

**A submission to the
Senate Select Committee on Energy Planning and Regulation in Australia**

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This submission is made as an individual and not on behalf of my employer or others.

Summary

If we are to rise to the immense challenge of the energy transition in the coming decades, Australia will need to excel at integrated energy system planning and implementation on a truly National scale. This has two, related, necessary and urgent conditions for success:

1. the need to establish comprehensive energy system planning: this is larger than but is most relevant to the Inquiry's Terms of Reference (ToR) a) and c); and
2. the need for several institutions to implement this planning: this will be via existing and new processes and, again, is larger than but most relevant to ToR b), c), d) and f).

The scale and urgency of this task is clear if we consider recent history to projections of what is required. As just one comparison, Australia's current domestic electricity system can be summarised as follows.

- The capacity of all electricity generation is approximately 100 GW, including fossil generation, wind, large-scale solar, energy storage and rooftop solar.
- The rate of renewable and large battery capacity addition over 2019-2023 was 5.9 GW pa.

The *Net Zero Australia Project* [1] projects that our domestic energy system in 2050 needs:

- about 510-640 GW of renewables and firming to get to net zero emissions whilst meeting demand at least cost, i.e. *about 20 GW pa of new build from today*; and
- about 220 GW of renewables and firming to meet demand at least cost *if we do not intend to achieve significant abatement*, i.e. about 4.4 GW pa of new build from today.

Further, our current export energy system is dominated by coal and natural gas and is significantly larger than our domestic energy system on energy and greenhouse gas emission bases. What form a future export system takes and who should pay for it are themselves major questions that I will not address in detail in this submission. Nonetheless, our energy system planning and implementation must be able to accommodate the export task.

And even excluding exports, we must still at least triple current build rates of renewables and firming, whilst implementing many other significant measures, if we are to make significant progress. We will fall far short of net zero by 2050 if we continue at close to current build rates.

The need to establish comprehensive energy system planning and implementation

The *Net Zero Australia Project* argues that *we must accelerate all options that could make a material contribution to decarbonisation*, with a summary of the immense efforts required to transform our energy system as follows.

Impacts

- The speed of land use change will be unprecedented and requires proactive management, particularly for First Nations communities and farming communities.
- Benefit sharing must be prioritised, proactive, and based on principles of partnership, inclusion and net gain.
- Net gain for environments and biodiversity should be pursued in parallel with net zero.
- Minimising public impacts requires orderly asset closures, supported by multiple policy mechanisms.
- Low-income households and fossil fuel regions will need support to mitigate impacts.

Roles

- Trust in government institutions and businesses involved in the transition is essential to its success.
- Governments must stimulate and coordinate private action, and decide who pays, and how.
- Private sector investment risk will be too high in many cases, unless mitigated by government.
- Building net zero workforces and supply chains requires a certain, large, and long investment pipeline.
- Net zero must be a high national priority for decades, requiring sustained leadership and collaboration.

Exports

- A clean energy export framework will be needed to ensure that we phase out fossil fuel exports and grow clean exports in an orderly, fair, and net zero-compatible transition.
- Both clean energy and clean processed minerals should be pursued as export opportunities.
- Industry strategies and import replacement pathways should be re-oriented towards comparative advantages.

Current Commonwealth planning efforts and a comprehensive plan

The Commonwealth's *Net Zero Plan* [2] is intended to "guide our transition to the legislated target of net zero greenhouse gas emissions by 2050". As such, the ToR of this Inquiry only covers part of the Net Zero Plan's remit but, ideally, should be consistent with it. The following are noted.

- The Commonwealth's Net Zero Plan is currently under development, being informed by the efforts of the Climate Change Authority, the Net Zero Economy Agency and several Commonwealth Departments.
- The Net Zero Plan is developing 6 sectoral emissions reduction plans for Electricity and Energy, Transport, Industry, Agriculture and Land, Resources and the Built Environment.
- Policies include the *Safeguard Mechanism*, the *82% renewable electricity target*, the *Capacity Investment Scheme (CIS)*, the *New Vehicle Efficiency Standard (NVES)* and the *Guarantee of Origin Scheme*, most of which are being developed.
- The Net Zero Economy Agency is currently being legislated as the Net Zero Economy Authority and has the remit of working with communities - an essential and immense task.

However, the Net Zero Plan hasn't yet stated *how* it will address the following important matters.

- Identification of the *hundreds to thousands of \$B of additional investment* across the Nation in electricity and other networked energy commodities, transport, industry, agriculture, resources and buildings, including minimising their impacts on natural ecosystems and farming.
- Identification of the required technologies and innovations. This includes the rigorous determination of the need (or not) for technologies that are controversial for some or not permitted by current policy, e.g. natural gas fired electricity generation, carbon capture and storage (CCS) and nuclear.
- Quantification of the number of people required by skill and location.
- Determination of how a net zero objective will integrate with and potentially be traded off against other important national considerations, including other social, economic and environmental impacts and national security.
- Determination of who will undertake this planning, how its scope will be set, and how will it be reviewed by governments, the community and industry. As part of this, how the Commonwealth will work with State planning bodies and AEMO's *Integrated System Plan (ISP)* is yet to be stated.

With respect to the last point, the following table summarises the size of the Australian energy system in 2020 [1], with the export GHG emissions including those that result from the overseas use of our exported fossil fuels.

	Primary Energy (EJ)	GHG Emissions (MtCO _{2e} pa)
Domestic Energy System	5.6	529
Export Energy System	16.7	1258
Total	22.2	1787

This table shows that our domestic energy system is the smaller part of our total energy system on both energy and emissions bases. Further, our domestic electricity and gas use is roughly 60% of our domestic primary energy and emissions and therefore less than 20% of our total primary energy and emissions. As such, the National Electricity Law, the National Gas Law and the National Energy Retail Law and associated agencies govern a minority of Australia's total energy markets on energy and emissions bases. These laws and agencies (and including AEMO's ISP) as currently defined therefore cannot be the primary means of integrated system planning, let alone implementation.

Finally, whilst the Net Zero Plan is intended to be a whole-of-government effort, it is led by the Minister for Climate Change and Energy. Determining how such an effort could remain a high national priority for decades, without being altered significantly when governments change, isn't yet clear.

A comprehensive system plan needs to do all these things, and very likely more, and good governance of this long-term planning effort will be essential.

The need for several institutions to implement this planning

Once we have a comprehensive system plan, numerous implementation measures are required across different sectors. A key result from the Net Zero Australia Project [1] is that achieving net zero by mid-century will likely result in higher energy costs than doing nothing about climate change, unless unforeseen technological advances enable otherwise. The following tables summarises the net present value (NPV, in 2020 \$) of the total costs of the domestic and export energy transitions from the NZAu Project, noting that many assumptions are made in deriving these figures and the inherent and significant uncertainty involved.

	Domestic NPV (\$Tr)	Export NPV (\$Tr)	Total NPV (\$Tr)
No abatement target	4.3	2.6	6.9
Net Zero Scenarios	4.8-5.1	4.1-6.1	9.0-10.9

These additional costs arise from numerous investments in mostly capital-intensive assets across all sectors. This includes renewables, transmission and distribution networks, energy storage and natural gas fired generation through to many different end-use appliances such as light-to-heavy-duty electric vehicles and electric heating. The following capacities of just the electrical generation and conversion assets for the domestic and export energy systems in 2060 are a significant part of these costs.

	Domestic (GW)	Export (GW)
No abatement target	220	n/a
Net Zero Scenarios	514-643	2241-5163

Investments of this scale across the Nation will be complex to implement, challenge our National capacity, and trade-offs with other, important National considerations are very likely inevitable.

If we are to make significant progress, we therefore need to expand our ability to implement significant measures both *outside and inside* the Australian domestic electricity and natural gas systems that this Inquiry's ToR cover. Yet, it is not currently clear *what* the required transformations of transport, industry, agriculture and land, resources and buildings *will be* (i.e. the comprehensive planning effort discussed earlier), let alone *how* they will be implemented. *This includes identifying the number of people required by skill and location and then investing in their attraction to and preparation for the sector.*

At the same time, the Australian domestic electricity and natural gas systems are governed by the 3 Commonwealth agencies named in the ToR plus several other, state-based agencies that include economic regulators and others tasked with maintaining public safety and environmental protection. If we are to make significant progress, these numerous agencies will have to *implement* numerous measures at an unprecedented rate, including the following.

- New market/system rules that accommodate new technologies or accommodate existing technologies in new and improved ways.

- Approvals to connect new assets at much faster rates than historically, including some that are essential at the system level but which would not pass current investment tests.
- Enhanced protections for energy consumers, particularly low-to-middle income earners and industrial energy users, particularly if energy costs rise significantly.
- New means of working with and supporting First Nations and regional communities.
- New measures for maintaining public safety and environmental protection, particularly as new technologies become widespread.

It is fair to say that this collection of agencies has not been designed and resourced for an implementation task of this scale and complexity. It is also likely fair to say that Australia's domestic electricity and gas systems have complex governance relative to international equivalents. For example, the world's largest, liberalised electricity system is called *the PJM Interconnection* and features a single organisation that functions as both rule maker and market operator and is principally regulated by a separate National regulator, *the Federal Energy Regulatory Commission (FERC)*.

How can this collection of agencies and their processes be re-designed and re-resourced such that rapid progress is more likely? These are matters that have been discussed in the sector for a long time, and current circumstances should justify urgent and pragmatic answers.

About the author

Prof. Michael Brear FTSE, FCI, FIEAust is the Director of the Melbourne Energy Institute (MEI) at the University of Melbourne. MEI facilitates the University's research on the technical, economic, environmental and social impacts of energy with the community, industry and government. Further background on Michael's career include the following.

- Fellow of three learned academies: the Australian Academy of Technological Sciences and Engineering (ATSE), Engineers Australia (IEAust) and the Combustion Institute.
- Established the *Master of Energy Systems* degree at the University of Melbourne in 2012, which continues today and teaches the technology and business of energy.
- Steering Committee member and Project Manager for the *Net Zero Australia Project*.
- Co-author of several commissioned works for the Commonwealth Government and its agencies, including work supporting the *Hydrogen Guarantee of Origin Scheme*, the *Finkel Review* and the *Australian Energy Regulator*.
- Previous visiting positions at Princeton and Stanford Universities, a PhD from Cambridge University and post-doctoral research at the Massachusetts Institute of Technology.
- Author of more than 200 peer reviewed works on different aspects of the energy and transport systems. In addition to the work of the Net Zero Australia Project, this also includes recent studies of decarbonisation pathways for Australia with renewable, fossil and nuclear generation and analyses of the technical, financial and environmental performance of conventional, hybrid and electric vehicles.

References

1. <https://www.netzeroaustralia.net.au/>
2. <https://www.dcceew.gov.au/climate-change/emissions-reduction/net-zero>