Briefing note

ANALYSIS OF FRONTIER REPORT: DEVELOPING A BASE CASE TO ASSESS THE RELATIVE COSTS OF NUCLEAR POWER IN THE NEM

This briefing note provides a critique of Frontier's paper: *Report 1: Developing a base case to assess the relative costs of nuclear power in the NEM.* The Clean Energy Council has conducted a thorough review of this report, highlighting its many flaws to ensure greater transparency and understanding of what it will cost to transition our power system.

The paper is ostensibly a calibration exercise to test the accuracy of Frontiers model against AEMO's ISP modelling. This is to inform a second forthcoming report which will assess the costs of including nuclear power in the NEM.

The Clean Energy Council's analysis concludes that throughout the report there are several examples of analysis and data illustration which are either inaccurate or otherwise could be easily misread as inflating the true costs of transitioning the power system to renewables.

The basis of Frontier's analysis appears to be the following two contentions:

1) the suggestion that new transmission costs will be very significant and prone to cost blowouts and
2) at least partially avoidable by making use of existing coal generation sites to host new nuclear generation.

Frontier's paper does not delve into the second contention, other than making a few headline assertions. Presumably, this will be the basis of the second forthcoming paper.

Instead, the paper focusses on the first contention, by attempting to demonstrate that transmission infrastructure costs will be much larger than included in the ISP.

The headline "results" of Frontier's paper are therefore as follows:

- **Transmission costs will be much higher than in the ISP**: its asserted these costs are likely to be underestimated and that "currently approved and planned transmission projects are likely to cost $62bn, expanding current regulated asset bases by 240%."

  Frontier have arrived at this figure by summing all ISP transmission projects, including currently commissioned and anticipated projects such as PEC and the Waratah battery – both of which are under construction. Most, if not all, of the other ISP projects are planned to be built ahead of 2035, being the

putative date for the first nuclear generation to be built under the Coalitions current policy.

- Applying this cost of transmission, Frontier find that "it takes about $500,000 of transmission costs to support each megawatt of new supply option".

  As above, the approach here is to simply sum all the transmission projects in the ISP and divide the aggregate cost against future generation build. This fails to account for the fact that a substantial portion of this transmission build would need to occur in any case – simply dividing it across all new connecting generation capacity simply is not meaningful.

- Finally, Frontier asserts that: "…the costs of AEMO's preferred Step Change scenario, which does not include the costs of consumer energy resources, is the sum of the real costs of the electricity supply options of $580 bn plus the $62 bn in transmission costs – or a total of $**642 bn**.

  These figures appear to come from a few sources and are themselves questionable in terms of the way the report positions them.

  Although it's unclear from the report, it appears the $580 billion dollar figure described above comes from summing the figures set out in the ISP workbook Step Change – Core, considering CDP14.[1] Frontier appears to have simply summed all of the real values expressed for the Step change to arrive at this figure. As such, the figure is not in the standard NPV format, but rather a crude summing that ignores time value of money and the staged nature of major transmission build out.

Below we step through the report in a little more detail, focusing on the following weaknesses:

- Firstly, the report contains some irregular representation of AEMO's figures from the workbooks that underpin the Integrated system plan.

- Secondly, the report presents some figures regarding the cost of transmission which do not reflect the reality of the changing power system.

- Thirdly, the report claims the energy transition is also likely to involve significant costs in the low voltage distribution sector through uptake of more consumer energy resources (i.e.; rooftop solar, home batteries EV home charging and energy management systems). This claim is false with CER already driving down energy bills and, in the future, can lead to better utilisation of the distribution network and bring down energy costs for all consumers even further.

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[1] CDP 14 is the Optimal development path. Available at www.aemo.com.au AEMO | 2024 Integrated System Plan (ISP)

Irregular representation of AEMO's ISP figures

Section 4 of the paper is nominally a calibration exercise comparing the detailed results of AEMO's ISP modelling against the outcome of Frontiers model. Generally, the results align.

What is most interesting here is the way that Frontier have re-presented these values from AEMO to deliver some very large numbers. While this section of the report does not directly criticize AEMO's numbers, the very large values that are selected and emphasised have fuelled the basis of tabloid stories in recent weeks and risks misleading the Australian public.

Below we step through how Frontier has treated AEMO's ISP values.

Firstly, Frontier have split out the various elements of the ISP workbook values, as shown above. They exclude DSP/USE, Flowpath augmentation and REZ augmentation, but include Generator capital, F/VOM and Emissions costs. They then adjust from 2023 to 2024 dollars. They reproduce different sets of these values in the report.

Real July 2023 dollars ($m)	NPV
Generator capital	$112,302
FOM	$44,082
Fuel	$21,726
VOM	$4,274
DSP+USE	$632
REZ augmentation	$1,714
Flow path augmentation	$15,248
Emissions cost	$42,475
NPV and annual costs	$242,453

*Net present value as at 1 July 2023

This section of the report therefore focusses on values that are based on the sum of generator capital, FOM/VOM, Fuel and Emissions cost. One can assume that this therefore means all of the values presented in Frontier's report capture the cost of the *entire future generating fleet* – including the ***fuel and carbon costs of fossil fuel generation***.

The inclusion of these numbers allows them to produce tables such as the below, which set out some large numbers indeed for the NPV of the transition.

Table 2: Comparison of NPVs of AEMO ISP costs and modelled costs – including cost of emissions

NPV ($bn)	AEMO ISP 2023 base - full cost	AEMO ISP 2023 base - generation and emissions costs	AEMO ISP 2024 base - generation and emissions costs	Modelled 2024 base
Step Change	$242	$225	$245	$237
Progressive	$216	$202	$220	$216

Source: AEMO 2024 ISP and Frontier Economics

The reason to highlight this inclusion of other costs is that it stands in contrast to the standard reporting of the NPV by AEMO in the ISP, which delivers an NPV value of **$122B,** based on the annualised capital cost of all ***utility-scale generation, storage, firming and transmission infrastructure*** – i.e. excluding costs like VOM/FOM, fuel and emissions costs.

Thirdly, and most impactfully, Frontier state that "to many people the concept of NPV is confusing". It's not clear to whom this refers, given that NPV is a standard and well understood metric that is universally applied across financial modelling.

NPV is also a sensible approach to be used in long term economic planning processes. NPV is the standard mechanism for reflecting future investment costs, to account for the time value of money. This is particularly critical when looking at the 25+ year time horizon of the ISP and the fact that many of the projects are not built until the out years of the period.

On the basis that some unspecified individuals struggle to comprehend this basic financial concept, Frontier present a sum of AEMO's real costs out to 2050 (as presented in the ISP workbooks) and represent this as a ***single figure***, ignoring the fact that this value will be incurred over 25+ years.

Table 4: Comparison of sum of real costs of AEMO ISP costs and modelled costs – including costs of emission (2024/25 to 2050/51)

Sum of real costs ($bn)	AEMO ISP 2023 base - full cost	AEMO ISP 2023 base - generation and emissions costs	AEMO ISP 2024 base - generation and emissions costs	Modelled 2024 base
Step Change	$660	$604	$671	$608
Progressive	$580	$533	$592	$548

This of course oversimplifies the costs that customers will bear by ignoring the fact they will be incurred over a long time period and ignoring the time value of money associated with that long period.

It's this particular "non-conventional" form of economic analysis that allows Frontier to make the headline statement on page 8 of the report that: "the costs of AEMO's preferred Step Change scenario, which does not include the costs of consumer energy resources, is the sum of the real costs of the electricity supply options of $580 bn plus the $62 bn in transmission costs – or a total of $642 bn."

Weaknesses with Transmission cost arguments

Frontier's report also gets it wrong when it comes to describing the costs of the transmission investment needed to deliver the transition. It also mistakenly infers that some of this inflated cost could be avoided through nuclear build.

Frontier state on page 34 that:

> "An important aspect of the Federal Coalition's proposal to introduce nuclear generation in the plant mix is the consequences for the future costs of high voltage transmission. *Depending upon where and when nuclear generators are developed, significant savings could be made in avoided transmission costs* [our emphasis].
>
> "If the nuclear generators are located near the strong connection points currently serving existing large scale or recently decommissioned coal generator sites, this could save considerable costs associated with configuring and then augmenting over time new REZ zones and flow paths to accommodate renewables as fewer renewables would likely need to be connected to meet demand with base load nuclear in the NEM. The additional economic saving would be lower loss
> of visual amenity to the rural and regional communities that are bearing the burden of visual pollution from new transmission systems to support AEMO's focus on renewables to meet demand."

This statement is not backed by any evidence or modelling. There is also no evidence to suggest that nuclear generation will reduce the need for the new transmission investment identified in the ISP.

As far as we are aware, there is currently no quantification of the extent to which new transmission build is necessitated by growth in renewables, vs that which would be needed anyway as coal assets retire in the time period to now out to 2037, when the Coalition says the first nuclear power stations will be built.

However, if we take Frontier at their word that brownfield nuclear investment means there will be fewer renewables and transmission, this requires us to consider what other forms of generation will be needed, given nuclear power stations are unlikely to

be built before 2037. This leaves only new gas generation and significant extensions of existing coal generation to meet demand.

Frontier are silent on the costs of these new gas generation assets that would presumably be needed to fill the gap out to 2037 when the nuclear stations are commissioned. There are material capital and fuel costs associated with the former, while the latter will undoubtedly require significant tax payer support for many of them to continue to operate well past retirement dates – even if we assume the 'announced' dates from the station owners are accurate.

Frontier also present a "range of transmission costs", which is based on another simplistic summing of the total cost of the ISP projects.

Table 7: Range of transmission costs

Range	Cost estimate (2024 dollars)
Lower bound cost estimate	$42,928
Mid cost estimate	$54,435
Upper bound cost estimate	$66,103

It's unclear to us how these bound estimates were calculated.

However, we understand that Frontier have included a larger number of transmission projects in the development of this estimation than what is included in the ISP. This has been achieved by including projects that are either under construction or already commissioned, such as Project EnergyConnect, the Waratah Super Battery, Central-West Orana REZ and Copperstring 2032, in their assessment of transmission costs.

This is relevant due to the way these numbers are used to calculate a single "cost per MW" value of $500,000/MW, which is the highlight value Frontier present.

The intimation here is the costs of these *already underway* transmission and storage projects, which are designed to meet current and near-term demand for energy, should be included in transmission costs that are then compared against a counterfactual world where nuclear generation materialises *in 2037*. Certainly, it appears that Frontier has rolled these costs into its calculation of the $500,000/MW measure that is one of the headline results of the report.

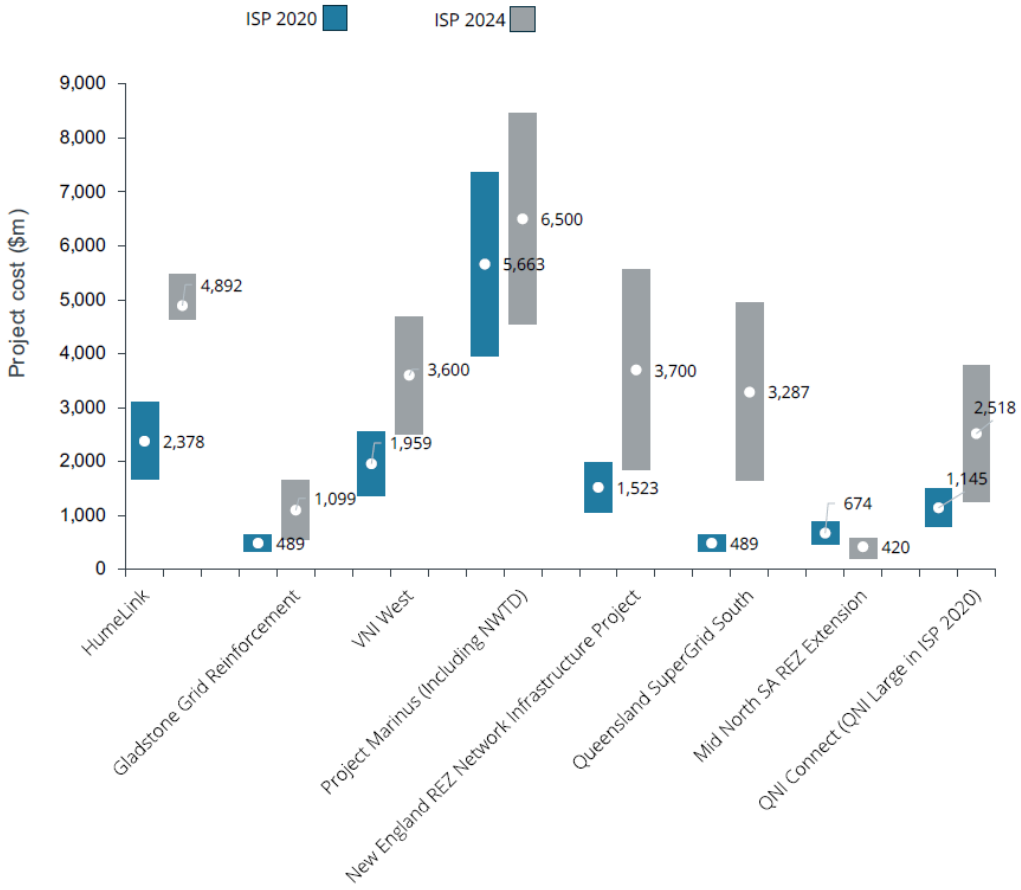
We don't yet know how Frontier intends to use this $500,000/MW measure in the Part 2 report and what this counterfactual comparison will look like. However, any attempt to use it as a measure of avoided transmission cost due to brownfield nuclear buildout should be immediately criticised on the basis that today's

transmission costs should not be compared against nuclear investments that are unlikely to appear before 2040.

Fourth, Frontier make some assertions about the 'economic benefits' of improved visual amenity associated with nuclear (through reduced requirements for wind and solar build). Of course, this ignores all of the equivalent costs from nuclear build, including waste, security, operations and regulatory costs.

Finally, Frontier highlight that transmission costs have increased markedly between the period of 2020 and 2024.

Figure 13: Comparison of 2020 ISP and 2024 ISP transmission cost estimates



This is factually correct. It's necessary however, to address the inference that these increases – which were driven by cyclical events – could somehow become structural elements of the transition over the coming 20 years.

The price increases that occurred between 2020 and 2024 were largely driven by the major inflationary pressure of the COVID pandemic, exacerbated by the effects of the Ukraine war. Additionally, some of the major transmission projects identified were subject to material expansions in scope.

Of course, future shocks may occur, which are likely to have similar impacts on supply chains and input costs. However, it would be a mistake to assume that the sharp increases between 2020 and 2024 are necessarily reflecting of future transmission network cost trends.

Consumer Energy Resources (CER)

The Frontier Reports makes a general statement claiming CER in the future will lead to higher low voltage distribution network costs.

This statement is dismissive of the value co-ordinated or orchestrated CER can bring to all consumers. AEMO's ISP notes that orchestrated CER will be one of the major energy supply and storage solutions in the National Electricity Market. Clean Energy Council modelling shows consumers who install solar battery solutions can save up to $900 pa and if they participate in a virtual power plant, this savings jumps up to $1,150 pa.

More importantly, the modelling shows that orchestrated solar battery systems will lead to better overall utilisation of the distribution network (i.e. more MWhs spread across the network). It is worth noting the distribution network is built to cope with very high peak events, hence, there is significant excess capacity that can be utilised. Solar battery systems provide for more flexibility in energy use, therefore leading to better utilisation of the system. Clean Energy Council modelling shows orchestrated solar battery systems will provide up to $2.4b saving through better use of the distribution network.

It is also important to note that four million rooftop solar installations already provide bill savings of $1,500pa on average to Australian households and small businesses that have installed them on their roofs. This represents on average a total bill savings of $6b per annum.

Conclusion

The Clean Energy Council's analysis concludes that Frontier's paper risks misleading the Australian public by potentially inflating the cost of transitioning to renewables through the use of irregular modelling approaches and presentation of data.

The price of replacing our aging electricity system in Australia is significant. However, any analysis must also consider the extraordinary benefits that these investments deliver in the form of reliable and least cost electricity to homes and businesses across the country.

The Frontier analysis fails to consider these benefits and the substantial net benefits of these impacts. In doing so it risks misguiding policy makers and the public's understanding of the cost of the current policy decisions for the future energy system, and inevitably distorts assessments of policy alternatives, undermining the achievement of a least-cost, energy transition for all Australians looking for cost-of-living relief through lower energy bills.

Ultimately what's crucial is that any new investment in the sector is made at the least cost to Australian consumers - only renewable energy (solar, wind, hydro), together with energy storage, is capable of delivering on this - and it's being built right now.