Submission of Professor Emeritus Aynsley Kellow

to the

INQUIRY INTO ENERGY PRICES IN TASMANIA

Legislative Council Sessional Committee Government Administration 'A'

I have more than 40 years' experience researching issues relating to electricity planning, the science-policy interface and climate change policy. My publications especially relevant to electricity systems are provided at the Appendix to this submission, but include research on electricity in Tasmania, Victoria, New Zealand, British Columbia and Ontario.

My book *Transforming Power* (Cambridge University Press 1996) focused on the adoption of approaches such as demand-side management (or energy conservation) in what is known as Least-Cost Utility Planning, which can reduce the costs of uncertainty imposed because of very long lead times associated with electricity projects. This work included analysis of planning in Tasmania for the controversial proposed Gordon-Below-Franklin Dam, but I also undertook a comparison of proposals for the conversion of the Bell Bay and Marsden B power stations.

I want in this submission to draw the attention of the Committee to some of the important factors that have increased electricity prices – not just in Tasmania, but in Australia at large in the National Electricity Market in which Tasmania participates. These are related to the enthusiasm over the past decade or so for non-dispatchable generation, or 'variable renewable energy' (VRE), which has led to marked increases in the costs of electricity systems.

This statement requires some explication, because the Commonwealth Minister, Mr Bowen, has repeatedly claimed that such renewables are the cheapest source of energy, and the Prime Minister promised consumers a $275 reduction on their annual electricity bills that was never likely to be delivered.

The Costs of Renewables

Mr Bowen's claim is incorrect. It is the case that some forms of renewable *generation* are cheap compared with conventional sources, but this statement ignores the costs of getting this generation to consumers, and these costs affect the final, delivered price.

It should also be noted that the funds manager Lazard (2023), provides a website with annual updates of the 'Levelised Cost of Energy' for various sources. (Notably, they also provide costings for transmission and storage).

It should be noted at the outset that Lazard list domestic rooftop photovoltaic (PV) solar generation as one of the most expensive sources of generation. Yet various Australian governments have subsidised the installation of this very source of generation.

This policy of subsidising PV solar has been an important factor increasing prices, especially broadscale solar energy farms which, coupled with wind generation have essentially cannibalised the despatchable capacity.

Both solar and wind are intermittent and cannot be relied upon at all times, as is required by electricity consumers (and system stability). Obviously, solar generation cannot occur at night – although a Spanish utility was once found to have overcome that inconvenience, using floodlights shining on their panels in order to collect the lucrative subsidies for solar generation. But wind is also unreliable, with 'wind droughts' sometimes lasting a matter of days. Indeed, longer term yields from wind generation can sometimes fall well below average yields. In the autumn of 2021, Europe found seasonal yields were low and was forced to increase reliance on natural gas for generation.

When unreliable renewable generation *is* available, it takes preference over non-hydro despatchable sources. The short-run marginal cost of renewables is essentially zero, while that of thermal plant is higher (fuel costs, at a minimum). When the wind is blowing and the sun is shining, thermal plant cannot compete. VRE generators can even bid into the market for effectively zero price, because this still produces Renewable Energy Certificates which have considerable value thanks to government regulation. Assuming adequate flows of water, hydro also has zero marginal cost, but in any mixed hydro-thermal system water has an opportunity cost as it can be used at a time when peak demand drives priced higher. And it can be kept in storage for generation when the sun is *not* shining.

Renewables therefore drive the utilisation of thermal capacity down from the 80-90% capacity factor of which they are capable, thus destroying the economics of their operation, as well as investment in maintenance and replacement. As they have found in Germany, this also increases greenhouse gas emission per kWh as thermal stations are then run at suboptimal load or even idled so that they can increase load as renewables output drops off.

Increasing the proportion of renewables in a system therefore cannibalises the reliable sources of generation in the system, something of which policy-makers should have been cognisant, as it was apparent in systems such as that in Germany (Ueckerdt, et al 2013; Hirth et al, 2015). (Unlike Australia, Germany could draw upon despatchable sources in neighbouring countries).

With diminishing despatchable capacity available, storage becomes important for system reliability. Michael Kelly (Professor Emeritus of Electrical Engineering at Cambridge University) has distinguished the need for essentially three categories of storage: intraday; interday; and interseasonal (Kelly, 2016).

Batteries can meet the first of these, but are more valuable at providing system (voltage and frequency) stability when wind or solar yields fluctuate. In October 2019, the system at Alice Springs went 'black' when a passing storm suddenly eliminated solar yields.

Pumped storage can be useful in providing interday storage but, as we are finding with Snowy 2.0, this can be very expensive. Both batteries and pumped storage are not sources of generation, but consumption, consuming at least 15% of energy over a complete charge-discharge cycle.

Interseasonal storage is even more problematic, requiring perhaps a hydro storage and generators (lying idle for much of the year) and driving Europe in late 2021 into the arms of Russia, importing more gas and perhaps convincing Russia they could not afford to react strongly to what was to happen in Ukraine.

These are significant costs that increase as the proportion of renewables increases, and increase the system costs as renewables penetration proceeds. The measure of LCOE has its limitations (and critics), but it should at least be replaced by the *System* Levellised Cost of Energy, under which VRE is much more expensive (Idel, 2022)..

It should be noted that by decreasing the capacity factor of thermal stations, renewables increase the unit cost for their production, because the ration of fixed (capital) costs to variable costs increases. It becomes less attractive to invest in thermal capacity or even spend substantial sums on maintenance.

The reason the Commonwealth Minister thinks that renewables are the cheapest is because he ignores system costs. He can, perhaps, be forgiven for this error, because he relies upon CSIRO's GenCost estimates and, remarkably, CSIRO simply ignores the system costs required before 2030 and projects generation costs then, quite erroneously treating these system costs as sunk costs which they most certainly are not. (Sunk costs are those that have already been expended, not those anticipated being spent – see Kellow, 2022). There is a commitment of at least $20 billion that is intended, but has not yet been sunk.

CSIRO is simply assuming the system costs have been paid – much like suggesting someone stranded on a desert island can be saved by assuming a lifeboat.

It should be noted that the recent escalation in electricity prices cannot be attributed substantially to the escalation in the global spot prices of gas and coal that followed the Russian invasion of Ukraine. Most thermal generators have long-term supply contracts and do not pay spot prices. It should also be noted that gas prices first took off in late 2021 as European demand for gas increased as renewables output diminished with a seasonal wind drought and high cloud cover – what the Germans call *dunkelflaute.*

Storage costs are only part of the system effects of increasing renewables, however. Renewables are also very low density energy sources, and as such are dispersed over vast areas of land (or sea, for offshore wind). Leaving aside the costs of lost agricultural productivity and environmental impact (including whale mortality for offshore wind) the cost of getting their output to market are also substantial.

Renewables often achieve capacity factors of only 25-30% and extra transmission requirements that arise because of their low density. That means that transmission assets also have load factors in this ballpark. This means transmission lines must be capable of carrying full output, but will be underutilised much of the time. If sufficient capacity is not available, generation must be spilled (as has often happened in the United Kingdom).

Widely distributed renewables therefore require substantial investment in additional transmission capacity that will go underutilised for much of the time. When storage through batteries or pumped storage is factored in, about four times average load is required in renewables capacity and transmission capacity, especially considering the efficiency of cycles in and out of storage. An overbuild of capacity is needed to recharge storages. It should be noted that where this transmission occurs at lower voltages, transmission losses will be more than the 5% or normally assumed with high voltage transmission lines between high density generation sources (hydro and thermal) and major consumption centres.

Transmission is not the only increased cost associated with renewables. There has been additional investment in retail substations because of the need for stability and security. I have one at either end of my street and one near the start of my street. VRE generation lacks the inertia that large synchronous generators bring to an electrical system that can cover sudden changes in load or generation.

The growth of VRE (especially rooftop solar) has increased system costs, but it has also resulted in a drop in the quality of electricity supplied, causing additional costs for consumers.

The nominal voltage in most areas of Australia had previously set been set at 240v in 1926. A new Standard (AS60038) was issued by Standards Australia in 2000 with 230v as the nominal voltage and a +10% to -6% variation (253v to 216.2v) permitted at the point of supply.

Then a new quality standard, (AS61000.3.100) was released in 2011 that stipulated a nominal 230v, with the *allowable* voltage to the customer's point of supply still +10% to -6% (253-, but with a *preferred* operating range of +6% to -2% (244v-225v).

In adopting this new standard in 2018, the Queensland Department of Natural Resources, Mines and Energy (2018) stated that the reason for doing was the increased use of grid-connected rooftop solar installations raising the grid voltage. They stated that 'Power that flows from large amounts of rooftop solar into the power grid can cause network voltage levels to rise. This rise increases the risk of electrical appliances performing poorly or being damaged' (Queensland, 2018). Lowering the voltage allowed additional future solar power of 960 megawatts to be connected without raising the voltage to levels dangerous for appliances.

Low voltage can also be a problem. On a personal note: I have on occasion experienced my heat pump refusing to start in the morning; when running the diagnostic system, I have found a code signalling 'insufficient voltage'. Such events will be driving up the cost of energy for consumers, because heat pumps usually enjoy a concessional tariff (Tariff 41, 19.4470c/kWh and 300% efficient) and if it fails to start, they will have to resort to other means of heating at higher cost (Tariff 31 at 29.9470 c/kWh or gas or wood).

Tasmania

These are comments general to the National Electricity Market (NEM), but Tasmania is part of that market and is therefore affected by price increases in the NEM. Transmission and distribution costs are undoubtedly different in Tasmania (though my Aurora bill no longer seems to give the detailed breakdown of costs it once did), but I would not expect Hydro Tasmania to bid low in the NEM. It has a duty to maximise its return on capital, so should be bidding to despatch when prices are highest, and conserve water in storage to maximise its value unless river flow conditions require generation rather than spillage. Basslink, after all, is designed for the importation of cheap base load electricity and the export of hydroelectricity at the best price, when demand is highest.

Conclusion

I have sought here to explain at a conceptual level why the Prime Minister's $275 promise is unachievable and why Minister Bowen's statement that renewables are the cheapest is simply wrong, depending as it does on simply omitting serious system costs associated with the NEM or any electricity system when the proportion of VRE generation to reliable, dispatchable generation reaches the levels it has in Australia.

I have not attempted to detail the increased costs of electricity supply in the Tasmanian context, but rather simply assist the Committee in its deliberations on the current malaise, if one could be forgiven a pun.

References

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Appendix: Career Research Activity on Electricity, Professor Aynsley Kellow

Book

Transforming Power: The Politics of Electricity Planning, Cambridge, Cambridge University Press, 1996. 229pp.

Short Monographs

'The Gordon Below Franklin Dam Proposal', *National Clearing House for Public Policy Cases,* Canberra, Public Policy Program, Australian National University and Royal Australian Institute of Public Administration, 1987. 31pp.

'Institutions, Coal, and Energy Policy in Tasmania', Board of Environmental Studies, University of Tasmania, *Working Paper 15,* Hobart, 1983. 61pp.

'An Economic Evaluation of Hydro-electric and Coal-fired Thermal Power Development Programs for Tasmania', Board of Environmental Studies, University of Tasmania, *Working Paper 14,* Hobart, 1982. 19pp.

Book Chapters

'Hydroelectricity' (with Ronlyn Duncan) in Lin Crase (ed) *Water Resource Policy in Australia.* Resources for the Future, 2008.

'The Environmental Effects of Energy Competition in the Asia-Pacific.' in Michael Wesley (ed) *Energy Security in Asia.* London, Routledge, 2007.

'Energy Policy' in Jay Shafritz, ed, *International Encyclopedia of Public Policy and Administration,* Boulder, CO, Westview Press, 1998. pp765-66.

'Electrical Energy' (with Hugh Saddler) in Tony Macdougall, ed, *The Australian Encyclopedia,* Sydney, Australian Geographic, 1996.

'The Gordon Below Franklin Dam Proposal' in C. Terry, R. Jones and R. Braddock (eds) *Australian Microeconomics: Policies and Industry Cases,* Sydney, Prentice-Hall, 1985. pp59-76.

Journal Articles

'Controlling Pollution Using Economic Instruments in Competitive Electricity Markets: The Challenges of Multilevel Governance' (with John Crosisca) *Energy and Environment* 11 (6) (2000): 681-695.

'Energy Service and Conservation: Exploring the French Connection' *Australian Journal of Environmental Management* 5(4) 1998, pp226-23.

'The Dispute Over the Franklin River and South West Wilderness Area in Tasmania, Australia' *Natural Resources Journal* 29 (1) 1989 129-146.

'Electricity Planning in Tasmania and New Zealand: Political Processes and the Technological Imperative' *Australian Journal of Public Administration* XLV (1) 1986, pp 2-17.

'A Neglected Option in Tasmania's Power Debate' *Search* 14 (11-12) December 1983 - January 1984, pp 306-308.

'Public Project Evaluation in an Australian State: Tasmania's Dam Controversy' *Australian Quarterly* 55(3), Spring 1983, pp263-277.

Non-refereed Reports

Regulation and Strategic Planning in Two Canadian Electrical Utilities, Report for the Electricity Development Strategy Consultative Panel, Department of Industry, Technology and Resources, Victoria, 1990.

The Environmental Impact of a Coal-fired Thermal Power Station at Conara Report to the Northern Midlands Environment Protection Committee, 1984.

Consultancy

Consultant, Sinclair Knight Merz, for Intergen, Greenhouse Policy Issues, Millmerran Power Station, 1998-99.

Community Service

Presented submission to the Senate Select Committee on South-west Tasmania, July, 1982; provided information on issues of power development in Tasmania to the Department of Prime Minister and Cabinet, Commonwealth Treasury, Federal Opposition, journalists, and coal companies with interests in Tasmania.

Invited address on 'Energy Options for Tasmania' to the Australian Labor Party Energy Policy Seminar, August 1984.

Submission to the Committee of Inquiry into Electricity Generation Planning in New South Wales, August 1985; provided invited comments on Inquiry Discussion Paper on Reserve Margins and Capacity Potential, May 1986.

Advice to Queensland Conservation Council on the place of demand-side management in Queensland electricity bidding process, August 1996.