Scenario Development – EDGS 2019 variations - pre-reading

Objective

The objective of this exercise is to review the Electricity Demand and Generation Scenarios (EDGS) 2019 published by MBIE and where necessary, recommend reasonable variations, to ensure Transpower has up-to-date scenarios for evaluating our Accessing Lower South Island Renewables (ALSIR) and Net Zero Grid Pathways (NZGP) projects.

EDGS 2019

On their website, MBIE explain that the purpose of the EDGS is to explore a range of hypothetical electricity supply and demand futures, considering different demographic, economic, policy and technology dimensions.

The EDGS are used in our transmission investment investigations. Transpower can recover the cost of investing in the grid by contracting with individual parties, but where multiple parties are involved (sometimes all electricity consumers in New Zealand), the negotiations involved would be impractical. Instead, the Commerce Commission effectively act as agents for those multiple parties and they require that we follow certain processes in order to recover our costs.

We undertake long-term planning to forecast the level of transmission services we should provide. Long-term planning is necessary because the assets we use to deliver our services are long-lived (20–80 years expected life) and the lead time to install new assets can be long (up to 10 years for a new transmission line).

When our forecasts predict we will need larger, or more, assets to provide the services consumers want[1], we consider enhancing the transmission grid.

If the expected cost of the enhancement exceeds $20 million, the Commission prescribe the process we must use in order to recover the costs from our customers. The process is described in the Transpower Capital Expenditure Input Methodology (Capex IM)[2]. It requires that we submit a Major Capex Proposal (MCP) to them, which is effectively a business case justifying the need for investment, the option we believe is most beneficial to consumers and the expected cost.

Because our investigations tend to look so far into the future, electricity supply and demand is very uncertain. We use scenarios to ensure we consider a plausible range of different futures and the Capex IM requires that we use the EDGS, or reasonable variations of those scenarios, when preparing MCP's.

The scenarios test the economic efficacy of potential investment options over a range of futures, so the scenarios need not be forecasts of the most likely future electricity supply and demand. Typically, the scenarios would include a central scenario which is thought to be most likely, but the other scenarios would be diverse in terms of the transmission grid that would be required to enable them. Regardless, the scenarios should be reasonable and not too extreme, or highly unlikely.

The Capex IM requires that we assign probabilities to each scenario and so scenarios included for transmission diversity, but which are less likely to occur, can be assigned a lower probability than more likely scenarios.

[1] As a result of load growth, new grid-connected generation, or to increase reliability of supply, for instance

[2] https://comcom.govt.nz/regulated-industries/input-methodologies/transpower-ims

The EDGS 2019 are fully described here, but in brief, consist of five scenarios which reflect future levels of electricity demand and generation out to 2050:

Reference: Current trends continue. The central theme of this scenario is that long-term historic trends continue, with minimal disruption.

Growth: Accelerated economic growth. Higher immigration drives increased population growth, while policy and investment focuses on priorities other than the energy sector.

Global: International economic changes. New Zealand's economy is battered by international trends, leaving little room for growth or innovation.

Environmental: Sustainable transition. Strong environmental leadership driven by regulation and incentives, rather than technology.

Disruptive: Improved technologies are developed. New and improved technologies enable rapid and disruptive transformation in the energy sector.

A summary of some key variables for 2050 in each scenario are included in Table 1. Percentage changes relative to 2019 are shown in grey, unless otherwise specified.

Variable/assumption	EDGS 2019				
	Reference	Growth	Global	Environmental	Disruptive
Grid energy demand					
2019 energy demand, TWh	39	39	39	39	39
2050 energy demand, TWh	57 ↑43%	65 ↑64%	47 ↑18%	67 ↑68%	71 ↑78%
Base energy demand growth, pa	0.8%	1.2%	0.2%	0.9%	0.7%
Process heat demand, TWh	1.5	1.9	1.2	6.5	13.3
Electric vehicles demand, TWh[3]	4.1 (44%/13%)	5.0 (44%/13%)	3.2(44%/13%)	7.6 (74%/45%)	7.6 (74%/45%)
Solar PV output, TWh[4]	2.3 (22%)[5]	2.8 (27%)	0.9 (9%)	4.6 (45%)	4.6 (45%)
Grid peak demand					
2019 peak demand, GW	6.3	6.3	6.3	6.3	6.3
2050 peak demand, GW	8.5 ↑34%	9.8 ↑56%	7.1 ↑12%	9.6 ↑53%	10.2 ↑62%
Embedded storage, GW[6]	2.1	2.6	0.8	4.3	4.3
Embedded storage, GWh	4.2	5.1	1.6	8.6	8.6
Electric vehicle storage, GW[7]	3	3	2	8	8
Electric vehicle storage, GWh	53	64	41	164	164
Supply					
New grid generation, GW	6.3	9.4	3.8	9.6	10.6
Environmental					
Carbon price, $US/t CO2e	$43	$43	$43	$100	$43
Emissions, mt CO2e[8]	23.7 ↓28%	26.7 ↓19%	19.6 ↓40%	17.2 ↓48%	16.9 ↓48%
Renewables generation, %	94.9	95.4	94.8	96.0	94.9

Table 1 – Some key variable settings and outcomes of the five scenarios included in the EDGS 2019

[3] (x%/x%) refers to light vehicle%/heavy vehicle% of fleet which are electric by 2050

[4] Solar PV is included as demand. Transpower plans on electricity demand at our GXP's. Domestic solar PV is treated the same as other embedded generation, as a subtractor from gross demand.

[5] x% refers to the percentage of houses in New Zealand with solar PV panel installations

[6] Mostly batteries at home, installed with solar PV panels. We assume each battery has storage capability of 10 kWh and peak capacity of 5 kW. These numbers are installed capacity, only a fraction of which is available for grid peak shaving.

[7] For the purposes of generating this number from EDGS data we have assumed that each vehicle travels 11,446km/yr (https://www.transport.govt.nz/mot-resources/vehicle-fleet-statistics/#annual) and the efficiency of EVs is 0.18kWh/km. Each electric vehicle is assumed to have a 60kWh battery, which could provide 3kW at peak. These numbers are EV capacity and only a fraction, if any, is available for grid peak shaving.

[8] 2050 energy sector emissions, compared to 2017 emissions

Potential variations to EDGS 2019

Whilst the underlying synopses behind the EDGS 2019 reflect a wide range of future uncertainties, 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 would like to consider varying the following aspects of EDGS 2019. For existing variables:

- Are the EDGS 2019 settings still appropriate?
- If not, what range of each variable should we reflect across the scenarios?

or for new issues not currently reflected in EDGS 2019:

- Is this something that should be reflected in the scenarios?
- If yes, what range of each variable should we reflect across the scenarios?

The aspects are:

Grid energy demand

- Base energy demand growth
- Industrial energy demand growth
- Process heat electrification, including accelerated electrification in the SI
- Electric vehicle demand
- Solar PV output
- COVID-19 effect
- Tiwai closure assumptions
- Tiwai replacement loads

Grid peak demand

- Embedded and electric vehicle batteries
- Grid-scale batteries

Supply

- Thermal generation options
- Cost and availability of new generation technologies
- Dry year reserve options

Environmental/policy/regulatory

- Net zero carbon by 2050
- Renewable generation goals
- Carbon price
- New TPM

In addition, panellists are welcome to raise other scenario variations and/or relevant issues they think Transpower should consider.

Process for developing variations to EDGS 2019

In the meeting on November 5, the panel will review these issues and provide advice to Transpower about reasonable variations to the EDGS 2019 in order to bring those scenarios up-to-date.

An output from the meeting will be to populate Table 2, below, as much as possible. This table will summarise the panels advice, excepting any additional issues the panellists raise.

Although, the meeting facilitator will decide how best to achieve this, one process would be to step through each of the potential variations identified - discuss and then summarise into the table entry.

Variable/assumption	EDGS 2019					Transpower variations EDGS 2019		
	Reference	Growth	Global	Environmental	Disruptive	Reference	High	Low
Grid energy demand issues to consider								
Base energy demand growth	0.8%pa	1.2%pa	0.2%pa	0.9%pa	0.7%pa			
Industrial energy demand								
Process heat electrification, TWh	1.5 TWh	1.9 TWh	1.2 TWh	6.5 TWh	13.3 TWh			
Accelerated electrification in SI?	N	N	N	N	N			
Electric vehicle demand	4.1 TWh	5.0 TWh	3.2 TWh	7.6 TWh	7.6 TWh			
Solar PV output	2.3 TWh	2.8 TWh	0.9 TWh	4.6 TWh	4.6 TWh			
COVID-19 effect	N	N	N	N	N			
COVID-19 reflected by								
Tiwai closure	N	N	N	N	N			
Tiwai closure phasing								
Tiwai replacement load								
Grid peak demand issues to consider								
Embedded storage utilised								
Electric vehicle storage utilised								
Grid-scale batteries	N	N	N	N	N			
Supply issues to consider								
Rankine retirement	2030-31	2030-31	2030-31	2030-31	2030-31			
Cost new generation technologies	N	N	N	N	N			
Dry year reserve								
Environmental/policy/regulatory issues to consider								
Net zero C by 2050?	N	N	N	N	N			
Extent electrification contributes								
Renewable generation target								
Renewable target date								
Carbon price $US/t CO2e	$43/t	$43/t	$43/t	$100/t	$43/t			
TPM changes	N	N	N	N	N			

Table 2 - Table to be populated in November 5 online meeting. Not all EDGS 2019 settings shown.

Transpower will consider the advice provided and produce a draft set of scenarios for review in our second meeting on December 2. We will also discuss the weightings that might apply to the scenarios in the second online meeting.

Panellists are not expected to contribute to all of the issues and questions. We suggest you contribute in those areas relevant to your experience.

Also, please note that it is okay for the panel to conclude it does not have enough information to make a recommendation.

The next section provides a more fulsome explanation of the above issues, provides some specific questions for each issue and an indication of the form of response that would assist. As discussed above, the scenarios would normally include a central scenario which is thought to be likely, but the other scenarios, should be diverse in terms of the transmission grid that would be required to enable them. For that reason, we would like the panel to consider the central setting for each variable and the range (between low and high) that it should cover.

The indications are to guide the panel in the form of information that would be most useful and are not suggested responses.

Where the panel considers that the EDGS 2019 settings should change, an indication of whether the setting should go up or down will suffice.

For information, we have included the equivalent variable range from both the Business Energy Council (BEC) scenarios[9] and Whakamana i Te Mauri Hiko (WiTMH) scenarios[10], where relevant.

Potential variations to EDGS 2019 in more detail

Base energy demand growth

The assumptions used to derive base energy demand growth are complex. They include factors such as GDP growth, population growth, energy intensity, etc.

It is not plausible to review all these variables and is not within the scope of this exercise. We are focussing on the major step changes since the EDGS were produced in July 2019, nevertheless, for completion we ask the question – would any variations to the EDGS 2019 base energy demand growth, be justified. The panellists are asked to consider the following questions:

a) Is growth of 0.8% pa reasonable in the Reference scenario? If not, should it go up or down?
b) Does the EDGS range of 0.2 (low) – 1.2 (high) % pa growth span a reasonable range of uncertainty? If not, should they go up or down?

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
Base energy demand growth, %pa	Y/N	Y/N	Y/N

[9] https://www.bec2060.org.nz/

[10] https://www.transpower.co.nz/resources/whakamana-i-te-mauri-hiko-empowering-our-energy-future

Reference: Base energy demand growth rates (pa) to 2050 of various scenario sets			
EDGS 2019	0.8%pa	0.2%pa	1.2%pa
BEC settings[11]		1.5%pa	1.5%pa
WiTMH settings	0.4%pa	0.1%pa	0.8%pa

Industrial energy demand growth

Commentator views are mixed on the future of large industrial plants in New Zealand. Some consider New Zealand's renewable resources will make it a haven for "green" manufacturing and that industrial manufacture will increase, others are less optimistic but expect our existing large industrials are likely to remain, while others are more pessimistic and expect more industrial closures.

EDGS 2019 assumes the large industrial plants remain, excepting there is a Tiwai closure sensitivity. Panellists are asked to comment on:

a) Should our EDGS 2019 variations include a range of futures for industrial demand in New Zealand?

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
Industrial demand variation?	Y/N	Y/N	Y/N
Possible futures[12]	eg Existing industrials remain	eg Large industrials move away from New Zealand	eg New Zealand becomes a haven for green manufacturing

Reference: Industrial energy demand in 2050 of various scenario sets			
EDGS 2019, TWh	9.2	9.2	10.0
BEC settings, TWh[13]		9.8	19.6
WiTMH settings, TWh	10.1	9.9	10.3

Reference: Industrial energy demand in 2020	
EDGS 2019, TWh	9.0
BEC, TWh	14.1
WiTMH, TWh	9.4

[11] The Tui scenario has strong initial base growth which slows as we approach 2050. The Kea scenario has slow base growth which accelerates as we approach 2050. The base growth is taken as the Residential, Commercial and Agriculture growth from the TIMES-NZ Data download on the page https://www.bec2060.org.nz/downloads

[12] The effects shown across the table are for illustration only.

[13] From the Kea and the Tui scenarios. BEC's Kea scenario assumes a large loss of industry in New Zealand. The demand here is taken from the 'TIMES-NZ Data' Data group = 'Energy – high level', Period = 2050, Attribute = 'PJ', Sector = 'Industry', Fuel = 'Electricity'. downloaded from https://www.bec2060.org.nz/downloads

In regard to the reference information, we add:

The estimates of the industrial energy for EDGS and WiTMH included above are the summation of the purely industrial GXPs only. They are not counting industrial load that at other GXPs, where electricity demand is a mixture residential, commercial and industrial. This approach may underestimate industrial load by as much as 50%, which has been 35-40% of New Zealand's total electricity demand in recent years.

An exit of NZAS at Tiwai Point would reduce industrial demand by 5.4 TWh, or approximately 35%.

Process heat electrification, including accelerated electrification in the SI

It is not plausible to review process heat electrification in detail, as a part of this exercise, and is not within the scope of this exercise. We are focussing on the major step changes since the EDGS were produced in July 2019, nevertheless, for completion we ask the question – would any variations to the EDGS 2019 process heat electrification be justified We note the government has announced a $70 million fund to accelerate electrification of process heat plant in the SI. The panellists are asked to consider the following questions:

a) Are the EDGS assumptions that 1.5 TWh (15% of low temperature process heat electrified) for the Reference Case and 1.2 – 13.3 TWh (15% of low temperature - 83% of low, medium and high temperature process heat electrified by 2050) for the other scenarios as the range of uncertainty reasonable? If not, should they go up or down?
b) Should we reflect accelerated electrification of process heat in the SI?

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
Process heat electrification, TWh	Y/N	Y/N	Y/N
Accelerated SI	Y/N	Y/N	Y/N

Reference: Process heat electrification by 2050 in TWh of various scenario sets			
EDGS 2019	1.5	1.2	13.3
BEC settings			
WiTMH settings	7	3	9

Electric vehicle electricity demand

It is not plausible to review electric vehicle uptake and demand in detail, as a part of this exercise, and is not within the scope of this exercise. We are focussing on the major step changes since the EDGS were produced in July 2019, nevertheless, for completion we ask the question - might any variations to the EDGS 2019 electric vehicle uptake/demand be justified? The panellists are asked to consider the following questions:

a) Does the Reference scenario electric vehicle demand of 4.1 TWh (reflecting an uptake of 44% light vehicles and 13% heavy vehicles by 2050) seem reasonable? If not, should it go up or down?
b) Does the EDGS range of 3.2 – 7.6 TWh electric vehicle demand (reflecting an uptake of 44 - 74% light vehicles and 13 - 45% heavy vehicles by 2050) span a reasonable range of uncertainty? If not, should it go up or down?

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
Electric vehicles, TWh	Y/N	Y/N	Y/N

Reference: Electric vehicle demand pa, by 2050 in TWh of various scenario sets			
EDGS 2019	4.1	3.2	7.6
BEC settings[14]		20.8	26.7
WiTMH settings	16	9	18

Solar PV output

Solar PV uptake/output is included as a grid energy demand variable because in our calculations, solar PV production is subtracted from behind-the-GXP demand in order to determine GXP demand.

It is not plausible to review solar PV uptake and output in detail, as a part of this exercise, and is not within the scope of this exercise. We are focussing on the major step changes since the EDGS were produced in July 2019, nevertheless, for completion we ask the question - would any variations to the EDGS 2019 solar PV uptake/output, be justified?

We note 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 panellists are asked to consider the following questions:

a) Does the Reference scenario solar PV forecast of 2.3 TWh electricity output (reflecting an uptake of 22% houses having solar PV installed on the roofs by 2050) seem reasonable? If not, should it go up or down?
b) Does the EDGS range of 0.9 – 4.6 TWh solar PV electricity output (reflecting an uptake of 9-45% houses having solar PV installed on the roofs by 2050) span a reasonable range of uncertainty? If not, should it go up or down?

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
Solar PV output, TWh	Y/N	Y/N	Y/N

Reference: New solar PV output by 2050 in TWh of various scenario sets			
EDGS 2019	2.3	0.9	4.6
BEC settings			
WiTMH settings	4.9	3.2	6.7

The BEC settings have not been included. The BEC numbers range between 10.1 – 15.9 TWh in 2050 and are taken from the 'TIMES-NZ Data'. Data group = 'Electricity', Period = 2050, Attribute = 'Generation in TWh', Fuel = 'Solar PV'. Downloaded from https://www.bec2060.org.nz/downloads. Unfortunately, it is not clear whether these numbers also include grid-scale solar output, so we have excluded them from the table.

[14] From the Kea and Tui scenarios, respectively. The transport demand is taken from the 'TIMES-NZ Data' Data group = 'Energy – high level', Period = 2050, Attribute = 'PJ', Sector = 'Transport', Fuel = 'Electricity'. downloaded from https://www.bec2060.org.nz/downloads

COVID-19 effect

COVID-19 has had a short-term effect on electricity demand, but commentaries differ on whether the effect will be short-lived only, or more permanent. The panellists are asked to consider the following questions:

a) Should we reflect the effect of COVID-19 in our EDGS 2019 variations?
b) If so, how should it be represented?

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
COVID-19 effect	Y/N	Y/N	Y/N
How effect included[15]?	eg 2 years no growth. No effect long term	eg 1 year no growth. No effect long term	eg No effect

Tiwai closure assumption

At this point in time, Rio Tinto have advised that the Tiwai aluminium smelter will be fully closing in August, 2021. We are aware that discussions continue on a phased closure, but have no further information at this stage. The panellists are asked to consider the following question:

a) Should we reflect Tiwai closing fully in August 2021 only, or should we reflect a range of Tiwai closures?

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
Tiwai closure	Y/N	Y/N	Y/N
How effect included[16]?	eg Full closure 2021	eg Phased closure 3 yrs	eg Full closure 2021

Tiwai replacement loads

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 electricity demand in Southland could be significant in our transmission planning. The panellists are asked to consider the following question:

a) Should we assume new load replaces Tiwai existing load in Southland once Tiwai smelter closes?
b) If so, how much should we assume and when?

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
Tiwai replacement	Y/N	Y/N	Y/N
How effect included[17]?	eg 100 MW in 2025	eg None	eg 600 MW 2025-2030

[15] The effects shown across the table are for illustration only.
[16] The effects shown across the table are for illustration only.
[17]The effects shown across the table are for illustration only.

Embedded and Electric Vehicle batteries

Embedded and electric vehicle batteries comprise domestic batteries installed with solar PV, larger batteries installed for commercial reasons and electric vehicle storage. It is not plausible to review this storage in detail, but as shown below, the amount of storage behind each GXP is considerable.

We envisage that as technology gets smarter and new markets develop, Transpower will be able to access this storage for peak demand shaving, where economic. It is too complex to imagine what might be economic and whether we will, in practice, use such storage for peak shaving, so instead we use an assumption on the percentage of embedded and electric vehicle storage used in this way.

The panellists are asked to consider the following question:

a) What percentage of both embedded and electric vehicle storage should we assume is utilised, through some contractual arrangement, for peak shaving in the MBIE scenarios?

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
Embedded storage used for peak shaving, %[18]	eg 100%	eg 50%	eg 100%
Electric vehicle storage used for peak shaving, %[19]	eg 0%	eg 0%	eg 10%

Reference: Embedded storage installed by 2050 of various scenario sets			
EDGS 2019, GW	2.1	0.8	4.3
BEC settings, total GW[20]		2.3	2.4
WiTMH settings, GW	3.3	2.8	3.5
EDGS 2019, GWh	4.2	1.6	8.6
BEC settings, total GWh[21]		4.6	4.8
WiTMH settings, total GWh	6.6	5.6	7
WiTMH % embedded utilised	100%	100%	100%
Reference: EV storage by 2050 of various scenario sets			
EDGS 2019, GW	3	2	8
BEC settings, total GW		13	17
WiTMH settings, total GW	10	6	11
EDGS 2019, GWh	53	41	164
BEC settings, total GWh		267	342
WiTMH settings, total GWh	204	117	229
WiTMH % EV batteries utilised	0%	0%	0%

[18] The effects shown across the table are for illustration only

[19] The effects shown across the table are for illustration only

[20] From the Kea and Tui scenarios, respectively. The solar generation is taken from the 'TIMES-NZ Data'. Data group = 'Electricity', Period = 2050, Attribute = 'Capacity in GW', Fuel = 'Batteries'. Downloaded from https://www.bec2060.org.nz/downloads.

[21] Assuming a storage – capacity ratio of 2kWh/kW. As in the BEC capacity below, these are the Kea and Tui scenarios, respectively.

Grid-scale batteries

Until very recently, there appeared to be little interest in grid-scale batteries in New Zealand. Recent interest though has placed attention on the potential for such devices to be economic given they may be able to earn revenue from multiple avenues.

Grid-scale batteries could play a significant role in the New Zealand electricity system if they were widespread enough. They could influence, or be a part of, the optimal dry year reserve solution for instance and so it seems appropriate to consider whether they should be reflected in any variation of the EDGS 2019. The panellists are asked to consider the following questions:

a) Should grid-scale batteries be reflected in the variations we make to EDGS 2019?
b) If we should include grid-scale batteries, we will need to determine a reasonable setting for the Reference Case and range for the other scenarios. We have yet to do that, but would report our assumptions on December 2, for review, if we do include them. To assist, we would appreciate panellist views on the most likely value streams which would drive investors in grid-scale batteries?

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
Grid-scale batteries	Y/N	Y/N	Y/N
Most likely value streams[22]	eg reserves, arbitrage	eg None	eg reserves, arbitrage, dry year reserve

Reference: Grid-scale battery uptake by 2050 in GW for various scenario sets			
EDGS 2019	Not included	Not included	Not included
BEC settings		2.3 GW	2.4 GW
WiTMH settings	2.2 GW	0.9 GW	3.3 GW

Thermal generation options

The amount and type of thermal generation in the North Island, at any one time, is an important variable in determining the overall generation mix.

Thermal generation can be either baseload, or peaking.

The Huntly coal-fired Rankine units are baseload thermal units in the North Island and they may become uneconomic if Tiwai smelter closes and there is no or little replacement load in Southland.

The peaking, gas-fired generation in the North Island has a different purpose and the economics of running such plants will be less affected by closure of the Tiwai smelter. We show them as retiring, either at the end of their economic life, or according to any renewable generation goal assumption, whichever is earlier.

The panellists are asked to consider the following questions:

a) Ignoring the potential for the Rankine units to be retained and used for dry year reserve, which is discussed separately, when should we assume the Rankine units are retired?

[22] The value streams shown across the table are for illustration only.

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
Rankine retirement[23]	eg 2023	eg 2030	eg 2023

Reference: Rankine retirement dates of various scenario sets			
EDGS 2019	2030-31	2030-31	2030-31
BEC		2035	Rankines replaced[24]
WiTMH	2030	2030	2030

Cost and availability of new generation technologies

The EDGS 2019 reflected international trends in renewable technology costs occurring in New Zealand. Since then, MBIE have commissioned experts in generation technologies to review the list of potential new generation projects and their cost. This information is used to form the generation stack, which is subsequently used to develop grid-connected generation expansion plans in the scenarios.

a) Should the new generation stack information should be included in the scenarios.

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
New generation info	Y/N	Y/N	Y/N

Dry year reserve options

Even though a lot of new renewable generation will be built by 2050, hydro generation will still be a dominant feature of our generation mix. This means our electricity supply will continue to be exposed to dry hydrological years, when the amount of hydro generation available is much less.

The Huntly coal-fired thermal plant can currently operate during dry years, but Genesis has publicly announced plans to retire those units by 2030, if not earlier.

To maintain a reliable supply of electricity, New Zealand's electricity system will need to replace the functionality that Huntly offers our electricity system. Options include:

- Retain existing or build new thermal generation
- Overbuilding renewable generation
- Assume the Onslow pumped hydro scheme is built
- Assume a North Island variant of the Onslow scheme is built
- Assume a smaller North Island variant of Onslow is built, plus an overbuild of renewable generation
- Assume gas peaking plant is retained
- Assume the existing Huntly coal plant is retained for dry year reserve only
- Assume the existing Huntly coal plant is replaced by a plant using CCS technology
- Hydrogen production is established: Hydrogen may be exported during wet and normal years and used for electricity generation during dry years

[23] The years shown across the table are for illustration only.
[24] BEC's Tui scenario assumes that *coal with Carbon Capture and Storage* is employed out beyond 2040.

How the New Zealand electricity system will protect itself against the supply issues arising from dry hydrological years is important from a transmission perspective, as the transmission system needs to be able to dispatch the dry year reserve as required. A South Island solution may have implications for the HVDC, whereas a North Island solution may have North Island AC implications. The panellists are asked to consider the following question:

a) How should we reflect dry-year reserve options in the scenarios? The indicative responses below do reflect that the impact on the transmission grid should be considered in determining these settings.

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
Dry year reserve [25]	eg overbuild/NI reserve	eg retain gas peakers	eg Onslow

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 Act was passed in Parliament late in 2019, almost unanimously. Dissent around the Act relates to methane emissions and the effect on our agricultural sector. The role of energy in achieving our reduction target and the requisite transformation of New Zealand's energy use is not controversial.

The route New Zealand will take to reduce our energy use to being net zero carbon by 2050 is unclear, but electrification of some fossil fuel usage and changing our generation mix to be highly renewable will form an important part. The role of alternatives such as hydrogen, biomass and other green fuels will take some time to clarify.

The EDGS 2019 were developed prior to the Climate Change Response (Zero Carbon) Amendment Act 2019 being passed and do not necessarily reflect its intent, so:

- should we vary the EDGS 2019 to reflect New Zealand achieving net zero carbon by 2050?
- if so, what extent of electrification (versus alternatives such as hydrogen, biomass, etc) should be reflected? Low, medium or high will suffice. We note that this choice is related to some of the variable settings above eg solar PV output and EV demand.

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
Net zero carbon by 2050	Y/N	Y/N	Y/N
Extent electrification	L/M/H	L/M/H	L/M/H

[25] The effects shown across the table are for illustration only.

Renewable generation goals

The government has stated that it will bring forward their existing target of 100% renewable electricity generation by 2035, by five years, to 2030.

This is more ambitious than achieving net zero carbon by 2050 and would likely require immediate action by the electricity industry. The EDGS 2019 all reflect renewable electricity generation being 95% of the generation mix by 2050, with the balance being gas-fired generation. The 95% occurs without having to force an outcome, as the cost of renewable generation reduces. Options for achieving 100% renewable generation are limited. The gas-fired generation not only balances the intermittency of wind and solar generation, but is also available during dry hydrological years. One alternative could be to over-build renewable generation, but that would be expensive.

a) Should we include scenario variations which reflect 100% renewable electricity generation and if so, by when?

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
Reflect renewables target	Y/N	Y/N	Y/N
Target date [26]			100% by 2030

Reference: Percentage of renewable generation by 2050 of various scenario sets			
EDGS 2019	94.9	94.8	96
BEC[27]		91	91
WiTMH	100	100	100

Carbon price

It is not plausible to review the carbon price assumption in detail within the scope of this exercise. However, we would be interested in panellists' opinions about whether the range represented in the EDGS 2019 is still appropriate. The panellists are asked to consider the following questions:

a) Is the carbon price included in the Reference scenario reasonable and is the range across the scenarios reasonable? If not, should the Reference scenario cost and range by higher or lower?

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
C price \$US/t CO2e by 2050	Y/N	Y/N	Y/N

Reference: Carbon price by 2050 in \$US/t CO2e of various scenario sets			
EDGS 2019	\$43/t	\$43/t	\$100/t
BEC		\$62/t	\$110/t
WiTMH	\$55/t	\$55/t	\$100/t

[26] The target dates shown across the table are for illustration only.

[27] We note that the BEC scenarios reflect replacing the existing Huntly plant with a coal fired plant using CCS technology

TPM changes

The Electricity Authority's review of the Transmission Pricing Methodology (TPM) may influence electricity participant investment decisions in the future. To that extent, the TPM changes may also affect the transmission grid. Should the demand and supply scenarios reflect the possible effects of the revised TPM and if so, how?

Indicative response			
	Transpower variations EDGS 2019		
	Reference	Low	High
TPM effect	Y/N	Y/N	Y/N

Any other variations?

Are there other variations we should consider to the EDGS 2019?

Next steps

We recognise that the variations discussed in this meeting and the variable settings recommended, will effectively result in many more scenarios than the five EDGS 2019.

Our intention following the November 5 online meeting, is to derive scenarios that cover the range of uncertainty discussed.

We will develop as many demand and supply scenarios as required, but then derive combinations which are variations of the EDGS and which would result in diverse transmission grid outcomes.

In the December 2 meeting we will:

- outline the resultant set of supply and demand scenarios
- outline the combinations we consider are variations of the EDGS 2019 and which will be suitable for our ALSIR and NZGP investigations
- seek feedback on whether those variations are reasonable
- seek feedback on reasonable weightings for those scenarios