To: VNIWestRITT@aemo.com.au

Submission on VNI West Project Assessment Draft Report

I wish to make a submission on the Project Assessment Draft Report (PADR) for the Victoria to New South Wales Interconnector West (VNI West), issued on 26 July 2022.

My focus is on what seems to be an implausible set of modelling assumptions/outcomes to 'justify' building VNI West, resulting in a flawed net benefit forecast for the project.

Questionable modelling assumptions/outcomes for the building of VNI West, compared to the Base Case (i.e. without VNI West), include:

- VNI West is forecast to accrue $0.7bn of benefits in the three years before it is expected to be approved (2026). It is also forecast to accrue $1.9bn of benefits before it is commissioned (2032)

- these pre-commissioning benefits, which accrue over nine years before VNI West is in service, amount to twice the benefits that are forecast to accrue over the following sixteen years when VNI West is actually operating (of $0.9bn)

- the pre-commissioning benefits arise supposedly from avoided construction costs of wind and solar generators, and batteries that are not built compared to the Base Case

- even more questionable, the energy that would have come from the unbuilt renewable generators and from reduced gas generation during those pre-commissioning years is replaced by additional coal generation. That is, coal generators will be operational for longer and generate more energy than the Base Case. Obviously, this results in a slower transition away from coal and in additional emissions, running counter to government emission reduction policies

- the model then assumes that after VNI West is commissioned the foregone renewables and batteries are then built, but in different locations with higher quality wind and solar resources

- avoided fuel cost benefits are incorrectly assumed to continue after the end of the 25-year modelling period. By 2050, or hopefully earlier, there should be no fossil fuel generation, with or without VNI West, and therefore no fuel costs to avoid

- the estimated cost of VNI West has increased 110% in the past four years, from $1.55bn in the 2018 ISP to $3.3bn in the PADR (for a shorter line and less substations). One would expect there to be further escalations, especially as the project will not start construction for another four years and not be completed for another nine years

Surely a decision to build VNI West would have minimal if any impact on the construction and operation of renewables and batteries compared to the Base Case during the years prior to VNI West's commissioning. If there were to be any impact, one would expect that more, rather than less, renewables would be built prior to VNI West's commissioning in anticipation of the increased transmission capacity coming into service. It would only be after VNI West was in

service that one would expect significant changes compared to the Base Case and for any benefits to start accruing.

These perverse modelling assumptions/outcomes seem far removed from what would happen in reality.

Without these aberrant assumptions there would be minimal benefits pre-commissioning, less benefits over the remainder of the 25-year modelling period, and negligible if any benefits thereafter.

The forecast net benefit of $884m (Step Change scenario) appears to be based on seriously flawed assumptions. It is far more likely that the cost of VNI West will far exceed its benefits.

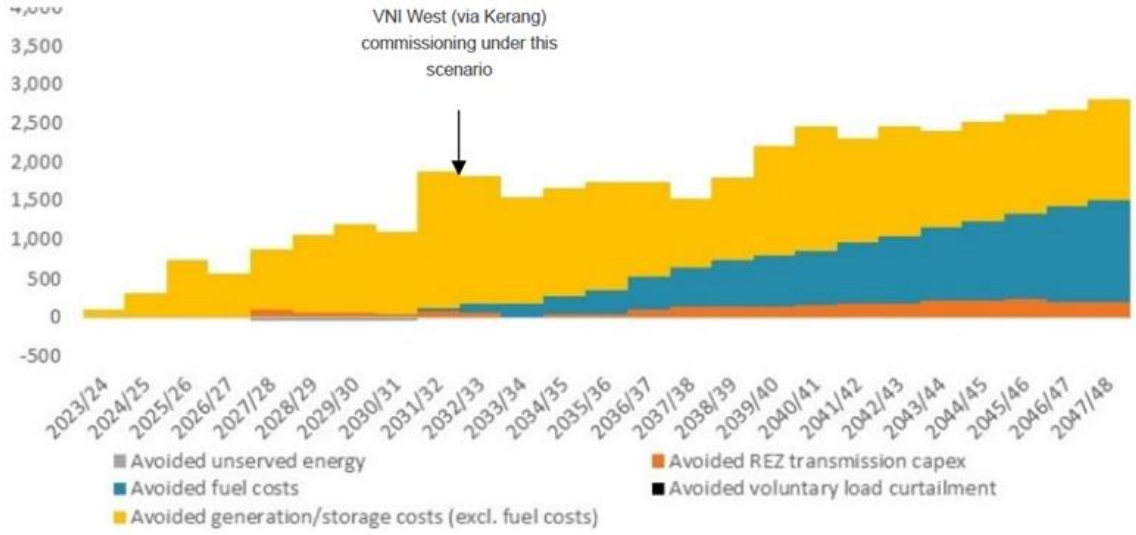
How can building VNI West be justified if it results in a net cost to consumers, a slower transition to renewables, a greater use of coal, and higher emissions (up to 2033)? Such outcomes are the very antithesis of government policies.

Ted Woodley
9 September 2022

1. PADR modelling outcomes

The forecast gross benefits for the Step Change scenario are conveniently displayed in Figure 8 of the PADR (extracted below for ease of reference – also see Attachment A).

Figure 8 Breakdown of cumulative gross benefits for Option 1 under the *Step Change* scenario



The cumulative gross benefits from building VNI West are estimated to be $2,795m by 2047-48, primarily from avoided generation/storage costs ($1,295m) and avoided fuel costs ($1,300m). A condensed extract from the VNI West PADR RIT-T NPV Model S1 is below.

Cumulative gross benefits pre-commissioning are estimated to be $1,878m, almost entirely from avoided generation/storage costs.

Cumulative PV	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2047/48
Avoided unserved energy	0	3	3	5	5	5	4	3	2	2	2
Avoided REZ transmission capex	0	0	2	5	2	97	62	64	49	88	204
Avoided fuel costs	0	-1	-7	-13	-19	-29	-29	-36	-25	27	1,300
Avoided voluntary load curtailment	0	3	3	3	2	2	2	2	2	3	-6
Avoided generation/storage costs (excl. fuel costs)	0	93	314	727	561	783	997	1,123	1,050	1,759	1,295
Total	0	98	315	726	551	859	1,036	1,157	1,077	1,878	2,795

According to the 2022 ISP:

> *"VNI West is a staged actionable ISP project, Stage 1 is to complete early works by approximately 2026, and stage 2 to complete implementation by July 2031".*

But the PADR seems to be based on a commissioning date of one year later for the Step Change scenario, even though it states the dates are aligned with the 2022 ISP (page 25):

> *"Subject to meeting the feedback loop requirements, Stage 2 of the project is targeted for completion as soon as possible in two of the three scenarios considered in this PADR, with the commissioning dates assumed under each scenario aligned with the 2022 ISP:*
>
> - *2030-31 under the Hydrogen Superpower scenario.*
> - *2031-32 under the Step Change scenario.*
> - *2038-39 under the Progressive Change scenario."*

Figure 8 indicates that VNI West will be commissioned at the end of 2031-32 under the Step Change Scenario. This submission assumes that is the date modelled in the PADR.

2. Substantial benefits accrue before VNI West is approved

According to the PADR, benefits start accruing in 2023-24 and continue thereafter to the end of the 25-year modelling period (2047-48) and beyond.

But the start of benefits accruing is some three years before VNI West is expected to be approved - the commencement of Stage 2 is expected in 2026.

The benefits in these three years, prior to formal project approval, total a staggering $726m. This is 25% of the benefits that are forecast to accrue over the entire 25-year modelling period! How could the mere prospect of VNI West being approved result in such substantial benefits compared to the Base Case?

To emphasise the incredulousness of such a huge benefit occurring before any substantive expenditure, it equates to over 80% of the estimated net benefit from VNI West over its entire 50-year economic life (of $884m).

Not only do benefits start three years before VNI West is approved, but they also continue accruing for another six years before it is scheduled to be commissioned.

3. Two-thirds of benefits accumulate pre-commissioning

If, as I assumed, VNI West is commissioned at the end of 2031-32, Figure 8 indicates gross cumulative benefits at that time of $1,878m.

These benefits, which have accumulated over nine years before VNI West starts operating, amount to twice the benefits that accrue in the following sixteen years when VNI West is actually in service and operating, of $917m.

The modelling forecasts that VNI West accumulates twice the benefits when it is not operational compared to when it is, and in half the time.

4. Apparent basis of modelling

The benefits that accrue pre-commissioning are mainly from avoided generation/storage costs.

The basis of the modelling seems to be that VNI West will somehow trigger a deferral of the construction of renewables/storage and gas before VNI West is commissioned, and hence 'avoid' the cost of installing this generation/storage for up to nine years or even longer. The modelling then assumes that the generation that would have been produced by the avoided generation/storage projects will be produced by a commensurate increase from coal generation at no capital cost, as it is already built and operating:

> *"Avoided/deferred generation and storage capital costs (the yellow sections of each bar in Figure 7) are primarily driven by deferred/avoided investment of large-scale storage and gas as well as some early deferral of predominantly wind capacity, though more wind and solar capacity is expected by the end of the study period"* (page 81)

The model then assumes that the deferred storage, wind, solar and gas will be built after VNI West is commissioned, resulting in a 'less frenetic' transition away from coal:

> *"The forecast increase in high quality renewable generation after the option is commissioned allows for a less frenetic transition away from coal in the 2020s without violating the*

emissions constraint. This ultimately drives the deferral of some capital investment in wind resources that would otherwise have been needed to help maintain energy supplies following the coal closure, until after the commissioning of VNI West" (page 81)

The model assumes that the very knowledge that VNI West is to be commissioned in 2031-32 will result in:

- a deferral of investment in storage, wind, solar and gas till commissioning, with $1.9bn of 'savings'
- a compensating increase in generation from coal plant
- the deferred generation/storage then being built after VNI West is operational

The remainder of my submission looks further into these seemingly implausible assumptions.

5. Less renewables and storage are built before VNI West is commissioned

The PADR assumes up to 528 MW less wind (in 2029-30), 444 MW less solar (in 2031-32) and 807 MW less batteries (in 2031-32) - see Attachment B.

How does the proposed building of VNI West influence the developers of renewable generators and batteries to defer their construction? What specifically will stop these developers from proceeding anyway?

If anything, wouldn't the knowledge that VNI West was to be built be an encouragement to proceed rather than delay building renewables and storage, as there will be more interstate transmission capacity for their use?

If this modelling 'rationale' were sound, then why not push back VNI West's commissioning beyond 2031-32, so that the benefits from avoided generation/storage costs last longer and accumulate even more savings? Existing coal generation could then be run even longer and harder, further putting off the need for, and cost of, renewables.

6. Less renewable generation

The modelling forecasts that building VNI West results in less generation from wind (9 TWh) and solar (2 TWh) before commissioning.

Solar capacity is projected to continue to be less than the base case up to 2035-36, in fact 921 MW less in 2032-33, resulting in 5 TWh less solar generation due to VNI West.

It seems incomprehensible that VNI West is being justified on the basis it will result in 14 TWh less generation from wind and solar through to the mid-2030s.

7. Extended coal plant life and extra coal generation

The modelling assumes that this (inconceivable) deferral of renewable generation, due to building VNI West, is replaced by extra coal generation. That is, existing coal plant will remain in service for longer and generate more than would have been the case had VNI West not been built:

- additional black coal generators will remain in service till 2039-40, generating an additional 13 TWh. Up to an extra 532 MW (2032-33) of black coal capacity will remain in service

- additional brown coal generators will remain in service till 2030-31, generating an additional 4.5 TWh. Up to an extra 231 MW (2030-31) of brown coal capacity will remain in service

The extra 17.5 TWh of coal generation amounts to about an extra 16 million tonnes of CO2 emissions.

Is it not paradoxical that the modelling and justification for VNI West is based on the project resulting in increased coal generation and emissions over nearly two decades?

Is not such justification against Federal and State Government policy?

8. VNI West results in "a less frenetic transition away from coal"

One of the modelling justifications is that VNI West will result in a *"less frenetic transition away from coal"* (page 81).

There is no question that the modelling forecasts less renewable generation and more coal generation into the middle-2030's, thereby slowing the transition away from coal.

However, the modelled reductions in wind and solar from building VNI West are minimal (and well less than the bounds of accuracy of the modelling). The reduction in wind generation represents less than 2% of the total wind capacity projected in the NEM in 2031-32 (34,606 MW). The reduction in solar generation is less than 4% of total solar capacity in 2031-32 (14,608 MW).

Putting the outcome in a starker way, over the 25-year modelling period, VNI West will result in 2% more black coal generation and 3.6% more brown coal, compared with 0.5% more solar generation and 0.02% *less* wind.

Again, it seems bizarre to extol VNI West for allowing more coal generation for longer, and less wind generation over the 25-year period.

Surely delaying new renewable generation that is to be built in the Base Case anyway and will contribute to the transition away from coal, is not a positive outcome.

9. No avoided gas capacity pre-commissioning

The PADR states that *"avoided/deferred generation and storage capital costs … are primarily driven by deferred/avoided investment of large-scale storage and gas as well as some early deferral of predominantly wind capacity"* (page 81).

But the PADR spreadsheets show no change in gas capacity pre-commissioning. In fact, there is no alteration in gas capacity till 2035-36, when 672 MW of OCGT plant is not required due to VNI West.

Whilst the model does not forecast any less gas capacity till the mid 2030's, it does predict 12% less gas generation over the entire 25-year period, initially replaced by additional coal generation and later by additional wind/solar generation.

10. Deferred renewable projects ultimately built in a different location

The model assumes that the Base Case renewable projects that are not built prior to 2031-32 would have been mainly located in Victoria. But the model then assumes they will be replaced by higher quality projects in windier and sunnier locations in NSW and northern Victoria after 2031-32.

What is the basis for this assumption and how realistic is it?

Is it feasible to assume that the Victorian Government would support less wind and solar projects being built in Victoria prior to 2031-32, so that higher quality projects can be built in NSW and northern Victoria next decade?

This modelling assumption runs counter to the Victorian Government's emission reduction and regional development policies.

11. The plausibility of an emissions constraint

It seems that the model knows that in the future (2035 to 2048) there will be a positive CO2 balance, from not needing to operate OCGT capacity of 672 MW (in 2035-36) up to 1,206 MW (in 2047-48).

The model then looked for the highest value way of using this 'credit' in the immediate future and opted for additional coal generation to maintain the so-called 'emissions constraint'. This then enables the deferral of renewables/batteries.

Is this how the model operated and if so, how does it relate to the real world?

Also, the model seems to be based on balancing out increased emissions from coal generation compared with the Base Case for the first decade or so, with reduced emissions later, from less gas generation. But in this case, additional emissions at the start of the period have far greater impact on climate change than equivalent reduced emissions decades later, even if the net is zero.

So, according to the model, VNI West would have a worse impact on emissions and climate change compared to the Base Case.

12. Snowy 2.0 benefits already claimed by HumeLink (and EnergyConnect)

VNI West is claimed to deliver benefits from enabling better utilisation of Snowy 2.0:

> *"Changes in resource sharing and better utilisation of Snowy pumped hydro, particularly Snowy 2.0, is found to defer and reduce the need for investment in new capacity, as well as deliver significant fuel cost savings by offsetting thermal generation that would otherwise need to operate."* (page 10)

But HumeLink is the primary contributor to the benefits of connecting Snowy 2.0 to the grid. Were it not for Snowy 2.0, HumeLink would have a shorter route, lower capacity, cost less and not be needed by 2026 (if at all).

The HumeLink PACR has already (over) claimed substantial benefits from connecting Snowy 2.0. The PACR assumed a Snowy 2.0 capacity factor of 25% for generation and 33% for pumping (see A review of the HumeLink PACR, Sep 2021, VEPC). That is, Snowy 2.0 is assumed to operate

(generate or pump) at an average of 1,200 MW for 24 hours/day every day of the year. As this would imply that Tumut 3 and other pumped hydro stations were also operating at similar elevated levels, it is an exceedingly unrealistic assumption.

All 'benefits' from connecting Snowy 2.0 have been well and truly claimed by HumeLink – Snowy 2.0 cannot be run any harder than assumed in the HumeLink PACR no matter what extra transmission is proposed.

Project EnergyConnect has also claimed duplicate benefits from connecting Snowy 2.0.

What are the claimed benefits in the VNI West PADR from connecting Snowy 2.0, and haven't they already been claimed by other transmission projects?

13. Analysis period once commissioned is only sixteen years, and ends before 2050

> *"The RIT-T analysis in this PADR spans a 27-year assessment period from 2021-22 to 2047-48. This period has been adopted to capture both the period of costs incurred for the early works (which commenced in 2021-22 for the New South Wales component) and 25 years of wholesale market modelling (covering 2023-24 to 2047-48).* (page 79)
> *Note this assessment period is slightly shorter than the 2022 ISP, which extended to 2050-51"*

Whilst it might be 27 years from now to 2047-48, the assessment period covering VNI West's operation is only 16 years. And for no explained reason it ends three years earlier than the ISP, and before the zero emissions target year of 2050.

For an asset with an economic life of 50 years and a technical life of far longer, is 16 years not a rather short analysis period, especially when it concludes before 2050?

14. Minimal benefits after 2047-48

The model applies a credit of $536m for benefits post 2047-48, based on the present value of the calculated residual value of $2,044m in that year.

It is argued that a conservative approach was taken, as the average of benefits over the last five years of the assessment period is projected to be $280m p.a.:

> *"AVP and TransGrid consider that the assumption that benefits over the remaining life of the assets will exceed the undepreciated capital costs and the ongoing operating costs is reasonable based on the market benefits assessment undertaken. The market benefits assessment projected that market benefits net of operating costs in the last five years of the assessment period stabilised at around $280 million per annum on a weighted basis. Using a benefit extrapolation approach would result in a terminal value approximately 1.6 times the terminal value used (in present value terms)."* (Page 79)

As a detail, the model actually forecasts gross benefits in the last five years to increase by only $69m p.a. (NPV) [($2,795m - $2,450m)/5], not $280m p.a. And neither do the yearly benefits 'stabilise' over that period, varying between -$53m and $158m.

Delving further, the major benefit category in the last five years is avoided fuel costs, which are forecast to average $89m p.a. Interestingly, avoided generation/storage costs averaged minus $24m p.a.

But the major flaw in the assumption that the average of market benefits over the last five years of the modelling period will continue for the remaining 34 years of VNI West's economic life (i.e. till 2081-82) is that there should be no fuel costs to avoid, compared with the Base Case.

By 2050, or hopefully earlier, there should be no fossil fuel use and hence no fuel costs to avoid.

The assumption that the residual value of VNI West is $536m is extremely overstated. And it accounts for 60% of the stated net benefits of $884m.

15. Capital cost escalation

The capital cost estimate has increased from $1.55bn in the 2018 ISP, to $1.73bn in the 2020 ISP, to $2.94 in the 2022 ISP, to $3.3bn in the PADR, an overall increase of 110% in four years. It is relevant to note that the increase is actually higher than 110% as the PADR project is shorter and has less substations than originally proposed in 2018.

The PADR's $3,256m cost is split almost equally between Victoria and NSW, $1,605m and $1,651m.

The PADR states (page 71) that *"the revised cost estimates are considered to an accuracy of ±30%, which AVP and Transgrid consider to be 'class 4' estimates".*

One would be very optimistic to think that there will be no further escalations, especially as the project will not start construction for another five years and not be completed for another nine years. Recent and ongoing supply constraints and cost increases, mounting local community opposition to transmission lines, and pressures from the massive transmission building program, do not auger well.

As an example, the PADR estimate for the Victorian section has increased $300m (23%) since the 2022 ISP, issued just two months earlier, due to social and environmental concerns:

> *"The VNI West cost estimates used in this PADR differ from that presented in the 2022 ISP by approximately $300 million due to a change in the level of line cost contingency provisioned in the Victorian component of the project to account for remediation of social and environmental concerns. As outlined in Section 5.1.2, this recognises that, based on recent experience, some level of route diversion, tower redesign, or screening may be required beyond that anticipated and included in the Victorian component of the estimate presented in 2022 ISP. This provision does not anticipate undergrounding costs. If partial undergrounding is required, a greater level of contingency would be needed."* (page 72)

16. Negative net benefits

History shows that modelling of costs and benefits should be considered with much caution, even scepticism. Costs should be reasonably known, though recent history shows massive underestimation. But estimated benefits are far more nebulous and involve forecasting well into the future over many decades.

The upfront capital cost of VNI West is unavoidable and immutable.

On the other hand, the estimated benefits are far more problematic. The PADR estimates cumulative gross benefits of $2.8bn by 2047-48 and $0.5bn thereafter. Both estimates appear to be wildly overstated.

Rather than having a modelled net benefit of $0.9bn, VNI West looks almost certain to result in a substantial negative net benefit.

17. Other comments

Following are further comments and apparent modelling anomalies:

- hydro generation varies in each of the twenty-five years between plus 375 GWh (2034-35) and minus 901 GWh (2044-45). Over the full period hydro generates 515 GWh less due to VNI West. In the pre-commissioning years hydro generates 198 GWh less. Why would hydro generation change at all, as the available water is not impacted by whether VNI West is built or not?

- wind generation over the modelling period is 659 GWh less. It seems incomprehensible that VNI West would result in less wind generation over the next 27 years

- solar capacity varies significantly year-on-year, depending on whether VNI West is built or not, for no apparent reason. For example, it is 921 MW less in 2032-33 and 1,199 MW less in 2040-41, but 2,245 more in 2043-44, ending at 1,440 MW more in 2047-48

- avoided generation/storage cost benefits in 2031-32, the year VNI West is commissioned, are estimated to be $720m. This is far greater than any other year, and accounts for one-quarter of the cumulative benefits over the 25 years

- after this stellar year the avoided generation/storage costs decline from $1,759m in 2031-32 to $1,295m in 2047-48, a 25% fall. 2037-38 accounts for 70% of the fall ($339m).

18. Postscript

The TransGrid's Transmission Annual Planning Report has just been released, proposing that the NSW section of VNI West be bundled with HumeLink and EnergyConnect for completion by 2028, three years earlier than proposed in the PADR:

> *"We believe the projects critical to implementing the recently released AEMO 2022 ISP could and should be completed faster than the current schedule and at a lower cost than the current approach. To this end, Transgrid proposes integrating the construction of three separate Southern Australia projects – HumeLink, Energy Connect and VNI West (Victoria NSW Interconnect) – into a single simultaneous program.*
> *We are confident this approach can deliver the portfolio by 2028 and earlier than currently projected in the ISP. By delivering efficiencies and benefits of scale, this program approach will likely save significant amount in program costs, which would see significant savings on the average residential customer bill."* (Section 1.4.3)

If this is achievable, which appears highly dubious at least for VNI West, it would result in significant changes to the VNI West modelling outcomes. On first glance it would seem that such an advancement of VNI West's commissioning would, based on the model (albeit flawed), reduce the deferral of renewables and use of coal. But it would also reduce the avoided cost benefits and increase the present value of costs more than the present value of benefits.

Obviously, there is no point in advancing the NSW section of VNI West without also doing likewise for the Victorian section.

This latest timing announcement warrants a revision of the PADR and its modelling.

Acknowledgements

I wish to acknowledge the assistance of Simon Bartlett, Bruce Mountain and Hugh Outhred in preparing this submission, but the final comments are my own.

Attachment A - Extract from PADR, pages 83 and 84

Figure 8 below presents the estimated cumulative expected gross benefits for Option 1 for each year of the assessment period under the Step Change scenario. It shows that, while benefits from avoided/deferred generation costs accrue straightaway, benefits from avoided fuel consumption begin accruing from commissioning in 2031-32 and accrue steadily from there.

Figure 8 Breakdown of cumulative gross benefits for Option 1 under the *Step Change* scenario

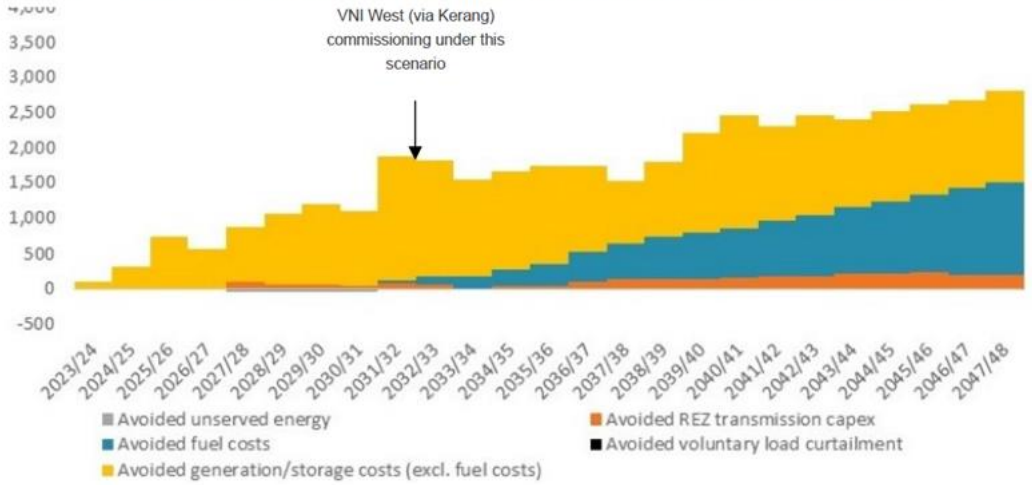


Figure 9 summarises the difference in generation and storage capacity modelled for Option 1 (in GW), compared to the base case; that is, what is found to be driving the avoided or deferred costs associated with generation and storage benefit.

With VNI West there is less solar generation build overall up to the end of the 2030s, with VNI West harnessing more high quality solar generation (higher capacity factor) in the Murray River REZ, and less solar generation development in Ovens Murray, Central North Victoria and Gippsland REZs in Victoria, as well as less in Queensland (Fitzroy REZ) and South Australia (Riverland REZ).

Figure 9 Difference in cumulative capacity build with Option 1, compared to the base case, under the *Step Change* scenario

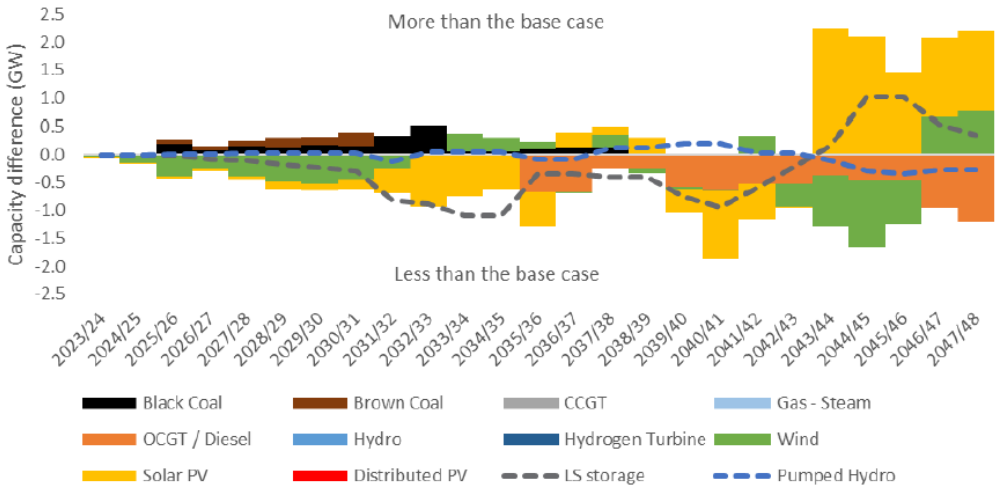
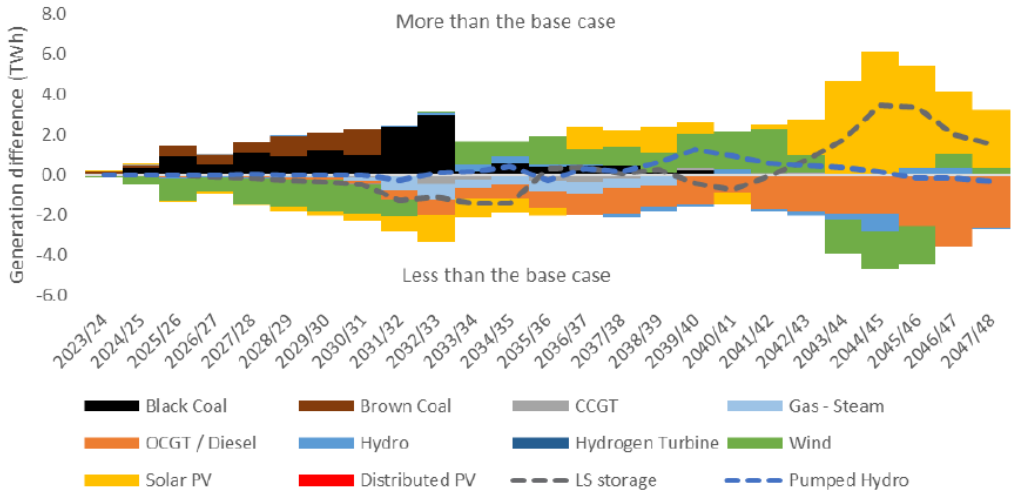


Figure 10 summarises the difference in generation and storage output modelled for Option 1 (in terawatt hours (TWh)), compared to the base case; that is, what is found to be driving the avoided fuel cost benefit. The reduction in OCGT/diesel utilisation is clearly evident.

Figure 10 Difference in output with Option 1, compared to the base case, under the *Step Change* scenario



Attachment B – Change in MW, GWh and Fuel Cost between the Base Case and Option 1 (derived from EY Workbook, Step Change)

Change in Capacity (MW) Option 1 minus Base Case

Region	Technology	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36	2036-37	2037-38	2038-39	2039-40	2040-41	2041-42	2042-43	2043-44	2044-45	2045-46	2046-47	2047-48
NEM	Black Coal	0	0	191	71	155	136	174	155	348	532	66	66	96	131	131	30	30	0	0	0	0	0	0	0	0
NEM	Brown Coal	0	0	81	81	88	164	140	231	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEM	CCGT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEM	Gas - Steam	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEM	OCGT / Diesel	0	0	0	0	0	0	0	0	0	0	0	0	-672	-672	-246	-246	-570	-625	-524	-524	-373	-457	-457	-948	-1,206
NEM	Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEM	Hydrogen Turbine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEM	Wind	-40	-144	-387	-241	-391	-490	-528	-439	-244	-13	318	243	129	-6	224	-88	-44	-35	337	-402	-909	-1,196	-797	659	762
NEM	Solar PV	0	0	-48	-48	-48	-118	-112	-183	-444	-921	-739	-608	-608	262	160	263	-423	-1,199	-632	-26	2,245	2,100	1,455	1,413	1,440
NEM	Grid Battery	0	0	0	-74	-103	-178	-223	-294	-807	-888	-1,090	-1,091	-337	-337	-401	-401	-756	-941	-579	-218	164	1,017	1,016	538	350
NEM	Pumped Hydro	0	0	5	5	29	29	29	29	-126	41	41	41	-73	-73	120	120	195	195	35	35	-105	-289	-335	-261	-263
NEM	VPP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total excluding storage		-40	-144	-162	-136	-195	-308	-326	-235	-341	-403	-355	-300	-1,055	-284	270	-41	-1,007	-1,860	-818	-952	962	446	199	1,124	995

Change in Generation sent out (GWh) Option 1 minus Base Case

Region	Technology	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36	2036-37	2037-38	2038-39	2039-40	2040-41	2041-42	2042-43	2043-44	2044-45	2045-46	2046-47	2047-48	SUM
NEM	Black Coal	-7	315	848	487	1,009	877	1,166	899	2,216	2,779	149	507	373	442	434	115	226	0	0	0	0	0	0	0	0	12,835
NEM	Brown Coal	153	122	472	410	465	877	778	1,214	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,489
NEM	CCGT	1	11	-16	1	-43	-18	-56	-102	-43	-411	-214	-76	-308	-351	-170	-35	73	-20	94	113	-57	36	-13	-4	2	-1,604
NEM	Gas - Steam	-2	-5	-63	-47	-55	-90	-82	-185	-659	-786	-405	-388	-483	-529	-458	-475	0	0	0	0	0	0	0	0	0	-4,714
NEM	OCGT / Diesel	0	-3	-60	-40	-46	-127	-70	-139	-484	-736	-512	-693	-809	-1,068	-1,250	-1,063	-1,418	-847	-1,667	-1,811	-1,823	-1,886	-2,507	-3,472	-2,619	-25,150
NEM	Hydro	-44	-47	-23	-28	-39	1	-33	-44	59	87	332	375	81	29	-220	-224	-147	301	-148	-203	-304	-901	323	333	-29	-515
NEM	Hydrogen Turbine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEM	Wind	-95	-447	-1,098	-692	-1,252	-1,352	-1,560	-1,417	-848	18	1,146	717	1,419	765	917	973	1,701	1,849	2,199	833	-1,693	-1,902	-1,879	690	350	-659
NEM	Solar PV	3	46	-46	-89	-80	-231	-224	-372	-720	-1,356	-972	-702	-386	1,128	843	1,304	590	-561	202	1,835	4,661	6,089	5,118	3,081	2,883	22,046
NEM	Grid Battery	-1	-2	8	-88	-144	-252	-358	-478	-1,285	-1,102	-1,421	-1,430	337	345	53	248	-406	-751	-73	758	1,713	3,451	3,364	2,002	1,516	6,003
NEM	Pumped Hydro	0	-9	0	14	40	11	-14	23	-239	80	164	434	-257	299	165	640	1,286	955	602	462	364	165	-172	-166	-313	4,534
NEM	VPP	0	0	0	1	1	-1	1	3	12	12	16	-26	21	38	42	44	30	24	14	44	45	109	103	130	93	756
Total excluding storage		8	-8	14	1	-40	-63	-81	-146	-479	-406	-478	-261	-113	416	96	594	1,025	723	680	767	785	1,436	1,043	629	586	6,727

Change in Fuel cost ($000s) Option 1 minus Base Case

Region	Technology	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36	2036-37	2037-38	2038-39	2039-40	2040-41	2041-42	2042-43	2043-44	2044-45	2045-46	2046-47	2047-48	SUM
NEM	Black Coal	-588	5,977	15,647	11,118	17,844	14,258	17,181	12,135	29,292	35,187	1,040	4,539	3,050	2,430	2,666	358	1,059	0	0	0	0	0	0	0	0	173,194
NEM	Brown Coal	1,173	880	3,019	2,496	2,678	4,848	4,089	6,009	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	25,186
NEM	CCGT	188	655	-860	58	-2,161	-1,045	-2,770	-4,599	-3,876	-18,055	-9,362	-3,626	-11,815	-12,424	-4,604	-1,142	1,798	-519	2,343	2,432	-1,112	648	-255	-78	35	-70,145
NEM	Gas - Steam	-189	-464	-5,957	-4,208	-4,609	-7,373	-6,254	-13,490	-45,286	-51,374	-25,387	-23,326	-27,882	-29,229	-24,096	-23,779	0	0	0	0	0	0	0	0	0	-292,901
NEM	OCGT / Diesel	-54	-351	-5,766	-3,551	-4,047	-10,991	-5,319	-10,146	-32,364	-47,632	-29,714	-44,551	-45,066	-60,039	-66,228	-55,681	-73,784	-41,358	-76,322	-76,029	-74,712	-71,433	-89,697	-122,176	-87,924	-1,134,935
NEM	Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEM	Hydrogen Turbine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEM	Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEM	Solar PV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEM	Grid Battery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEM	Pumped Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEM	VPP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total excluding storage		531	6,697	6,084	5,913	9,704	-303	6,928	-10,091	-52,235	-81,875	-63,424	-66,965	-81,714	-99,262	-92,261	-80,244	-70,927	-41,877	-73,980	-73,597	-75,824	-70,785	-89,951	-122,254	-87,890	-1,299,602