms which relate to NEM security, reliability and affordability; and
- A review of the appropriateness of existing regulatory arrangements for interconnector investment

In light of this body of work, the Australian Government's commitment at Paris and the integrationof climate and energy policy at the federal level, it is timely for a wider process to take stock of thecurrent state of the security, reliability and governance of the NEM and provide advice to governments on a coordinated, national reform blueprint.

Review purpose and scope

The purpose of the review is to develop a national reform blueprint to maintain energy security and reliability in the NEM, for consideration by the Council of Australian Governments through its Energy Council.

The review will draw together and build on the analysis and findings of the recent and ongoing work streams, as identified above. It will also consider any other matters and processes that may be relevant to system security and reliability.

The blueprint will outline national policy, legislative and rule changes required to maintain the security, reliability and affordability of the NEM in light of the transition taking place.

Consistent with the National Electricity Objective, the review will examine the costs and benefits, including to consumers and industry, of the options to address any current or future vulnerabilities identified in the NEM.

The report will be by chaired by Dr Alan Finkel AO, Commonwealth Chief Scientist, and supportedby two deputies to be determined by Council.

It is envisaged a preliminary report will be prepared for the COAG Leaders' Meeting in Decemberwith a final report early in the new year.

7 October 2016