Scenario Development – EDGS 2019 variations - pre-reading document for 2nd panel meeting

Scenario development - EDGS 2019 variations

The purpose of the EDGS is to describe a range of hypothetical electricity supply and demand futures, considering different demographic, economic, policy and technology dimensions.

As we are about to embark on Phase One of our Net Zero Grid Pathways (NZGP) project, also called Accessing Lower South Island Renewables (ALSIR), it is important the EDGS are up-to-date.

Whilst the underlying synopses behind the EDGS 2019 reflect a wide range of futures, some important changes have occurred since their release in July 2019, from the point of view of demand, supply and energy policies or regulatory influences.

We assembled a panel of subject matter experts, who met in an online meeting on November 5th, to provide guidance to Transpower on potential EDGS 2019 variations. A summary of the issues discussed by the panel, their thoughts and Transpower's proposed EDGS variations taking their advice into account, is include in Appendix 1. Each issue is described separately and a table, summarising the relevant EDGS 2019 variable settings, along with our proposed variations, is provided at the end of Appendix 1. The issues are numbered as per the table and are not necessarily in the order discussed in the meeting.

Draft EDGS 2019 variations – take one - energy demand forecasts

We fed the proposed EDGS variations into our demand forecasting models, with the following result:

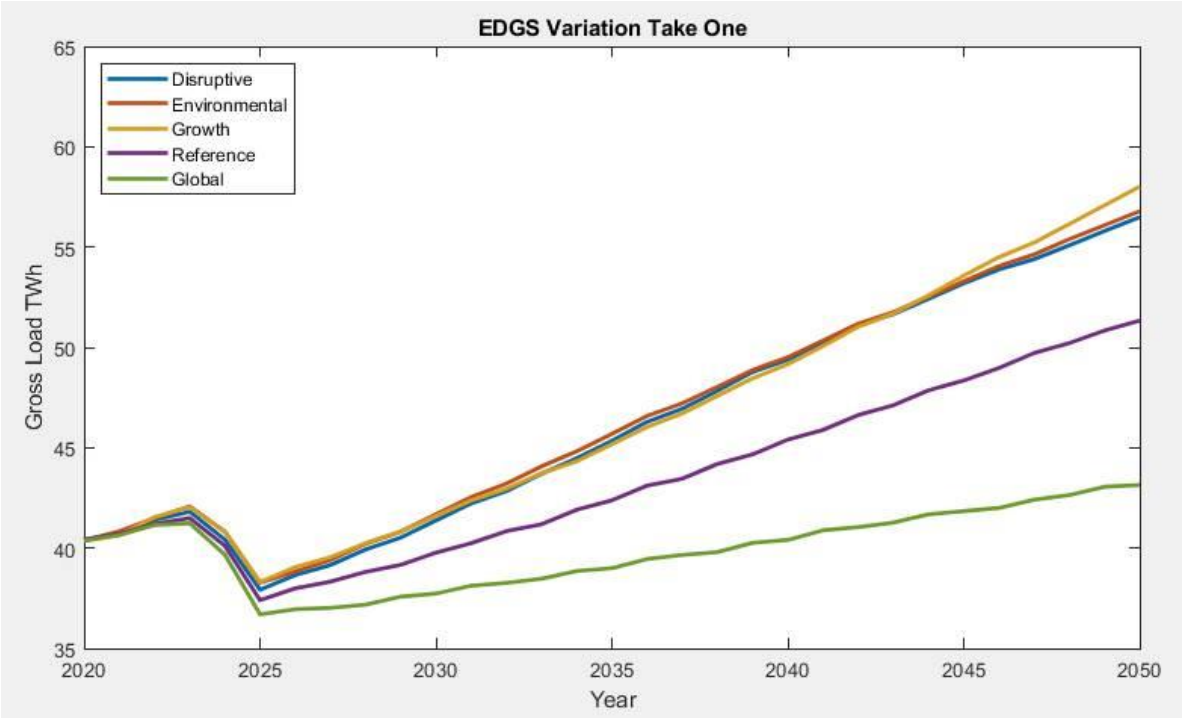

Figure 1 – Draft EDGS 2019 variations – take one – energy demand forecasts

The reader might look at those results favourably. Three of the scenarios have basically identical energy demand forecasts, so perhaps there is a high level of certainty for our transmission planning?

As the saying by Peter Drucker goes, “The only thing we know about the future is that it will be different.”. We cannot forecast with certainty and the reason we are using a scenario approach is because of the high level of future uncertainty.

The EDGS need to represent a diverse range of futures in order that we test various transmission options over a range of possible futures.

Given the lack of diversity in the take one scenarios, we changed some of the variables to spread the energy demand forecasts out. The result is our take two EDGS variations as shown in Figures 2, 3 and 4 below. These are draft EDGS 2019 variations we consider reasonable and which we proposed to use for our investigations.

Draft EDGS 2019 variations – take two - energy demand forecasts

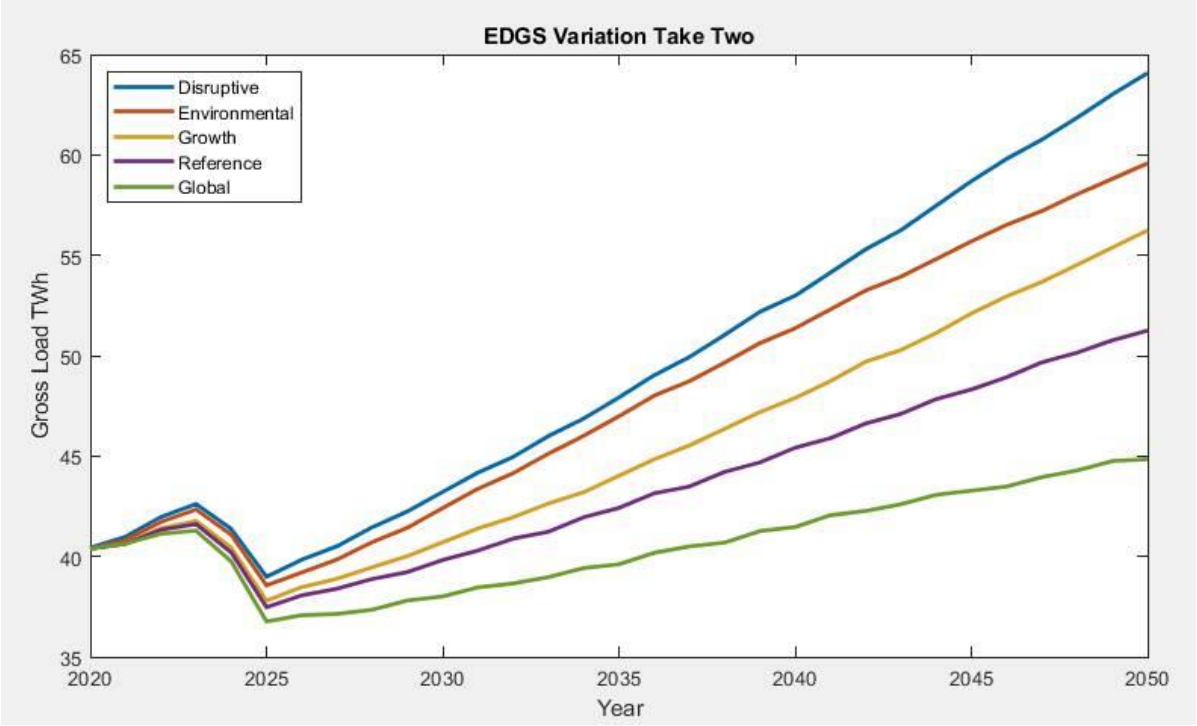

Figure 2 – Draft EDGS 2019 variations – take two – energy demand forecasts

Figure 3 compares our draft EDGS 2019 variations with the EDGS 2019. Because the EDGS 2019 include Tiwai load, we have also developed Figure 4, which compares our draft EDGS 2019 variations with the EDGS 2019 adjusted for a simulated Tiwai reduction.

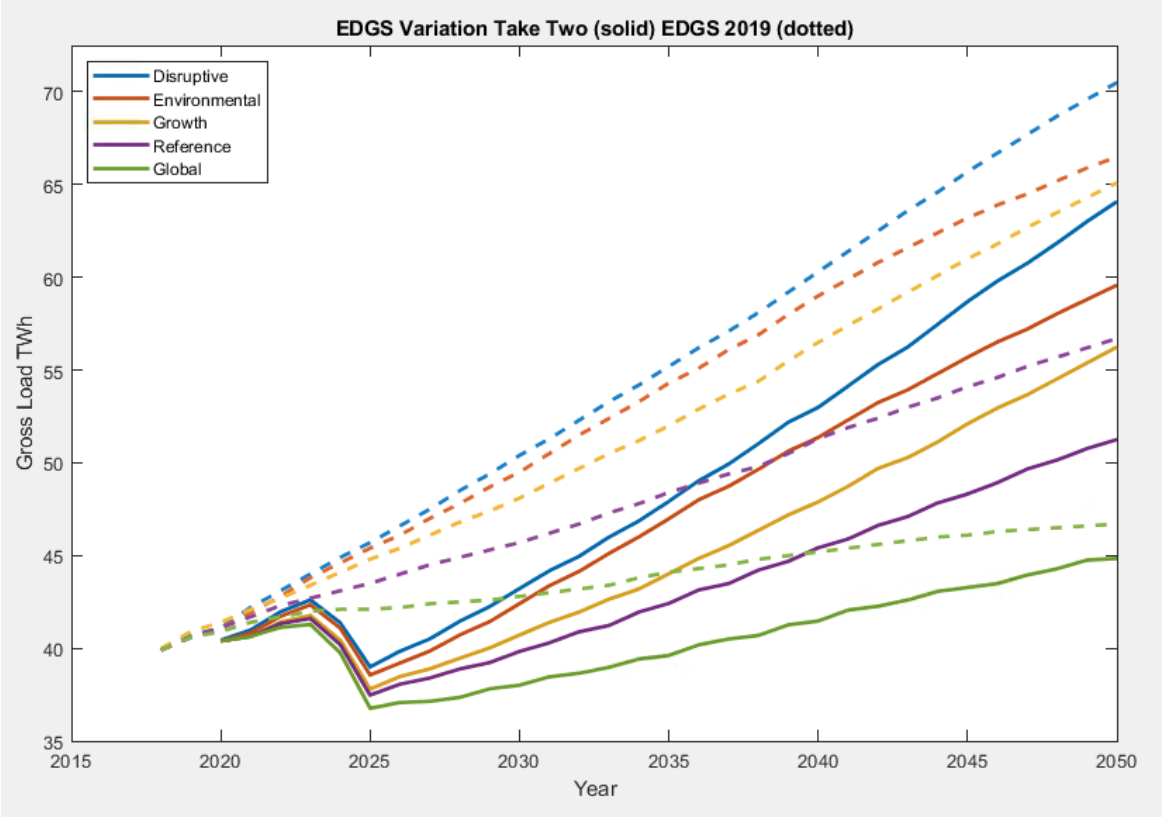

Figure 3 – Draft EDGS 2019 variations – take two – energy demand forecasts compared to EDGS 2019

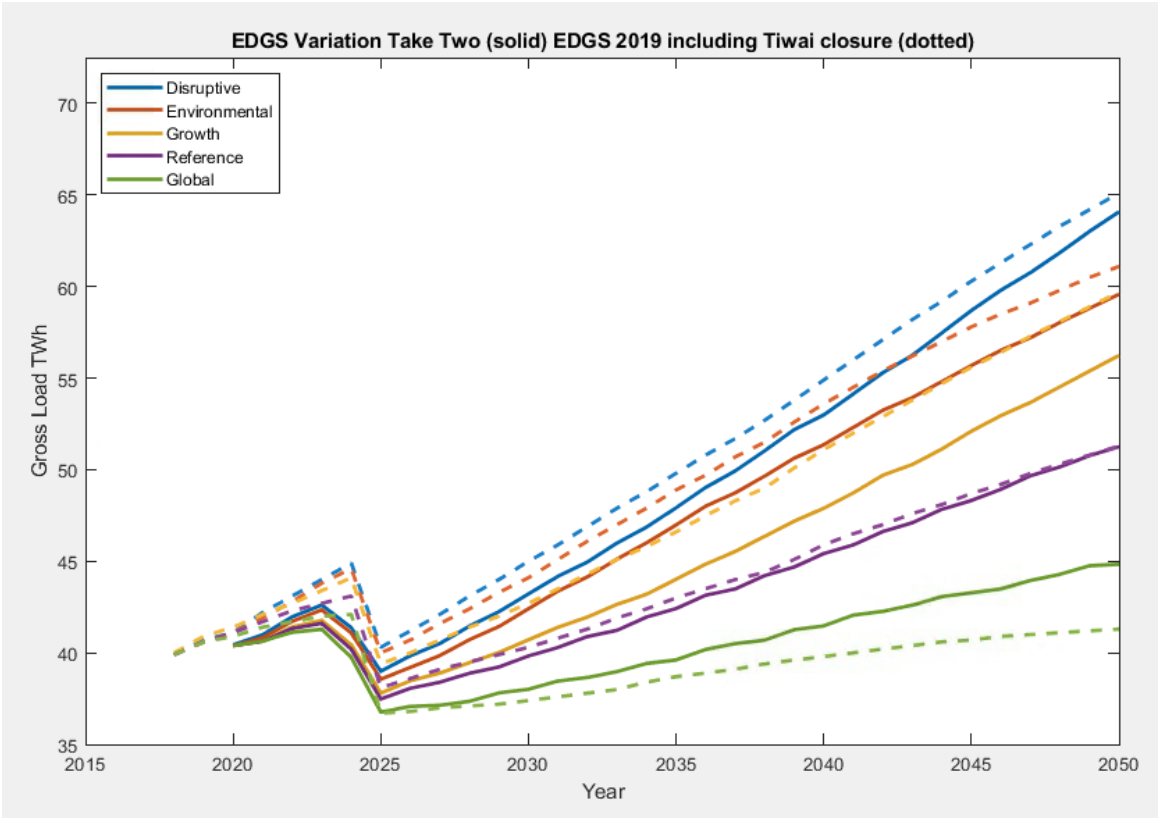

Figure 4 – Draft EDGS 2019 variations – take two – energy demand forecasts compared to EDGS 2019 adjusted for a simulated Tiwai reduction

As can be seen in Figure 4, our draft EDGS 2019 variations cover a slightly narrower range of energy demands by 2050. This mostly reflects adjustments made to the base energy demand growth rates, where the range reflected has changed from 0.2% - 1.2% per annum to 0.2% - 0.7% per annum. The rationale for this is included in Appendix 1.

To get the take two forecasts, we had to reinstate some of the original EDGS 2019 assumptions, which the panel had suggested we change.

A brief summary of those changes is:

- Used 13.3TWh for process heat electrification in the disruptive scenario
- Reducing the availability of batteries for peak shaving, both domestic batteries attached to PV installations and EV to grid availability.

Other changes included

- Reducing the amount of 'Smart' charging associated with light Electric Vehicles (to reflect commercial vehicles with high utilisation rates).
- Using a demand profile for non-Dairy process heat electrification that reflects intra-day variability (rather than a flat profile).
- Not incorporating any specific replacement loads for Tiwai
- Assumed a faster recovery in economic growth post COVID-19

In our view, incorporating these changes to improve diversity between the EDGS is appropriate. Our view is that the EDGS need to be:

- reasonable electricity supply and demand forecasts
- diverse in order to be useful for evaluating transmission investment options

in order to meet both objectives, the scenarios in the EDGS may not be equally likely. Some scenarios may be less likely but are included to provide diversity. This be the case in our draft EDGS 2019 variations.

We note that our draft EDGS variations ultimately assume both a higher degree of peak shaving (due to smart integrated technology) than the original EDGS 2019 and lower assumptions for gross energy demand.

In our economic analyses for major investment in the grid, we evaluate each scenario included in the EDGS separately and then to determine an overall economic result, we apply a weighting to each scenario.

The default position is that each scenario is equally likely and in the case of the EDGS 2019, there are five scenarios each with a weighting of 20%.

Draft EDGS 2019 variations – take two - scenario weightings

We have not attempted to assign weightings to our draft EDGS 2019 variations and would ask that the panel consider whether those weightings should vary from 20%. Given the subjective nature of assigning weightings, we are not expecting the panel to attempt to assign a single weighting to each scenario, but it would be helpful if the panel could assign a possible range. For illustration, consider the following indicative ranges:

TWh	Reference	Global	Growth	Environmental	Disruptive
EDGS 2019	20%	20%	20%	20%	20%
EDGS 2019 variations	20-40%	10-20%	15-25%	15-25%	10-20%

The sum of the mid-ranges is 100%, but the probabilities vary between scenarios. In this illustration, the main point of difference is that the Reference scenario is considered more likely than either the Global or Disruptive scenarios.

It would be helpful if the panel could define ranges akin to those shown in the table.

Draft EDGS 2019 variations – take two - peak demand forecasts

We derived the draft energy demand forecasts for the EDGS 2019 variations first, but our transmission planning focusses more on the peak demand forecasts. The peak demand forecasts for our take two EDGS 2019 variations, compared to EDGS 2019, are:

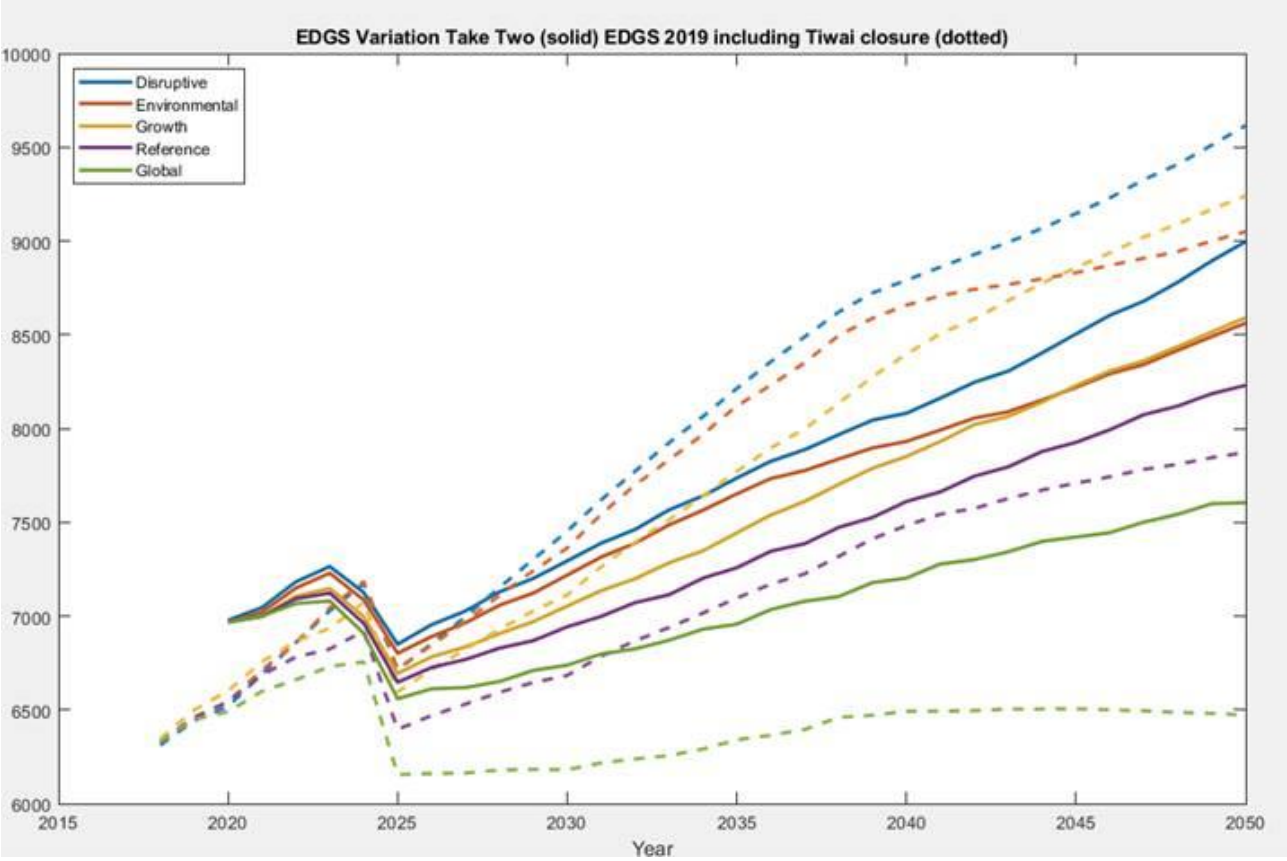

Figure 5 – Draft EDGS 2019 variations – take two – peak demand, compared to EDGS 2019 adjusted for a simulated Tiwai reduction

Unfortunately, it is difficult to compare Transpower's and MBIE's peak demand forecasts directly as they have been derived using different approaches. In general, Transpower's forecasts are lower than our previous forecasts, reflecting different utilisation of new technologies as described in the next section.

Use of smart devices

In deriving these peak demand forecasts we noted that the peak demand forecasts are sensitive to assumptions around the "smartness" of future distributed resources. We make assumptions about:

- electric vehicle charging (whether electric vehicles charge throughout the day, including at peak demand times versus charging during off-peak times)
- extent to which electric vehicle storage can be used for peak shaving
- extent to which battery storage installed with solar panels can be used for peak shaving

and those assumptions are important in forecasting future grid peak demand.

For illustration, Figure 8 shows the national demand profile[1] for the peakiest day in 2050, in the Disruptive scenario. This profile assumes that a proportion of the battery storage installed with domestic solar PV installations is used for peak shaving, but in this case electric vehicle charging is not coordinated to occur off-peak. The national system peak occurs in the evening and is approximately 10.2 GW.

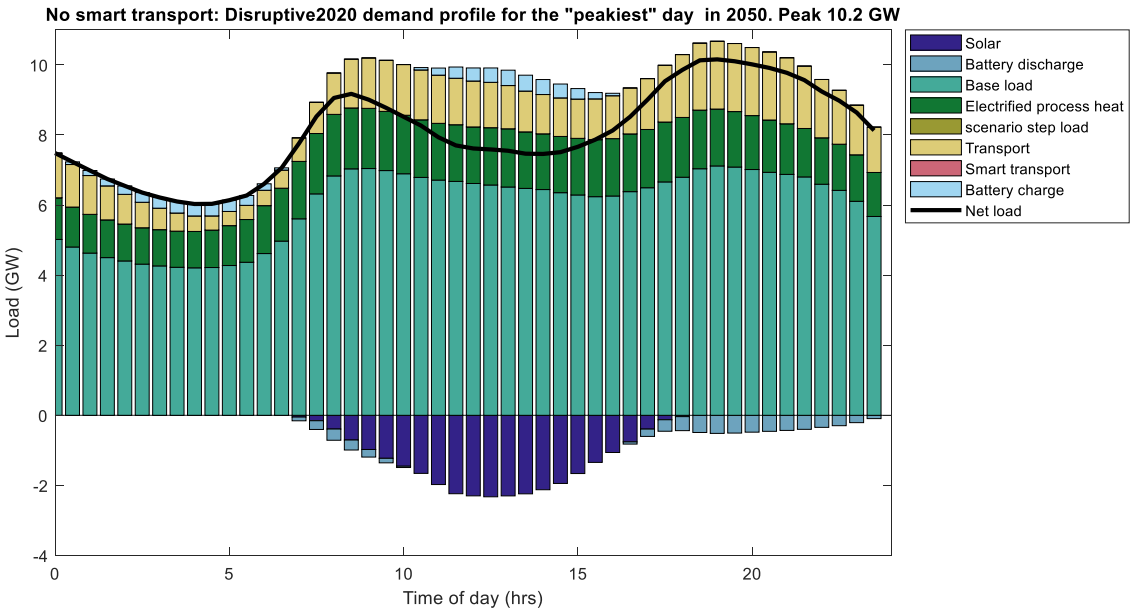

Figure 8 – National demand profile for peakiest day in 2050 - no coordinated electric vehicle charging

By way of comparison, Figure 9 shows the same day, as included in our draft EDGS 2019 variation for the Disruptive scenario. We have assumed that 60% of the electric vehicle demand is 'smart' and coordinated to be off-peak. National system peak still occurs at the same time of day, but is now approximately 9 GW.

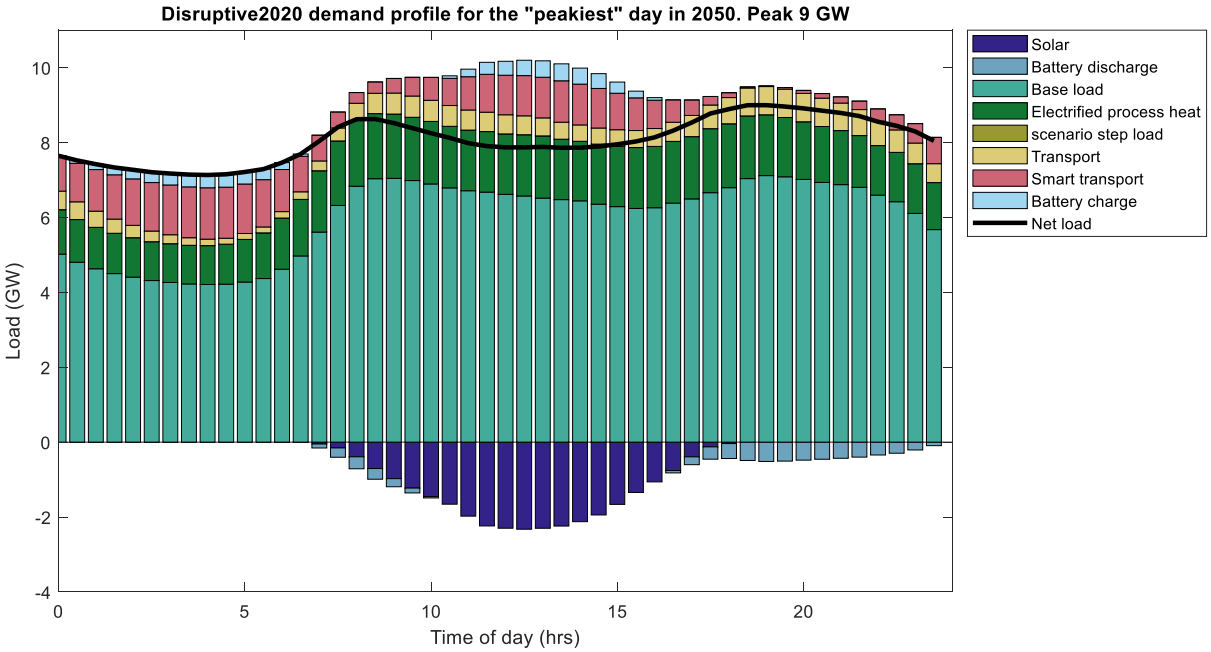

Figure 9 – National demand profile for peakiest day in 2050 assuming off-peak electric vehicle charging

[1] Rooftop solar PV is shown as negative demand because Transpower's main interest is demand at our substations, or GXP's. Rooftop solar PV is "behind" the GXP's and effectively reduces the demand at the GXP.

The difference is significant in terms of the need for transmission services and the grid assets required.

The assumptions we use in our demand forecasting are quite optimistic in terms of our ability to access "smartness" in the future. We note though, that only a proportion of consumers would be prepared to allow their resources to be used for peak shaving and that there will be competing interests. Distribution companies will be interested in using the "smartness" for their own purposes and generators/retailers may also be interested, as a means of managing supply risk, for instance.

The mechanisms for accessing this "smartness" have yet to be developed and the markets to allow potential users of the "smartness" to attract consumers have yet to be developed, so our existing assumptions in this area are relatively subjective.

Given the importance of these assumptions to our peak demand forecasting, we may look to continue a conversation about forecasting the use of future "smartness", beyond development of our draft EDGS 2019 variations.

Draft EDGS 2019 variations – supply forecasts

As well as electricity demand forecasts, the EDGS include supply forecasts (generation scenarios) as well. These describe what new grid-scale generation will be built – when and where.

We addressed some of the reasons the EDGS 2019 supply scenarios need to be reviewed in our first panel session.

In considering the panel's feedback and developing our draft EDGS 2019 variations, we have come to the conclusion that while we can mix and match the electricity demand variable feedback into variations on the five EDGS, that does not seem appropriate for the supply scenarios.

We use a generation expansion model to develop generation expansion plans. The model builds the lowest cost generation mix it can to meet forecast electricity demand.

Our model incorporates the updated generation cost stack information. Some observations are that the model:

- likes hydro generation and builds it, if offered. Although new hydro may be economic, is it realistic to assume it would receive the necessary resource consents?
- doesn't build a lot of new geothermal generation, because at the costs included in the updated generation cost stack information, it is expensive. However, the economics of new geothermal plants also depend upon other coincident uses, such as process heat, so the costs in the model are not representative of geothermal economics
- includes varying costs for both wind and solar over time, but what if the relative cost between the technologies change?

We have concluded that a pure cost stack approach does not represent certain realities and so for our draft EDGS 2019 supply scenarios we would prefer to develop scenarios which are dominated by various technologies:

- Hydro
- Geothermal
- Wind
- Solar

Along with uncertainties around how dry year reserve is provided, and the potential imposition of renewable generation targets we are not convinced that having five supply scenarios is the most

appropriate. Our preference is to develop a matrix of future supply possibilities and not assign them to the five demand scenarios at this point. We will provide more information on our thoughts early next week, but may not have draft supply scenarios to consider until the day of the second panel session.

Appendix 1 - Scenario development - EDGS 2019 variations – take one

Panel comments and Transpower proposed variations

A panel of subject matter experts, met in an online meeting on November 5th, to provide guidance to Transpower on potential EDGS 2019 variations. A summary of the issues discussed by the panel, their thoughts and Transpower's proposed EDGS variations, follows. Each issue is described separately and a table, summarising the relevant EDGS 2019 variable settings, along with our proposed variations[2], is provided at the end of this document. The issues are numbered as per the table and are not necessarily in the order discussed in the meeting.

18. Should the scenarios reflect net zero carbon energy by 2050?

The Climate Change Response (Zero Carbon) Amendment Act 2019 sets a greenhouse gas emissions reduction target for New Zealand to reduce net emissions of all greenhouse gases (except biogenic methane) to zero by 2050.

The panel thought the EDGS should be consistent with this legislation, but it is not clear what that means for electricity demand. Electrification is not the only means of decarbonising our energy consumption and alternatives such as biomass, hydrogen and forestation are likely to play a part.

Transpower notes the panel's opinion. To achieve net zero carbon by 2050 will be challenging for New Zealand and it is expected that the energy sector overall will need to maximise its decarbonisation efforts.

19. What extent of electrification should be reflected in EDGS?

Given uncertainty around the future cost and likelihood of the alternatives to electrification, the panel did not consider it was plausible to define the overall extent of electrification by 2050. Rather, the settings for the main contributors to electrification (process heat conversion, electric vehicle uptake, solar PV installations) should be discussed individually and rated as increase/decrease/leave as-is.

Transpower agrees with this approach.

1. Base energy demand growth

Are the settings in the EDGS 2019 reasonable, or should they be varied?

The panel thought that the EDGS 2019 growth rates are slightly high, but the overall range covered by the extremes is reasonable.
Transpower tends to agree and so we propose lowering the per annum growth rates for low/Reference/high from 0.2%/0.8%/1.2% to 0.2%/0.5%/1.0%.

2. Industrial energy demand

Commentator views are mixed on the future of large industrial plants in New Zealand, so the question was, should our EDGS 2019 variations include a range of futures for industrial demand in New Zealand?

The general feeling of the panel was that existing industrial demand may decline over coming years. Just as Tiwai aluminium smelter is closing, other New Zealand industries may also close.
Counter to that though, we may also see some new industrial demand emerging, reflecting New Zealand's competitive advantage in innovation and being clean and green.

Transpower's proposed response is to assume a 20%-50% reduction in existing industrial demand by 2030 within the global and environmental scenarios. The base demand growth assumes sufficient growth in industrial demand, so no further adjustments are recommended to reflect new industrial demand.

[2] Please note that these are the variations that were used for our take one EDGS 2019 variations.

3. Process heat electrification

Process heat conversion away from fossil fuels is likely to be a key contributor to New Zealand's decarbonisation approach. Electricity is the lowest cost substitute for fossil fuel energy and so we may expect that electrification will be maximised – especially for transport and low temperature process heat. Our question to the panel was whether the process heat electrification assumptions in EDGS 2019 are reasonable and are they consistent with New Zealand's net zero carbon by 2050 goal?

The EDGS 2019 assumptions are that 15% of low temperature process heat will be electrified by 2050 in the Reference case and that this increases to a maximum of 83% of low, medium and high temperature process heat electrified by 2050, in the Disruptive scenario.

The panel reminded Transpower that electrification is only one response to decarbonisation. Both energy efficiency and alternatives such as biomass and hydrogen are also likely to be important in decarbonising process heat. MBIE did consider alternatives when developing the EDGS 2019 and without specific guidance there seems little basis for changing their assumptions.

The panel advised Transpower not to overstate process heat electrification.

Transpower proposes increasing all the low temperature heat electrification from 15% to 40%, the medium temperature heat demand reduce to 66% of the original demand, and the high temperature heat to 77% of the original demand. This results in increases across all scenarios except for Disruptive, which remains the same.

4. Accelerated electrification in the South Island

Earlier this year, the government announced a $70 million fund to accelerate decarbonisation of process heat plant in the South Island. Our question was whether we should reflect accelerated process heat conversions in our electricity demand forecasts.

The panel reminded Transpower that the government's $70 million pledge was to fund decarbonisation, not electrification specifically, as indicated in our title for this discussion.

It is not clear how this government funding may affect electrification, so Transpower proposes to ignore it for the Global, Reference and Growth scenarios, but reflect 10 MW of earlier electricity demand growth, in the South Island, in the Environmental and Disruptive scenarios.

5. Electric vehicle demand

Electric vehicle uptake and a move away from fossil fuelled vehicles is likely to be a key contributor to New Zealand's decarbonisation approach. Our question to the panel was whether the electric vehicle uptake assumptions in EDGS 2019 are reasonable and are they consistent with New Zealand's net zero carbon by 2050 goal?

The Reference scenario electric vehicle demand of reflects an uptake of 44% light vehicles and 13% heavy vehicles by 2050. The EDGS range is 44 - 74% light vehicles and 13 - 45% heavy vehicles by 2050.

The panel discussed light and heavy vehicle uptake separately:

a) In relation to heavy electric vehicle uptake, the panel thought that the EDGS assumptions were reasonable. The uptake for heavy vehicles may not be high and alternatives such as hydrogen, may be preferred.
b) In relation to light electric vehicle uptake, the panel thought that the assumptions of 44% to 74% uptake were too light, especially to be consistent with New Zealand's net zero carbon by 2050 goal.

Transpower proposes to predominantly leave the EDGS 2019 heavy vehicle uptake assumptions as they are, except for a small increase for the Disruptive case. Transpower also proposes to change the range for light vehicle uptake from 44% - 74% to 60% - 90%.

6. Solar PV uptake

Solar PV uptake reflects electricity demand that does not need to be provided via the transmission grid, so it is an important variable in our electricity demand forecasting.

We noted that in some overseas countries, domestic roof-top solar PV is forecast to grow to as much as 20% of total electricity supply. The highest penetration in the EDGS 2019 is 7%. The cost of solar PV is decreasing and our question to the panel was whether the EDGS 2019 assumptions for solar PV uptake were reasonable.

The Reference scenario reflects 22% of domestic houses having solar PV installed on the roofs by 2050 and the range in the other scenarios is 9-45% domestic houses.

The panel felt that domestic solar PV installations might be higher than reflected in EDGS 2019 as costs come down and given the net zero carbon by 2050 goal. In the last twelve months, the economics of commercial solar PV have improved and the panel recommended a reasonable uptake of in the scenarios.

Commercial solar PV installations are likely to be many times the domestic installations, so even a small increase would increase solar PV uptake significantly. Without undertaking a detailed study, Transpower proposes to increase the solar PV output (in TWh) by 50%, in all scenarios, to account for the panel observations.

7&8. COVID-19 effect

COVID-19 has definitely affected electricity demand, as many commercial premises were closed during lockdowns and domestic consumption increased with more people being at home.

We asked the panel whether a COVID-19 effect should be reflected in our electricity demand forecasts.

The panel agreed that there was a short term COVID-19 effect on electricity demand, but there was general agreement that electricity demand would recover within 1-3 years.

Transpower proposes to include a range of short term COVID-19 effects:

a) A 1 year flattening of electricity demand followed by accelerated demand growth, such that electricity demand is not affected long term
b) A 2 year flattening of electricity demand followed by a return to normal demand growth, such that electricity demand is slightly reduced long term

9. Tiwai closure

Tiwai aluminium smelter has announced that it is fully closing in Aug 2021. Transpower is aware that discussions continue with the owners of the smelter, with a view to keeping the smelter open for longer, but at this point in time we have no information to that effect.

Our question to the panel was what assumption we should use in our EDGS 2019 variations.

The panellists opinions were aligned and they have a view that the smelter will remain open post 2021. The suggestion was to reflect publicly available information and assume 2024.

Transpower proposes to adopt this advice and to include Tiwai aluminium smelter closure in 2024 in all scenarios.

Reflecting the relative importance of this assumption, we also intend to undertake sensitivities, where relevant, with Tiwai closure in 2021 and 2026.

10. Tiwai closure phasing

A similar question is whether we should assume the smelter closes all at once, or whether it ramps production down over a period.

The panel were unanimous in suggesting the smelter would close all at once. Given the reasons for closure, the panel view is that it would be even less economic to phase production out over a period of time.

Transpower proposes to adopt this advice and to reflect the smelter closing all at once, in all scenarios.

11. Tiwai replacement loads

The need for our ALSIR project is on the presumption that Tiwai closes and all of Manapouri's hydro generation is then available for the electricity market.

We have heard that the prospect of reliable and potentially low-cost electricity in Southland is tempting some industries to consider building new plant in Southland once Tiwai has closed.

New (replacement) electricity demand in Southland could be significant in our transmission planning, so we asked the panellists for their view on the potential for replacement load.

The panel did not have a view on the likelihood of replacement load emerging, but they did point out that the most commonly mentioned replacement load was a data centre or centres and that such load would only amount to tens of MW. The possibility of a large hydrogen plant being built in Southland was raised but felt to be too speculative at this stage.

Transpower proposes to reflect replacement loads as sensitivities only.

12. Embedded storage utilised

One future change which could significantly affect the electricity system, is energy storage and in particular, batteries.

It is expected, in coming years, that battery prices will decrease and every solar PV installation will include battery storage. If these were also connected to the New Zealand power system and were available for use at peak demand times, they could be used for peak shaving. The transmission grid is sized to ensure that peak demand can be met, so if peak demand is reduced, the transmission grid will be affected.

The amount of storage assumed in each scenario is important, but even more important is the assumption regarding the amount that can be accessed for peak shaving. There will need to be an appropriate "peak shaving" market for future battery owners if Transpower is to utilise such batteries. Assuming there is, we then need to make an assumption about what proportion of such batteries will actually be available for peak shaving. At this point in time we do not know what the economics of offering batteries for peak shaving would be and neither do we know how those economics will compare to other uses for the battery.

The panel were asked for their opinion on a reasonable assumption.

In Whakamana i Te Mauri Hiko, we assumed 100% of embedded batteries would be available for peak shaving. No comments were specifically made regarding that assumption so we propose to use that assumption in our EDGS 2019 variations.

What was not explained at the time, was that our 100% assumption seems aggressive, but it also reflects that we expect variable demand to be available in the future as well. Smart household devices are expected to be able to react to price signals and turn on or off as required. Our 100% of embedded batteries is a simplistic assumption which is intended to cover both forms of household peak shaving capability.

13. Electric vehicle storage utilised

The batteries in electric vehicles are charged from the grid, but they can also discharge back into the grid. Vehicle-to-grid charging has the same effect as embedded batteries and could be used for peak shaving.

The willingness of electric vehicle owners to allow their vehicle batteries to be used for peak shaving is likely to be different to other battery owners though. Our view is that most electric vehicle owners would prefer their car is fully charged than otherwise and that they would be only be willing to offer a portion of their battery for peak shaving.

The panel were asked for their opinion and although they relayed that electric vehicle owners would be reluctant to offer their batteries for peak shaving, they thought that a proportion would.

Transpower proposes the following assumptions:

	Reference	Global	Growth	Environmental	Disruptive
% EV fleet available	10%	0%	10%	10%	10%
% EV battery available	10%	0%	10%	10%	10%
% EV battery storage available	1%	0%	1%	1%	1%

% EV fleet available is the proportion of electric vehicle owners prepared to allow their electric vehicle to be used for peak shaving. The proportion in the Disruptive scenario is reduced due to the higher potential for autonomous vehicles. These would be more highly utilised and therefore less available for peak shaving.

% EV battery available is the proportion of each battery that would be available for peak shaving. We assume that electric vehicle owners would not want to go below having a battery 75% charged (ie 25% of their battery is available for peak shaving).

% EV battery storage available is the resultant proportion of total EV battery capacity that is available for peak shaving.

20. Renewable generation target and 21. Renewable generation target date

Our modelling assumes new generation is built in order of increasing cost. We use a generation expansion model which chooses the next cheapest generation from a stack of potential new generation projects which typically includes new gas generation. The model assesses cost over the expected lifetime of the new generation and accounts for some security and reliability constraints. This approach results in a particular renewable generation build, which may or may not get to 100%, depending on the cost of renewable generation versus other technologies.

A renewable generation target imposes a constraint on the modelling and forces it, typically, to build a minimum proportion of renewable generation by a target date.

The current government has pledged to introduce a 100% renewable generation by 2030 target date.

We asked the panel for their advice on whether to include this pledge or not.

Their advice was that such a target would be very expensive to achieve. If we phased out all thermal generation by 2030 and replaced it with renewable generation, New Zealand would also be forced to build the Onslow pumped storage scheme, as this would be the only feasible renewable option which could provide reserve for dry hydrological years.

On the other hand, if we relaxed that target to 2035-2040, options other than Onslow could be utilised. By 2035-2040 we would expect that the amount of embedded storage would be significantly higher, alternative fuels such as hydrogen might be available, demand response technologies would be improved and there may be wind generation in the North Island built with battery storage that could serve as dry year reserve. The panel was of the opinion that a mixed North Island solution may be cheaper than building Onslow.

There was also an opinion that a mixed solution might not emerge until the 2040's. In this case, New Zealand might allow gas peaking plant to remain until that time.

This discussion was very helpful as it covered a range of major uncertainties for transmission planning. Transpower proposes to use the following assumptions in our EDGS 2019 variations:

	Reference	Global	Growth	Environmental	Disruptive
Renewables target	100% by 2040	100% by 2050	100% by 2050	100% by 2030	100% by 2040

17. Dry year reserve

At present the existing thermal generation provides a good backup energy supply in the event of a dry hydrological year.

To be consistent with the above renewable energy targets, the existing thermal generation will need to be closed by the renewables target date, which means that alternatives for meeting the expected energy shortfall in dry hydrological years will need to be in place by then.

Much of the discussion on what assumptions would be reasonable, coincided with the discussion on renewable generation targets and is mentioned above. Rather than repeat that discussion, the Transpower proposed assumptions are shown in the table.

	Reference	Global	Growth	Environmental	Disruptive
Dry year reserve	Batteries, demand response, generation overbuild, alternative fuels	Batteries, demand response, generation overbuild, alternative fuels Thermal peakers permitted	Batteries, demand response, generation overbuild, alternative fuels Thermal peakers permitted	Onslow	Batteries, demand response, generation overbuild, alternative fuels

15. Rankine retirement

The Huntly Rankine units are expected to retire in the near future, although Genesis Energy advise no particular decision has been made.

The panel were asked for their view, with the discussion suggesting that the published statements to the market should be used in the EDGS.

It was also pointed out that it is likely that TCC will retire before the Rankine units.

Transpower proposes to use the following assumptions for thermal units:

- TCC retires in 2025
- Rankines will retire after 2023. No coal will be used after 2025. The Rankines will retire by 2030.
- All other thermal generation will retire at the end of its economic life, as published by WSP in their generation stack update on thermal generation in November 2020, or in time to meet any renewable generation target date assumption.

16. Generation stack cost update

The generation expansion modelling undertaken to produce the EDGS 2019 used generation cost information produced between 2010 and 2016.

MBIE, with assistance from Transpower, commissioned a range of updated generation cost reports during 2019 and 2020. These have been published on the MBIE website.

Transpower proposes to use the information contained in those reports for the EDGS 2019 variations.

22. Carbon price

The Carbon price, as reflected in the Emissions Trading Scheme was discussed. There was some confusion around whether the numbers were in $US or $NZ. Eventually the panel decided to talk in $NZ terms.

Transpower proposes to adopt the panel recommendations for Carbon prices at 2050, which are as follows:

	Reference	Global	Growth	Environmental	Disruptive
2050 Carbon price, $US/tonne CO2e	$43	$43	$43	$100	$43
2050 Carbon price, $NZ/tonne CO2e	$75	$75	$30	$200	$75

23. TPM changes

There was some discussion about whether there might me any modellable changes in either electricity demand, or new generation build, as a result of the new TPM.

The discussion was not conclusive, so Transpower proposes to ignore the new TPM in varying the EDGS 2019.

24. Other changes

The panel were also asked whether there any other changes since the EDGS 2019 were produced, that should be taken into account as variations are developed.

There were two suggestions:

Big data/Analytics - Transpower was advised not to ignore what is happening in this space and that when any effects occur, they may occur quickly. We have considered what that might mean for electricity demand and supply and expect the main effect to be in adding variable demand to the mix of tools which could be used for peak shaving.

In Transpower's view such demand is unlikely to contribute significantly to the dry year reserve requirement, as this need is for a sustained reduction in energy demand whereas variable demand is expected to be shorter in term.

As explained earlier, our Whakamana i Te Mauri Hiko assumption that 100% of embedded storage would be available for peak shaving, actually incorporates the concept of variable demand. Rather than try to forecast this separately, we assumed 100% of embedded batteries as a simplistic assumption which is intended to cover both forms of household peak shaving capability.

Renewable incentives – could these effect the new generation build included in the scenarios? Transpower has considered how any renewable incentives might affect new generation build and believe that imposition of renewable energy targets would have a similar impact. For that reason we are not planning on reflecting renewable generation incentives explicitly.

Summary table of proposed EDGS 2019 variations

	Variable/assumption	EDGS 2019					Transpower variations EDGS 2019				
		Reference	Growth	Global	Environmental	Disruptive	Reference	Growth	Global	Environmental	Disruptive
	Scene setting issue										
18	Net zero C by 2050?	N	N	N	N	N	Y	Y	Y	Y	Y
19	Extent electrification contributes	Incorporated in individual assumptions					Incorporated in individual assumptions				
	Grid energy demand issues to consider										
1	Base energy demand growth	0.8%pa	1.2%pa	0.2%pa	0.9%pa	0.7%pa	0.5%pa	1.0%pa	0.2%pa	0.6%pa	0.4%pa
2	Existing industrial energy demand change	0	0	0	0	0	0	0	-100 MW by 2030	-100 MW by 2030	0
3	Process heat electrification, TWh	1.5 TWh	1.9 TWh	1.2 TWh	6.5 TWh	13.3 TWh	1.5 TWh	1.9 TWh	1.2 TWh	6.5 TWh	10.0 TWh
4	Accelerated decarbonisation in SI?	N	N	N	N	N	N	N	N	10 MW	10 MW
5a	Heavy electric vehicle, fleet %	13%	13%	13%	45%	45%	13%	13%	13%	45%	45%
5b	Light electric vehicle, fleet %	44%	44%	44%	74%	74%	60%	60%	60%	90%	90%
6	Solar PV output	2.3 TWh	2.8 TWh	0.9 TWh	4.6 TWh	4.6 TWh	3.4 TWh	4.2 TWh	1.4 TWh	6.9 TWh	6.9 TWh
7	COVID-19 effect	N	N	N	N	N	Y	Y	Y	Y	Y
8	COVID-19 reflected by						21yr flat then normal	1 yr flat then ++	2 yr flat then normal	1 yr flat then normal	1 yr flat then normal
9	Tiwai closure	N	N	N	N	N	2024	2024	2024	2024	2024
10	Tiwai closure phasing	N	N	N	N	N	N	N	N	N	N
11	Tiwai replacement load	N	N	N	N	N	N	N	N	N	N
	Grid peak demand issues to consider										
12	Embedded storage utilised						No comments offered				
13a	EV storage available for peak shaving						25%	25%	0	25%	25%
13b	EV storage offered for peak shaving						20%	20%	0	40%	10%
14	Grid-scale batteries	N	N	N	N	N	xxx	xxx	xxx	xxx	xxx
	Supply scene setting issue										
20 21	Renewable generation target/date						100% renew by 2040	100% renew by 2050	100% renew by 2050	100% renew by 2030	100% renew by 2040
	Supply issues to consider										
15	Rankine retirement	2030-31	2030-31	2030-31	2030-31	2030-31	2023-30 No coal after 2025	2023-30 No coal after 2025	2023-30 No coal after 2025	2023-30 No coal after 2025	2023-30 No coal after 2025
15a	TCC retirement						2025	2025	2025	2025	2025
16	Cost new generation technologies	N	N	N	N	N	Y	Y	Y	Y	Y
17	Dry year reserve						Other(1)	Other(1)(2)	Other)1)(2)	Onslow	Other(1)
	Other issues										
22	Carbon price $US/t CO2e	$43/t	$43/t	$43/t	$100/t	$43/t	$NZ75/t	$NZ75/t	$NZ30/t	$NZ200/t	$NZ75/t
23	TPM changes	N	N	N	N	N	N	N	N	N	N

(1) Batteries, demand response, generation overbuild, alternative fuels (2) Thermal peakers permitted

Appendix 2 - Scenario development - EDGS 2019 variations

Comments on written submissions

From MEUG:

The 2030 [100%renewable generation] target is a political aspiration rather than a legal binding requirement.

"…should the NZ Battery option to support 100% renewable generation by 2030 be treated as a scenario? The Reference Case for the EDGS should remain with gas as the marginal back-up generation to support intermittent renewables in the longer-term until the economics of gas-fired generation is no longer lower cost from the next best alternative.".

Transpower response:

The panel discussion was that Onslow would be required if a 2030 100% renewable generation target was imposed by the government.

The approach we will describe at the second panel meeting for developing appropriate supply scenarios, means that 100% renewable generation targets would be dealt with as described by MEUG.

From Trustpower:

"We generally agree with the Panel's view on most topics….".

We believe an "if <event> then <action>" approach should be used for major disruptions such as Onslow Pumped Hydro scheme. That is, these types of disruptive changes should not be assumed in any of the core scenarios (reference, high, low), but this should not prevent Transpower from developing possible options such that they are prepared for these disruptive eventualities (much like they did with Tiwai and lower South Island upgrades).

Transpower response:

The approach we will describe at the second panel meeting for developing appropriate supply scenarios, means that 100% renewable generation targets would be dealt with as described by MEUG.

"…the reference case should assume further industrial exits (although not a complete closure of all those users currently under review) and only a small amount of replacement demand following Tiwai closure.".

Transpower response:

Agree.

"…EDGS is overly conservative with respect to electric vehicle (EV) uptake, solar photovoltaic uptake and battery penetration and support increasing these components in the scenarios.".

Transpower response:

Agree.

"…the EDGS high scenario is overly optimistic with respect to industrial electrification (i.e. 13.3 TWh additional demand by 2050) and underlying growth (i.e. 1.2% per annum) and recommend limiting these components to 9-10 TWh and 0.7-0.8% respectively in any high scenarios developed (and consequential adjustments to other scenarios as appropriate).".

Transpower response:

We have lowered based demand growth, but have retained the 13.3 TWh demand growth for process heat electrification in order to reflect diversity in the scenarios.

"We propose that thermal retirements are not be treated as an independent variable and instead inherently linked to Tiwai closure and relevant grid upgrades following the closure. That is, when Tiwai closes it is likely Taranaki Combined Cycle and the Huntly Rankine units will close shortly after.".

Transpower response:

Noted. We are assuming TCC will close in 2025, one year after Tiwai closure. The Huntly Rankine units are retained until 2030, although only with gas as a feedstock at this stage because of their role in providing dry year reserve.

"We also agree with the comments from the Panel regarding vehicle to grid technology given the time frame involved. While it is unlikely a large proportion of energy from domestic vehicles will be made available for grid use, a smaller proportion (<20%) is quite possible assuming the right incentives are developed.".

Transpower response:

Agree.

"Regarding the comment on autonomous vehicles reducing demand: while we agree the number of vehicles on the road may be lower, this may not translate to lower demand as demand per vehicle is likely to increase significantly. Therefore, any demand growth should use actual consumption estimates rather than the number of EVs.".

Transpower response:

Noted.

From Wellington Electricity:

Is Manapouri generation being considered for dry year reserve, rather than building the expensive Lake Onslow?

Transpower response:

We have had a quick look at this idea. The Lake Onslow storage would be approximately 5 TWh for dry year reserve. Lake Manapouri storage totals approximately 0.5 TWh, so would not be particularly useful for this purpose. If the lake level was raised, the 0.5 TWh increased and combined with Lake Te Anau, which is approximately a further 1.5 TWh, it might be, but that seems an unlikely option.