1st October 2023

Submission to the 'Community Engagement Review' regarding:

- **Renewable energy infrastructure**
- **Planning, developing and operating energy infrastructure to benefit communities, landowners and First Nations peoples.**

Also known as the Federal Review being led by Andrew Dyer, Australian Energy Infrastructure Commissioner (AEIC): Community Engagement Review - DCCEEW

Lighter Footprints welcomes the opportunity to make a Submission to this Review.
In relation to the broader subject of 'renewable energy infrastructure', Lighter Footprints would like to focus on the topic of '**Transmission'**.

Who We Are

Lighter Footprints is a community-based group that works towards Australian local, state and national decision makers taking the action necessary to halt global warming as a matter of urgency. For over a decade, we have educated, advocated and brought people together in Boroondara, Melbourne, and surrounding suburbs to inform the community and promote a clean energy future. We have 3,500 people on our mailing list.

We wish to acknowledge the input from Carolyn Ingvarson (Founder of Lighter Footprints and Deputy Chair of Electrify Boroondara), Michael Nolan (Co-convenor of Lighter Footprints, and a national engineering background), David Strang (Energy Transition Group Convenor – Lighter Footprints, and a CFO background in energy distribution companies) and Russell Williams (extensive technical background in telecommunications communications and member of the Energy Transition Group, Lighter Footprints).
We hope that the Report and recommendations from this review will be used to gain bipartisan and widespread support for the decisive actions to improve the national connection of renewable energy resources.

Summary

- De-carbonisation of the electricity grid can ill-afford delays. Timing in bringing new Transmission connections to renewables generation is critically important.

- Timing for new Transmission is currently not properly weighted in the AEMO Multi-criteria Assessments (MAC's). Delays in transmission upgrades are widespread. The AEMC should revise weighting of some criteria to improve the score of those options that have a quicker implementation (and/or options that have reduced risk of delays).

- Any time and every time a 'Transmission Option' is taken to the community for consultation, an 'existing easement solution' should be explored in parallel.

- There are two significant alternatives that could be considered when contemplating transmission upgrades. First, Virtual Power Plants (VPP's) i.e. aggregated solar and batteries, and secondly, the increased penetration of normal rooftop solar (*not* aggregated under a VPP). It should be a requirement that these two solar options be assessed as part of evaluation of options alongside any new transmission planning or upgrades.

- Wind farms always require connection to transmission and in that respect, they are very different from solar farms. Rooftop solar should be recognised for the ability to be partly community funded, and for not tying up HV transmission capacity. They should probably be prioritised ahead of large solar farms, though commercial interests favour in-front-of-the meter solutions, and so will try to stop or slow rooftop solar and household batteries replacing solar farms.

- Batteries will play an increasingly larger part in reducing the transmission capacity required, by charging in solar peaks and discharging in evening and morning peaks. In addition, grid-scale batteries can also be held in reserve for hot, windy days (1% of the year) when transmission capacity has to be curtailed.

Detailed response

Our detailed response follows on pages 3 to 19. It is structured as follows:

We agree to publication of this submission.
Community Engagement Review - DCCEEW
The closing date for the committee receiving submissions is 1 October 2023.

SUBMISSION BY:

Organisation name:	Lighter Footprints Inc.
Organisation Position:	Co-Convenor
Date:	1 October 2023

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1.0 Introduction

In relation to the broad topic of 'renewable energy infrastructure', **Lighter Footprints** would like to focus primarily on the topic of '**Transmission'**.

We want to focus primarily on transmission because in decarbonising the electricity grid, we see that new Renewables Energy Zones (REZ's) require significant transmission upgrades. However, major high-voltage (HV) transmission upgrades are facing 'stiff opposition' in regional communities that won't be going away any time soon[1]. Consideration of alternatives that avoid much of this ongoing conflict and the resulting delays seems a logical position for both state and federal governments to provide more focus on. Otherwise, transmission looks set to hold up the implementation of renewable energy.

We explore a number of ways to avert or reduce transmission issues and delays.

Renewables and Transmission: Although renewable electricity generation must be built quickly, 'new renewable energy zones' (REZ's) are being held up by delays in transmission lines to connect them, caused by both supply chain bottlenecks and by stiff opposition by some regional communities. [2]

The delays in transmission projects – including Hume Link in NSW, VNI-West in north-west Victoria, and connection of Snowy 2.0, highlight the difficulties.

Delays subsequently lead to cost blow-outs to budgets and become substantial barriers to meeting emissions reduction targets. They become the focus for local communities and media thrive on these stories, which rattle local MPs, and dominate popular media coverage.

The brief analysis above, including nuclear not stacking up as a solution (for reasons given later in Section 4) and recognition of the issues confronting transmission, is the rationale behind why Lighter Footprints' Submission focusses on improving transmission planning, and where practical, circumventing the need for new transmission.

Where new transmission is necessary, we have focussed on minimizing time delays by addressing key issues associated with social license, and an improved approach to multi-criteria assessments, as well as some engineering considerations.

2.0 What's the problem from a community perspective?

Historically, and today, land owners (and regional communities including indigenous communities) are often late in finding out about plans that will affect their properties. Many complain there is not the understanding and respect they would expect. Many, with their 'backs up', then oppose new HV transmission lines – to a large extent as a reaction to not being properly consulted. Among some, this leads to a jaundiced view that the new infrastructure (e.g. wind towers, transmission) is planned to run through 'safe National seats' and interests close to AEMO stand to benefit from longer transmission solutions. This type of opposition is not unique to Australia.

We have observed in relation to VNI-West (Victoria) in particular, that AEMO have created a blue-print for a 500 kV upgrade over many years of analysis, and then set about consulting with regional communities and farmers on the detail of the route in a relatively short time-period.

[1] Energy transition: Farmers fight Victoria's powerline grab for Western Renewables Link (afr.com)
[2] Energy transition: Face reality about transfer of power from coal (afr.com)

"*Land-owners only got wind of VNI-West in north-west Victoria in March 2023*" (anonymous source). The consultation in community forums, as well as consulting with some landowners regarding routes and new easements is regarded by many with suspicion.
"*It looks like the government has no understanding, and no respect. They see open land in these parts…….and think that no-one will care. But many of us are running multi-million dollar businesses, with multi-million dollar debts, and trying to do the best we can from an environmental and land point of view*". (Anonymous source)

The current approach has led to some significant impasses and the Victorian Government has had to step in to manage procurement of the land for the new easements. Throwing money at farmers is not likely to resolve the issues. Our real fear is that the Victorian Government may be doomed to slugging it out with regional communities for some years, leading to associated delays in implementation.

As has been shown with similar regional issues (e.g. Victorian north-south pipelines, various wind farms), regional communities, and landowners/farmers don't respond well to government bodies making decisions that negatively impact them. They show that it is not just an issue of being paid well for their land. In order to have transmission issues addressed and getting implementation done as quickly as possible, a range of genuine community concerns must be taken seriously.

"*I went to a public consultation in town. They couldn't even answer the basic questions, like: How does insurance work? What if we have a fire caused by power lines? We won't be able to do aerial spraying in future above power lines. We are not sure how transmission will affect future drone technology. How will compensation work for land de-valuation? They couldn't answer any of these questions*".

As well, broader regional concerns include environmental issues like clearing native woodland, and impacting biodiversity; carving up previously united communities with infrastructure corridors.

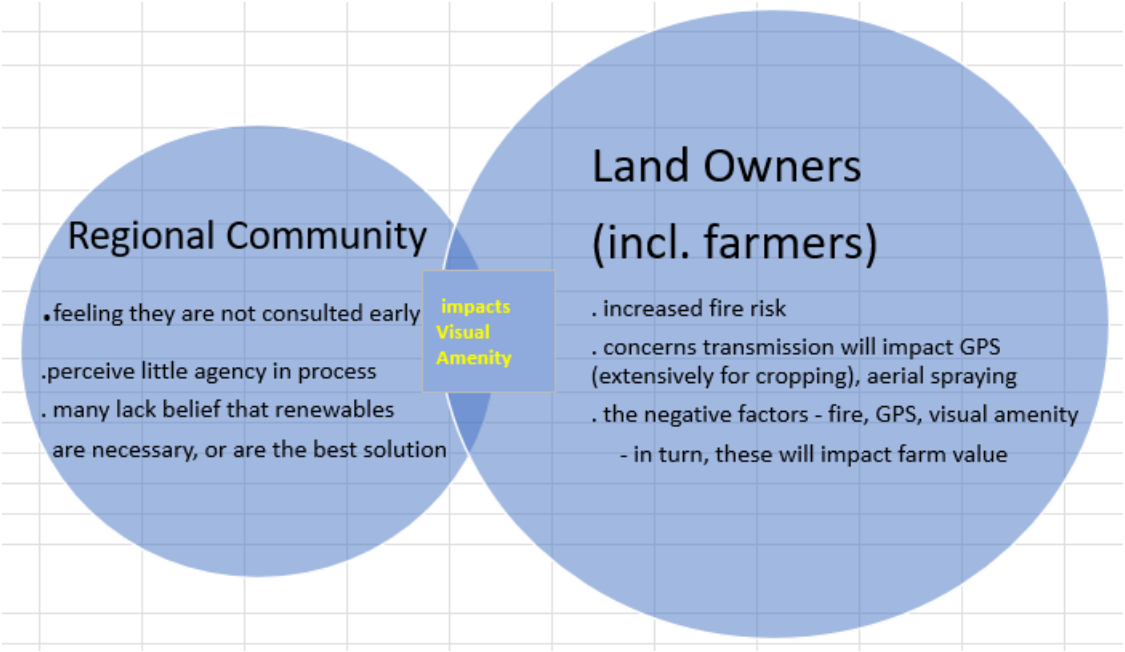


Diagram: Some concerns of land-owners and regional community concerns.

Suggestons for improving Consultation:

Address community and landowners concerns earlier and more thoroughly. Publish data and FAQ's earlier, and on public websites, including the following:

- Consult with affected community early in the piece
- Explain there is an alternative 'on-the-table' that uses *existing* easement!
- Provide answers to known questions like:
- What effect will HV transmission have on GPS? (farmers use global positioning systems extensively)
- What effect will transmission towers have on aerial spraying? On new future technology such as drones?
- What effect will HV transmission have on land-values? (Government may need to under-write some level of land-value losses up to 10 years from transmission build)
- What effect will HV transmission have on insurance, fire insurance in particular for land-owners (particularly fire risks from clashing conductors on hot, windy days)?

3.0 Alternatives for consideration to address transmission problems

3.1 Transmission upgrades – put existing easement on the table, along with new easement

Building **new HV transmission on new easements** is one way to bring more renewables into the electricity grid. But this is not the only way.

Upgrading HV transmission on existing easements - primarily duplicating towers, and/or duplicating conductors – can go a long way towards delivering the required connection of additional renewable capacity.

By going to stakeholders with an *existing* easement solution, AND a *new* easement solution, we see that firstly, this would be a better way to get consensus because land-owners know they won't be forced to accept 'the solution'. And secondly, it would be better negotiating position for transmission proponents as there is a 'best alternative' mind-set created around two separate proposals.

In some ways then, Landholders have more agency in whether a new easement goes ahead or not, but they also know that rejection of a *new* easement Option, likely results in proceeding with the *existing* easement Option. An existing easement solution is very likely to encounter 'less resistance, and lead to better project timing'. And perhaps it will be better cost.
We develop this approach in more detail later.

In summary, for each and every transmission project, we propose that:
Firstly, fully develop the **best option** that uses **existing easement**. And secondly, even if a **new easement** option appears to be better at the feasibility stage, then nevertheless, *both* options should be taken to community consultation.

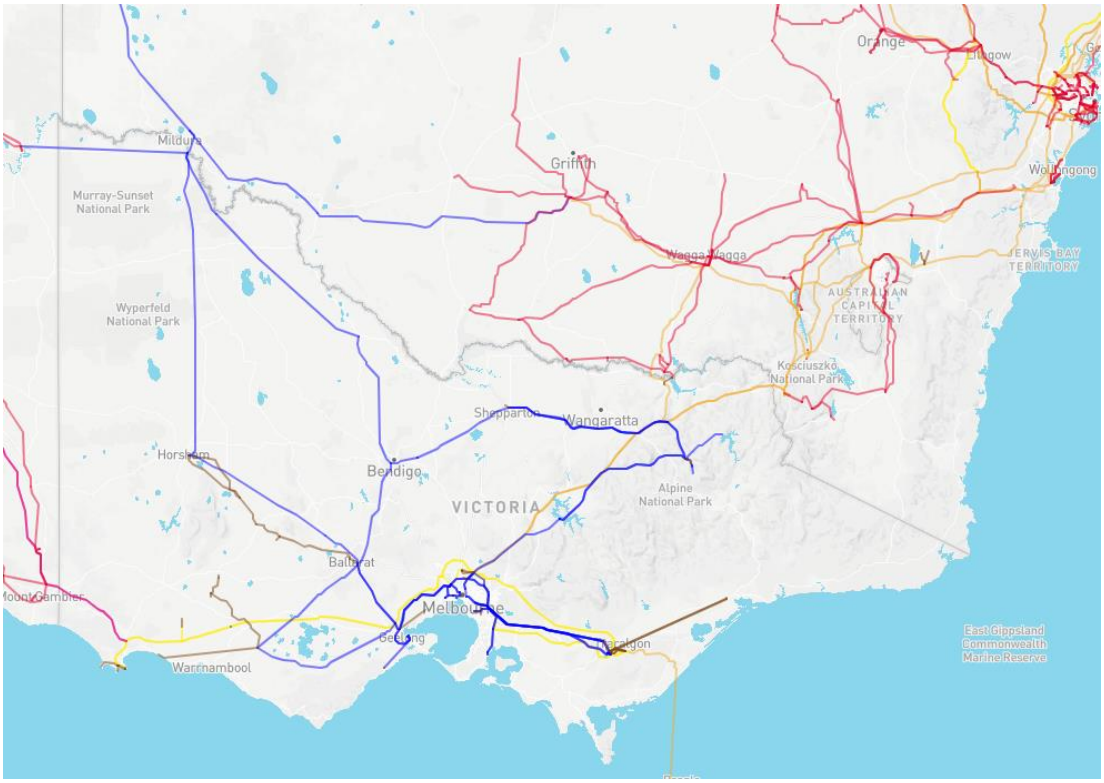
Identifying the best option that uses the existing easement:

We outline some of the considerations to find the best option in **Sections 3.1, 3.2, 3.3 and 3.4**

3.2. Maximise the benefits of existing assets by duplicating towers.

- At a high level, 220kV transmission is typically rated for 200 MW capacity per conductor. By duplicating conductors and/or by duplicating towers, an existing 220kV can be upgraded to approximately the same capacity as 500 kV transmission. (Bartlett and Mountain [3] *refer Table 13 , page 60*).
- Upgrading existing 220kV transmission lines on <u>existing easement</u> option variously involves one or more of the following:
  - Add additional conductors on existing towers e.g. *twin Peach* conductors
  - Use existing easements, with a 10 metre shift
  - Use spare easements to obviate the need for new easements

  In simple terms, duplicating the 220 kV conductors or providing dual towers on one easement delivers the equivalent of 440 kV. Further, a 20% augmentation of conductors through the use of Dynamic Rating Equipment – see following point - delivers the approximate equivalent of 500 kV. *i.e. Existing 220 kV transmission on existing easement with upgrades can be made to nearly match the transmission capacity of building new 500 kV transmission on new easement.*



From: AEMO Map (selecting 'layer' > Transmission infrastructure > Transmission lines). Blue lines depict 220 kV transmission.

3.3 Augment the existing HV conductors.

Nearly all Victorian transmission lines have Aluminium Conductor Steel Reinforced (ACSR) conductors with a steel core that reduces the sag of the conductor enabling them to run at higher temperatures than the 75 degrees C they were designed for. Operating these lines at 90 degrees C enables them to carry 20% more capacity, while still being compliant on

[3] 92a2aa_76c7e6d656a6439b8ad5488f0a37c941.pdf (vepc.org.au)

conductor-to-ground clearance, avoiding conductor issues linked to differential expansion *(refer Section 3.1).* This can be achieved in practical terms as follows:

- The maximum current the conductor can carry is based on assumptions of maximum ambient temperature and wind speed. But these conditions only occur for a very small number of hours per year (hot, windy days in summer months), which for the sake of discussion we are assume is approximately 100 hours per year, or less than 1% a year.

Therefore, controls can be added – specifically, **Dynamic Rating Equipment** (with weather stations measuring temperature and wind-speed) - so that the transmission can be dynamically rated to carry higher loads 99% of the time - while curtailing the carrying capacity of transmission 1% of the time, i.e. on hot and windy days. [4] *(refer Section 3.1*)

3.4 Design for additional rooftop solar or grid-scale batteries to help manage transmission curtailment on hot (sunny) days.

As noted under Section 3.3, it is probably economic to curtail transmission capacity on hot windy days so that conductors carry more load and run hotter normally, but capacity will be automatically curtailed on hot days.
In order to reduce the impact of this curtailment, one or more of the following can be implemented:

Rooftop solar along Transmission routes:
More solar rooftop installations can be installed along the transmission line through targeted incentives, to deploy more solar power capacity close to point-of-use, allowing the HV transmission to be curtailed on the 1% of hot summer days.

Grid-scale batteries can increase effective capacity:
"By connecting batteries in at least two locations we can create….. a 'virtual' transmission line. It's storage (via battery) as a transmission asset. The first battery is close to the wind generation and when the transmission is at capacity limits, the battery charges to avoid curtailment" said Lara Kruk, Jacobs APAC Substations Technical director the Wind Industry Summit[5].

A battery at the *supply end* can store the excess energy the grid cannot carry at the time of high generation and a battery at the *demand end* of the weak part of the transmission line, which has been charged during periods of low demand, can then supply the excess capacity in peak demand periods.

In addition to being used for evening and morning peaks, battery capacity at the end of long transmission lines, can be used as a reliability 'reserve' to enable transmission capacity to be 'dynamically curtailed' on hot, windy days.

[4] 92a2aa_76c7e6d656a6439b8ad5488f0a37c941.pdf (vepc.org.au)

[5] https://reneweconomy.com.au/big-batteries-as-virtual-power-lines-could-be-quick-solution-to-unleash-wind-and-solar/

3.5 Develop the new easement solution:

We suggest that any **subset of Transmission upgrade Options** should contain at least the **best 'existing easement' upgrade** option, and any preferred upgrade option (e.g. new easement option). We don't have much to comment on regarding development of new easement solutions, although we note it is seems to have been mainly about route planning.

One additional suggestion we would make is that two (2) x 220 kV transmission lines on new easement should possibly be reviewed, noting that typically, HV transmission for long distances is either 220 kV or 500 kV. But that the VNI-West option focuses almost exclusively on 500 kV.

Some 220 kV transmission advantages:

- **Visual amenity** - 2 x 220kV transmission towers have much lower impact on visual amenity. 220 kV towers are around 40 metres height and has a quarter (1/4) of the visual impact versus 500 kV towers which are around 80 metres high.
- **Complexity and familiarity** - 220 kV equipment is less complex and less costly than 500 kV equipment; 220 kV is more readily available from global supply chains.
- **Availability:** Covid-19 has taught us all, that global supply chains are impacted by global demand. It was recently reported that "Power grids needed to expand by about 2 million kilometres each year through to 2030 as electricity became the "new oil" of the global energy system"[6]. Supply chain reviews are important in order to to stay abreast of what are the lead-times globally for 220 kV componentry and 500 kV componentry.

220 kV has a number of advantages, with one key disadvantage being loss factors. Conventional wisdom might have been to avoid loss factors by installing 500 kV instead of 220 kV but this mind-set should be challenged given the contemporary social license issues that are faced with 500 kV towers, particularly where they are planned on new easements.

New high-voltage transmission lines are facing community opposition. **Luis Ascui**

AFR: 19th September 2023

[6] Carbon emissions: Window closing on 1.5 deg as IEA spells out $US4.5t/yr challenge (afr.com)

4. What about Nuclear?

We also want to acknowledge that a part of the community supports ***Nuclear*** electricity-generation solution instead of renewables. Proponents argue that a key benefit is that nuclear can be built at existing coal-fired power station sites, which would minimize the need generally for major transmission upgrades.

As its stands now in Australia, though, nuclear power is higher *cost* and would be much *slower to implement* than the renewables and transmission pathway. Looking at cost and timing:

Nuclear Cost: Regarding cost, according to the most recent CSIRO-AEMO Gencost 2022-23 Report[7], nuclear comes in between $130 and $311 per MWh (levelized cost of energy). Adding $30/MWh for transmission = nuclear = $160 to $341. A median cost of **$250/MWh (25 c/kWh).**

Solar and Wind plus storage and firming costs between $60 and $100/MWh. Assuming assume Transmission costs double i.e. $60/MWH, then total renewable energy cost = $120 to $160/MWh. A median cost of **$140/MWh (14 c/kWh).**

Nuclear timing: The Federal Government Target for Australia is 83% decarbonisation of electricity by 2030. And to be announced but likely to be close to 90 to 95% by 2035 (to be advised).

There are only 3 or 4 small modular reactors (SMR's) operating in the world, and so Australia is at least 10 years away from being able to place SMR orders, contingent on both social license in Australia, and commercialization of SMR's. If both developed favourably over time, then Australia could in theory place orders, and be in an order queue for SMR's in around 10 years. After order placement, implementation would take a further 10-20 years using AUKUS as a reference point (i.e. delivery and commissioning). That puts Australia hypothetically (at the earliest) with nuclear power around year 2050 to achieve 'clean nuclear electricity' in the grid. It would still then be necessary to convert a large percentage of home appliances and transport to electric at that point. So, conversion of near all appliances running on nuclear electricity probably sits around the year 2065. This is 30 years too late to meet Paris commitments, unless something changes in terms of the development of nuclear power.

Nuclear social license: Currently the development of nuclear power is prohibited in Australia under legislation, a position that has been supported by both major parties. NIMBY (not in my back yard) syndrome is still very high in Australia for nuclear power and nuclear waste – for example, Australia has still not found anywhere to store even the small amount of nuclear waste from medical use.

Given the possibility that these key factors could change favourably - i.e. nuclear's cost, timing, and social licence, over the next decade - we think it is sensible to keep it on the table as a possible option, so that whenever comparisons are made, nuclear is regularly assessed as a possibility. This would go some way to removing the perception by some that current rejection of nuclear is 'merely' political and ideological.

In summary, nuclear *currently* loses out convincingly to renewables for Australia on cost and timeliness and acceptability to the Australian people. But we suggest nuclear should feature in ongoing comparison of options for decarbonising the electricity market.

[7] GenCost: annual electricity cost estimates for Australia - CSIRO

Meanwhile, it is imperative that Australia gets on with the urgent business of building renewable energy from wind and solar and connecting it to the grid.

5.0 Revise Multi-criteria Assessment (MCA) – we need much greater emphasis on 'Project Timing'

We have already noted wide-spread opposition to new HV Transmission projects here in Australia. Some of the reasons for this opposition are noted in our Introduction, and we also note that similar opposition is common in the western world.
Given the urgency of addressing climate change, and the urgent need to substantially decarbonise the electricity grid, our view is that any transmission option that materially reduces opposition among affected stakeholders should be more thoroughly explored.

We have already suggested that first and foremost, 'Alternatives to transmission such as VPP's and rooftop solar (Section 3) should be explored, and that any 'existing easement' solution will encounter way less opposition than a 'new easement' solution. So, secondly, we suggested that an **existing easement solution** should always be taken to consultative phases**. In parallel to a new easement solution**. (Also in Section 3).

The third point we wish to make, in this section 5 is in reference to the Multi-criteria Assessment (MCA) used by AEMO and its consultants (AVP and AECOM) – using the VNI-West transmission assessment as an example. We are very concerned that MCA's generally, are not sufficiently taking into account **criteria that impact project timing.**
The VNI-West MCA has a weighting of **70% for economic benefit,** a **weighting of 15% for Environment/Heritage/Future land-use,** but only **10% for minimizing impact on local communities**.

This weighting all but ignores 'impact on local communities' and so by extension, a 'new easement solution' scores similarly to an 'existing easement solution'. But we know negative 'impact on local communities' leads to project delays. There are options that won't get communities backs up, but they are not being properly explored because the current MCA's Weighting makes community support immaterial.

This is problematic because opposition by community in a democracy leads to delays and cost blow-outs.

"In summary, (ref: VNI-West-PACR-Volume2*) while Option 5 to Bulgana (new easement) has met with opposition, we expect we would have seen the same or more opposition should any of the other options have been proposed as the preferred. It was for that reason that an MCA approach was developed, so the selection criteria was as objective as possible, and the reasoning for preferencing one option over another was made clear"* [8] **VNI-West Consultations Report: Options Assessment**

[8] vni-west-pacr-volume-2_additional-consultation-report-submissions.pdf (aemo.com.au)

Report (page 30). But we note that **all five (5) options** assessed in this detailed analysis were 500 kV transmission on new easement. It was a route planning assessment only.

We see that the 'impact on local communities' is what is holding up Transmission projects – and that opposition is seen in the consultation feedback, through public demonstrations, through court actions and through some political agitation/political fall-out.
We are a community wanting action on climate change. We won't get the urgent action, if local communities are very opposed to the transmission as proposed[9] .
Refer article: **'They will fight to the death': Farmers revolt at Victorian power plan'**

The preferred solutions need to surface that have reduced 'impact on community', which will lead to much better **implementation timing**.

Table 12 VNI West criteria

MCA objective	MCA criteria	Criteria weighting	Objective weighting
Maximise economic benefit of the project	Maximise economic benefit	100%	70%
Avoid and/or minimise impact on the natural environment	Protected areas	40%	5%
	Native vegetation	30%	
	Habitats	20%	
	Waterways	10%	
Avoid and/or minimise impact on Cultural and Historic Heritage	Non-Aboriginal cultural heritage	40%	5%
	Aboriginal cultural heritage	60%	
Avoid and/or minimise impact on local communities	Amenity	70%	10%
	Affected parties	30%	
Avoid and/or minimise impacts on existing and future land use	Severance	20%	5%
	Agriculture	50%	
	Forestry	15%	
	Resource development	15%	
Limit engineering and operational complexities and impacts on existing infrastructure	Third party infrastructure	20%	5%
	Engineering complexity	20%	
	Bushfire	20%	
	Technical complexity	30%	
	Constructability	10%	

MCA Table [10] : VNI-West Consultations Report: Options Assessment Rpt (page 12, page 64)

> Six objectives, containing a total of 18 criteria, were considered in this MCA methodology and each option was scored on each criteria using a rating from 1 (being most favourable) to 5 (being least favourable). Each criterion

Excerpt above: Current use of weighted scoring (same reference as footnote 10)

[9] Energy transition: Farmers fight Victoria's powerline grab for Western Renewables Link (afr.com)
[10] vni-west-consultation-report---options-assessment.pdf (aemo.com.au)

We have suggested that much more weight needs to be given to the impact of transmission projects on local communities. Also, more weight should be given to **speed of implementation** - by revising MCA weighting criteria, that addresses less complex engineering solutions.

We demonstrate below this change in emphasis, via re-weighting specific criteria in the MCA. We have compared VNI-West and Plan B as a worked example to show how re-weighting would work. NOTE: We have assumed for the sake of this exercise that a VPP project (aggregated rooftop solar and batteries), has already been determined to be less favourable than transmission upgrade options.
Below, shows our worked example, an MCA that compares VNI-West and Plan B:

Multiple-criteria assessment (Decision analysis):
to select the preferred **'Transmission upgrade project'** for connecting Victorian REZ's into the NEM (National Electricity Market) v1.1

OBJECTIVES:		**VNI-West**			**Plan B** (refer 'Lost in Transmission p. 36)		
MUST Objectives		**Go / No Go**			**Go / No Go**		
able to host 14,830 MW Renewables by 2035		Yes			Yes		
able to be implemented by 'x' date		?			Yes		
WANT Objectives	**Weight**	**Information**	**Score**	**Weighted score**	**Information**	**Score**	**Weighted score**
Maximise Economic benefit	**25%**	$1.44 Mn p.a.	**1.2**	0.3	**less curtailment so greater benefit**	**1.0**	0.25
Minimise Capital cost	**20%**	$11 billion	**2**	0.4	$6 billion	**1.0**	0.20
Minimise impact on local communities - consider timing	**20%**	1,270km new easement	**1.5**	0.3	130km new easement	**1.0**	0.20
Minimise impact on natural environment	**5%**		**1.5**	0.08		**1.0**	0.05
Avoid or minimise impact on land use	**5%**	new easement impacts above and below ground	**1.5**	0.08	just 10% new easement vs VNI-West	**1.0**	0.05
Limit engineering and operational complexities and impacts on existing infrastructure; consider timing	**10%**	80m towers, 500 kV equipment, new ground to be assessed	**1.7**	0.17	40m towers, 220 kV equipment, much less new ground to be assessed	**1.0**	0.10
Minimise curtailment of renewables	**15%**	20 to 40%	**0.7**	0.11	13% curtailment	**1.0**	0.15
Weighted Score (lower score means higher ranking)				1.43			1.00
RANK				2			1
Note: Timing must be consistent with need for renewables infrastructure to address climate urgency							

Our worked example, shown above, uses the same weighting method on page 12, of the relevant AEMO Report,[11]
Instead of 'economic benefit' being 70%, we have made 'economic benefit 25% and capital cost 20% weighting. (Note that Plan B authors calculate that the economic benefit of **Plan B** is higher than VNI-West so we might not be changing the result by re-weighting for economic benefit in this example). What we are aiming to do is provide more weighting to local community social license, 20% instead of 10%, consistent with the need to reduce community opposition and the resultant transmission delays. And also we see a strong need to add the criteria to reduce renewables curtailment with a weighting of 15%.
TABLE : Revised Multi-criteria Assessment for AEMO VNI-West vs. Plan B (by Lighter Footprints)

In the MCA worked example above, the *new easement* proposal, AEMO VNI-West, on the left has an overall score of **1.43**. The *existing easement* Proposal, Plan B, is on the right has an overall score of **1.00**. A lower score is a higher ranked alternative.

If the figures for Plan B are accurate, they clearly rank as the preferred solution, and this largely arises out of the MCA process because:

- The capital cost of Plan B is $6 Bn versus $11 Bn for VNI-West.

[11] vni-west-consultation-report---options-assessment.pdf (aemo.com.au)

- Plan B uses existing easement so has much greater social license, takes less time to procure a small fraction of the easement versus VNI-West, and will therefore take less significantly less time overall to implement.
- Under Plan B, there is less curtailment of renewables
- There is less engineering complexity in Plan B, so it is quicker to implement

Most other criteria do not materially affect the Weighted Score and Ranking.

Using the information, we have access to, the MCA for Plan B looks compelling in comparison to VNI-West, and we anticipate that in today's community that a multi-criteria assessment will often show the benefits of an existing easement option.

Summary of approach to future Multi-criteria Assessments:

Alternate options should always be properly evaluated and considered – with options including installation of more rooftop solar + batteries, installation of grid-scale batteries etc.

IF a transmission upgrade is required, then it should be superior on an MCA Assessment to the non-transmission alternatives mentioned immediately above.

IF a transmission project is required, then an **existing easement** solution should also be properly assessed alongside a new easement solution.

IF a transmission upgrade project is required, then the MCA weighting system should better reflect materiality of the importance of 'impact on local community', so that existing easements solutions might score more highly, since we know they are much less likely to encounter community opposition, and translate to inordinate delays in implementation.

6.0 Consider rooftop solar alternatives, to avoid or reduce transmission upgrades

There are also rooftop solar options that partly – or wholly - circumvent the need for new HV transmission or transmission augmentation. Firstly, Virtual Power Plants (VPP's) i.e. aggregated solar and batteries, and secondly, the increased penetration of normal rooftop solar (not necessarily with batteries, and not aggregated under a VPP). It should be a requirement that both these solar options are assessed as part of evaluation of options alongside any new transmission planning or upgrades.

It has been predicted that the continued uptake of rooftop solar may well alter the demand for the levels of transmission required, and indeed prove to be a far mor effective government tactic for achieving reduction of carbon emissions in the short term than large solar developments. We would like to take the opportunity here to argue for such a shift in emphasis in government policy, as we are looking at current commitments and their requirement for transmission links. Were the government to focus on supporting PV's on household and industrial roofs around the country (which could be huge) , the level of requirement for new transmission grids could be significantly impacted. Despite continued growth of PVs on roofs, this major focus is not the path we see the government currently taking.

6.1 Virtual Power plants (VPP's)

The first alternative to be considered when looking at alternatives to upgrades of transmission to service solar farms are Virtual Power Plants (VPP's).

The 'virtual' refers to aggregating solar and batteries from different locations and co-ordinating their charging and discharging with 'smarts' so they can act in concert, to replicate a convention coal-fired power plant.
"*The rooftop solar, the batteries, the electrical appliances and electric vehicles (EVs) in a VPP are all real, but in different locations. While distributed energy resources such as these are very different from a conventional power plant, they are aggregated to operate like one – hence the word "virtual*"[12].

A Virtual Power Plant consists of a network of distributed rooftop solar and battery systems and may include other energy resources and controlled loads (such as electric domestic hot water systems). These Distributed Energy Resources (DERs) are co-ordinated by a central VPP operator that releases some of the batteries' stored energy into the grid during periods of peak demand when wholesale electricity prices are high. The virtual power plant operator may also direct the batteries to charge to help grid stability.

Households with rooftop solar and signing up to a VPP (virtual power plant), give up control of their battery to a third party. In return, the householders might get an upfront discount on the cost of a battery, and a higher solar feed-in tariff, or both.

Currently, commercial interests such as Transmission companies and Generation companies favour in-front-of-the meter solutions. They do not want the major influx of behind-the-meter solar rooftop, owned by households, and batteries that can charge and discharge locally, via the electricity distribution system. Even increases through 'electrification' will offset reductions they anticipate.

With the right regulatory framework, VPP's could become the most capital and cost-efficient solution to providing a substantial amount of solar power to the grid, while reducing the amount of large-scale solar farms and the connecting transmission.

CASE STUDY: (the following article is from an IEEFA article, "**How the sharing economy could play a major role in helping Eraring (power station) close on time**"[13]

"**Origin Energy** is the company in Australia that best understands the potential of consumer-owned Distributed Energy Resource (DER) and is Eraring's power station owner. Last year Origin announced plans to expand its relatively small 205-megawatt (MW) VPP almost ten-fold to 2,000MW (70% of the Eraring power station's peak capacity).

Origin noted at the time that: *"A VPP is a capital and cost-efficient tool to create capacity"*; and "*VPP assets tend to have very low or even zero upfront capital cost to establish*."

This means that the majority of the cost of VPP's is borne by households and businesses. To date, Australian households have spent an estimated A$25 billion on rooftop solar and other distributed energy. Three and a half million homes already have solar, and household investment is likely to increase at least six-fold over the next decade.
Households and businesses buy the devices, all Origin has to do is pay to connect them and pay to use them. You can buy a discounted battery through Origin, or bring your own, and join its "Loop" VPP, for a one-off credit.

[12] How the sharing economy could play a major role in helping Eraring close on time | IEEFA
[13] How the sharing economy could play a major role in helping Eraring close on time | IEEFA

Last week Origin's annual report revealed its VPP has grown to in less than 18 months. This includes more than 200MW of large business demand able to be used flexibly and more than 400 EVs under management. Origin has also taken a final investment decision on a 460MW battery storage system with a dispatch duration of two hours, which could be increased to 700MW and four hours dispatch duration. Eraring can produce up to 2,880MW of coal-fired power, so Origin is some of the way towards meeting the replacement peak capacity it needs, spending next to nothing on developing a VPP.[14]

END CASE STUDY

The Case Study above is an example of corporate entity, Origin, a 'Gen-tailer' (Generator-Retailer), using a VPP - aggregated household rooftop solar and batteries, to replace an ageing coal power-station (Eraring power station). Origin plans to reach a capacity of 2,000 MW of peak capacity under a VPP, which represents 70% the Eraring Power Station's peak capacity.

This is but one example which could be generalized across the country, under a properly designed regulatory environment that more equitably rewards both corporate and household interests. With the right settings, this could become a massive opportunity for all Australians and could reduce the amount of transmission required to a significant extent.

6.2 Normal rooftop solar (not aggregated under a VPP):

The second option is to continue to encourage the adoption and installation of rooftop solar with or without batteries in the short-medium term.

Rooftop solar is incredibly low-cost right now (it generates at 4c/kWh including capital cost), and rooftops are free real estate. Right now, batteries are not so cheap, and while they continue to rapidly come down the cost curve, it might be 3 to 5 years before batteries too are easily affordable by households. It is notable however that many households are increasingly choosing to add batteries even at current prices.

So rather than building large-scale solar farms remotely to cities, which then in turn require major transmission upgrade, rooftop solar can be built right now as an immediate response to the need for renewables in cities.

The IEEFA article prediction is that "*while three and a half million homes already have solar, household investment is likely to increase* *at least six-fold over the next decade* as families electrify their homes and vehicles".

This is equivalent to an investment, by households, in renewable energy of six times $25 Billion, which is an investment totalling $150 Billion!

Looking to the future, perhaps in 5 years' time, the preferred battery solutions can then be installed (EV batteries or grid-scale batteries or street-scale batteries or household batteries) and by **aggregating** the earlier solar with the new battery they become a VPP, i.e. a distributed solar power station.

[14] How the sharing economy could play a major role in helping Eraring close on time | IEEFA

Including of course the possible additional capacity that industrial rooftops could provide.

In summary, we recommend that:

- Households be incentivized to install six times (6x) behind-the-meter (BTM) **rooftop solar** installations over the next 5 years (i.e. enough for household self-consumption + grid import/export functions)
- The regulatory environment be developed so that the VPP co-ordinating company has a sustainable business case, **but importantly, it is regulated so that the householder is also properly rewarded.**
- It makes sense that large-scale solar farms not be built without a comprehensive review of the comparative case for **economics of large-scale solar + transmission versus:**

    - **behind-the-meter rooftop solar**
    - **solar + batteries under VPP's**

7.0 Wind farms require Transmission, but large-scale solar might not be necessary

We have already suggested in Section 6 that there are two key rooftop solar options that partly – or wholly - circumvent the need for new HV transmission or transmission augmentation.

From a transmission planning perspective, we observe that wind farms do not have alternative options, like solar has. Rooftop solar on households and business could replace the need for large-scale solar farms, but the same is not true for wind farms. Wind farms cannot be replaced with wind turbines dotted around cities and housing.

Decentralized rooftop solar uses local distribution networks - wind farms always require connection to transmission.
However, as per other parts of the energy transition, we need to recognize that commercial interests favour in-front-of-the meter solutions, and so would provide their own narratives opposing this thinking.

8) Summary of a step-by-step process to get better outcomes

Our main aim is the achievement of growth in renewable energy and its transmission to places it is required, avoiding unnecessary delays. We believe that following an improved process would achieve a much better outcome on all factors, but particularly on social license leading to better timing and cost.

In broad terms we have sequenced a process that encompasses our recommendations 1 - 7 above as follows through six steps:

Step 1A:

Identify the following: -

Q1: What Alternative Options are there, that avoid HV Transmission upgrades altogether.

For example, would implementation of a Virtual Power Plant (VPP) – using rooftop solar and batteries, or just distributed rooftop solar alone reduce or eliminate the need for new HV transmission to large-scale solar?

Possibly the transmission upgrade needs to only connect large-scale wind farms, rather than both solar and wind.

Q2A: What existing HV transmission, on existing easement, could be upgraded (e.g. existing 220 kV)?

Q2B: What is the best option for new HV transmission on new easement? (e.g. 500 kV or 2 x 220kV).

> Can this be 220 kV transmission instead of 500 kV? Given that 220 kV towers have ¼ the visual impact in comparison to 500 kV towers.
> What are the cost and timing implications of both 220kV and 500 kV?

Step 2:

Consult with community on these distinct options, with their separate implications, in a way that allows for community comment and contribution - indicating at least two distinct options, not merely different routes of new 500 kV - are still open to consideration.

Step 3:

Collate stakeholder feedback

Step 4:

Complete the Multiple-criteria Assessment (MCA) for above options.

Identify the top two (2) Options - if one preferred Option is *new easement*, then an alternative of *existing easement* should also be assessed and taken forward to the next round of Consultation.

Step 5:

Consult again with community and landowners on the top two (2) options. Make it clear that an existing easement option is being evaluated, as well as the new easement option.

Conduct 'new easement' procurement negotiations with landowners.

Prepare final costing, inclusive of land procurement for the top two options.

Prepare and verify as acceptable a Risk Assessment for the top two options.

Step 6:

Select **Preferred Option** and implement.

These steps might or might not take more time, but it will achieve a positive outcome, something that does not seem assured from the current approach.

END SUBMISSION (See Appendix next page: the Table on page 13 is in land-scape format).

Multiple-criteria assessment (Decision analysis):

to select the preferred **'Transmission upgrade project'** for connecting Victorian REZ's into the NEM (National Electricity Market)

v1.1

OBJECTIVES:		VNI-West			Plan B (refer 'Lost in Transmission p. 36)		
MUST Objectives		**Go / No Go**			**Go / No Go**		
able to host 14,830 MW Renewables by 2035		Yes			Yes		
able to be implemented by 'x' date		?			Yes		
WANT Objectives	**Weight**	**Information**	**Score**	**Weighted score**	**Information**	**Score**	**Weighted score**
Maximise Economic benefit	**25%**	$1.44 Mn p.a.	**1.2**	0.3	**less curtailment so greater benefit**	**1.0**	0.25
Minimise Capital cost	**20%**	$11 billion	**2**	0.4	$6 billion	**1.0**	0.20
Minimise impact on local communities - consider timing	**20%**	1,270km new easement	**1.5**	0.3	130km new easement	**1.0**	0.20
Minimise impact on natural environment	**5%**		**1.5**	0.08		**1.0**	0.05
Avoid or minimise impact on land use	**5%**	new easement impacts above and below ground	**1.5**	0.08	just 10% new easement vs VNI-West	**1.0**	0.05
Limit engineering and operational complexities and impacts on existing infrastructure; consider timing	**10%**	80m towers, 500 kV equipment, new ground to be assessed	**1.7**	0.17	40m towers, 220 kV equipment, much less new ground to be assessed	**1.0**	0.10
Minimise curtailment of renewables	**15%**	20 to 40%	**0.7**	0.11	13% curtailment	**1.0**	0.15
Weighted Score (lower score means higher ranking)				1.43			1.00
RANK				**2**			**1**
Note: Timing must be consistent with need for renewables infrastructure to address climate urgency							

APPENDIX: Land-scape depiction of Table above (i.e. enlarged view of above Table):