MEMORANDUM

Date:	**23 January 2026**
To:	**Te Runanga o Ngāi Tahu**
From:	**Lodestone Energy**
Re:	**Mackenzie Area Transmission Capacity and Energy Market Cumulative Effects**

Introduction

The purpose of this document is to provide a short summary of the regional transmission capacity in the Mackenzie area. The discussion is relevant from the cumulative effects perspective because it is important to know what practical and economic limitations exist to the development of new solar generation in the area. There are two principal questions:

1. From a physical perspective what line and substation capacity exists in the region and how many solar farms could this support?
2. What is the probable effect on the energy market of multiple solar projects with coincident generation being dispatched at the same time? Would this effect market prices in such a way that would discourage further development?

This memo seeks to provide a brief overview of both issues.

Regional Transmission (Physical) Capacity

Figure 1 shows a map of the area and the major transmission lines along with their summer capacity shown in MVA below. For the purposes of high-level understanding, MVA is approximately the same as MWac or nameplate capacity of a generation facility. This information is a stylised version of the information that is freely accessible on Transpower's Envision Opportunities website and transmission circuit ratings on their freely published single line diagram.

For the most part, the lines in the area are high capacity 220 kV lines that were built during the development of the major Waitaki hydro schemes in the 1960s and 1970s. The network historically was built with redundant capacity to ensure that the failure of any one line does not cause a loss of supply. The network was also built with future expansion in mind and as such is one of the highest capacity transmission areas in NZ. Importantly, the lines also service two quite different regions of the country, with the AC lines feeding into Christchurch and south and the HVDC line that feeds Wellington and north.

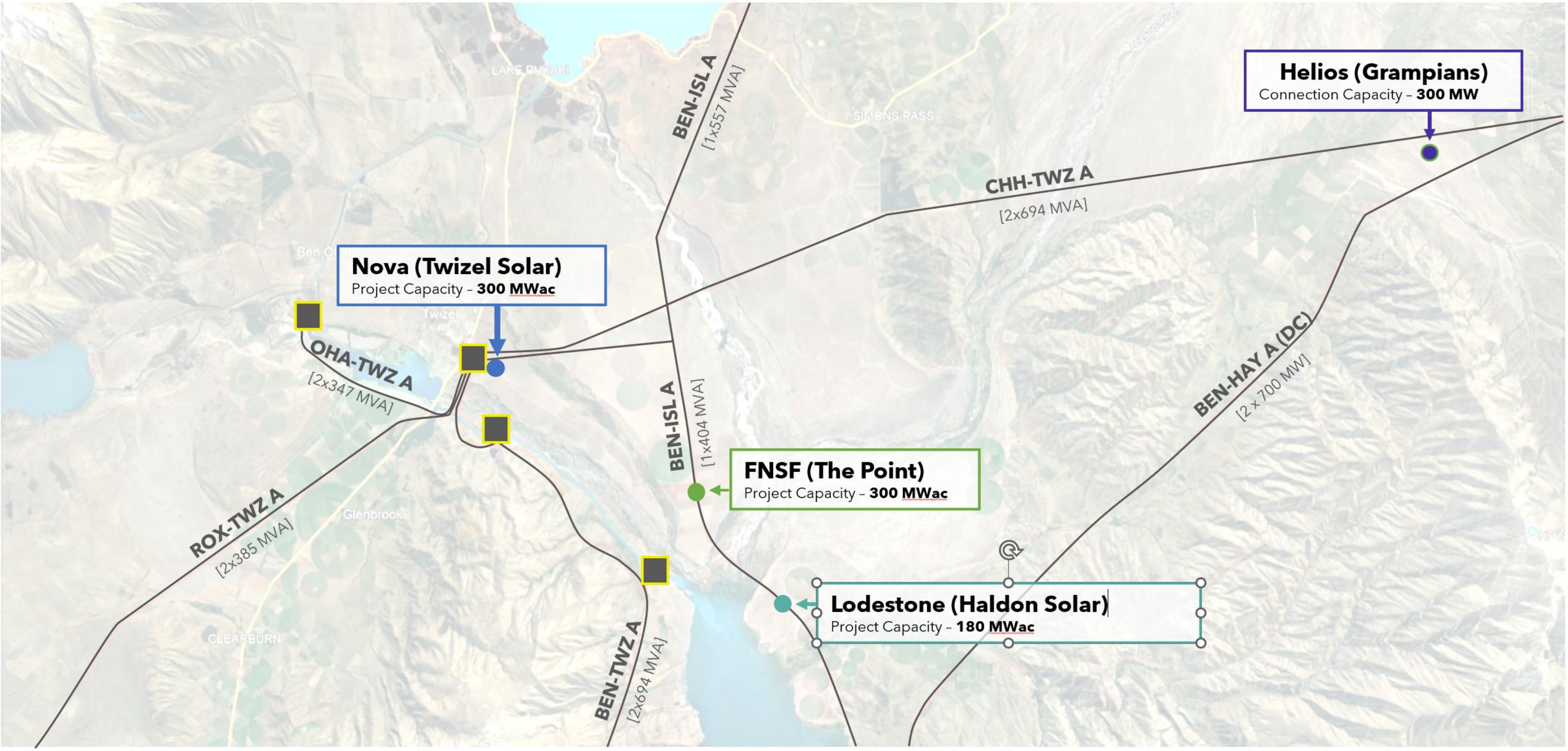

Figure 1: Regional Transmission Capacity

The map also shows the four solar projects that have either submitted substantive applications (FNSF, Lodestone) or have been referred to the fast-track process (Nova, Helios). From a simplified reading of the diagram, it is noted that there is mostly sufficient transmission capacity to accommodate all four projects.

For example, the Nova project is proposed to directly connect to the existing Twizel substation which has ten 220 kV lines connected to it. The Helios project will connect to one of the 694 MVA circuits running adjacent to the site.

The Lodestone and FNSF projects are interesting from a transmission perspective, largely because they connect into the same transmission circuit, which has a nominal summer rating of 404 MVA that is slightly smaller than the 480 MW combined capacity of both projects. However, there are two other factors that make the possibility of constraint lower:

1. Power flows are not uni-directional. Therefore, a portion of the generation from each of the solar farms will travel towards the Southern terminal of the line at Benmore, and a portion will travel to Twizel. In a perfect world, this split would be 50/50 which would in effect double the capacity of the line to 808 MVA and provide more than enough capacity for both projects. However, due to the complex nature of power flows, the split will not be even, although it will certainly mean the actual capacity is higher than 404 MVA.
2. Existing power flows on the circuit mean that the spare capacity on the circuit is not 404 MVA, rather a little less. This counter-balances the prior point to some extent.

The residual effect means that if both projects do proceed at their nominal capacities, there remains a small residual risk that they will be curtailed by a small fraction to avoid over-loading the connected transmission circuit during the hottest, and sunniest hours of the year[1].

A brief power flow analysis undertaken by Lodestone, examining the situation, has shown that the circuits could only be forced to overload in the case of very low Waitaki hydro chain generation (Benmore, Aviemore, Ohau, Waitaki), combined with low or Southward power flow on the HVDC link.

For otherwise equivalent sources, Transpower's market systems generally allocate such a constraint on a pro-rata basis, so in such an event we could expect The Point to be constrained by around 50 MW and Haldon by around 30 MW, neither of which is massively detrimental to the project economics for short periods. It is further noted that the rating of the circuit increases to 450 MVA in spring/autumn (shoulder periods) and 492 MVA in winter, meaning that this constraint is only possible during rare summer periods.

The other proposed sites in the region are connecting to other circuits or major substations with ample capacity for their generation. This is especially true, when consideration that hydro's either won't or can't (if dry) run in the same coincident periods.

In summary, for the four projects currently being considered by the fast-track process, a simplified desktop assessment shows that there is considerable spare transmission capacity. There is a

[1] The transmission core grid is operated to N-1 security which means that it must be able to remain intact for the loss of any one component. As such, the analysis presented here is simplified and there are complexities around contingencies of the connected circuits and other circuits in the region. However, there are potential solutions to some of these challenges with special protection schemes and so forth, so although the analysis is simplified the general principles remain sound.

possibility that Haldon and The Point may cause some small transmission curtailment for each other, but this is not likely to occur frequently. Transmission physical capacity is unlikely to be a major barrier to the currently contemplated projects. However, as the next tranche of projects get considered, this may start to become more significant.

Market Economic Cumulative Effects

Solar generation is highly predictable because it is possible to predict the position of the sun in the sky thousands of years in advance. For solar farms that are very close geographically, for which all the Mackenzie solar farms are, the proportional output from each site will be nearly identical.

NZ has a nodal price market system. This means that all generation plants make "offers" into the system. The market system then decides what generation to "dispatch" to meet the required load. The lowest price generation is dispatched first and the higher priced generation is progressively stacked up until the required load is met. All generation then gets paid the cost of the marginal price offer.

As an example, consider the hypothetical scenario of summer 2026/27[2], shown in Figure 2. The South Island will have approximately 220 MW of commissioned solar generation which adds cumulatively to the approximately 130 MW of wind generation and > 3,500 MW of hydro generation. Because the wind and solar generation "fuel" is not controllable, and there is zero marginal cost to generation (no fuel cost) then it is almost always bid into the market at the minimum bid of $0.01 to ensure that it is on the bottom of the stack and gets dispatched.

Hydro generation typically bids into the system in various tranches based on the perceived value of the water. This depends on hydrological conditions, but there are usually several "tranches" with different values.

During a load peak in summer there will be approximately 2,400 MW of load. To meet the demand the System Operator will need to dispatch all of the tranche 2 hydro and a little bit of the tranche 3. As the tranche 3 hydro has offered at $80 / MWh, all of the generation that gets dispatched (including the wind and solar that bid in at $0.01) gets paid $80 / MWh for that trading period.

[2] Note as a caveat that this is a highly simplified presentation of the market but serves to illustrate the general principles. In reality, location also matters due to losses. The HVDC link mostly acts as a large load meaning that some of the South Island generation is often powering the North Island.

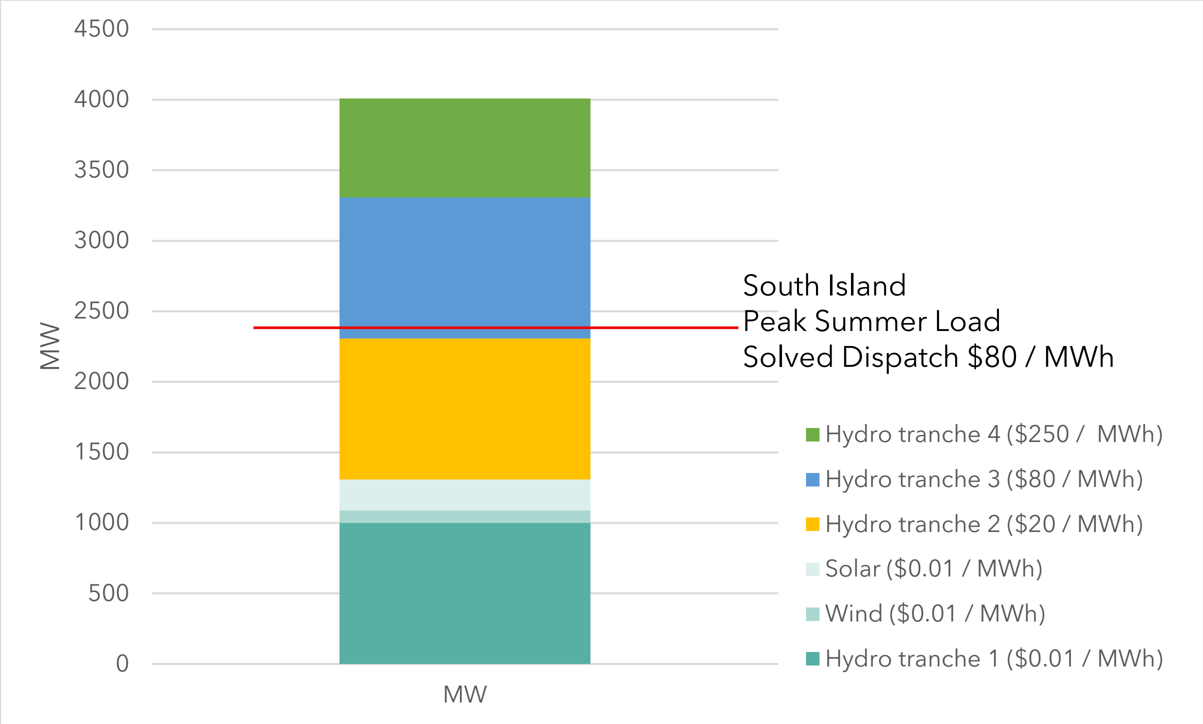

Figure 2: Base Case Summer 2026/27

Now consider a hypothetical situation in summer 2030/31 shown in Figure 3. In this scenario both Haldon and The Point have been commissioned along with Kaiwera Downs wind farm. Peak demand remains at approximately 2,400 MW. In this case, the solar has displaced the tranche 3 hydro and the solved dispatch price is now $20 / MWh. This is great for power consumers, but this price would be unsustainable for generators over the long term.

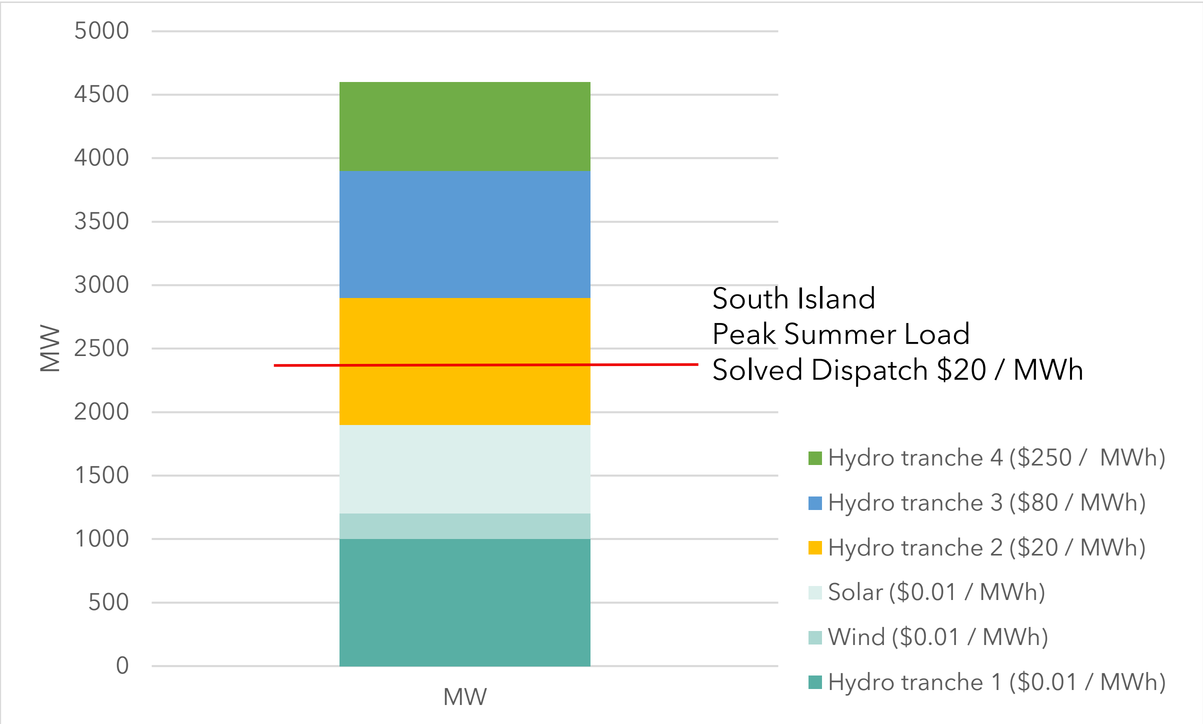

Figure 3: Base Case Summer 2030/31

In summary, coincident solar generation in the South Island and NZ is likely to significantly drive nodal dispatch prices down during the day. The average price received for solar generation will be less than the average market price. There is therefore a significant economic disincentive to the construction of additional large solar plants, unless there are significant increases in electricity demand. We can therefore conclude that based on present market dynamics it appears unlikely that more than one or two large South Island projects will be able to obtain project finance and get constructed.