Haldon Solar Project Economic Impact Assessment

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m.e consulting

Haldon Solar Project

Economic Impact Assessment

Prepared for

Lodstone Energy Limited

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Executive Summary

This Economic Impact Assessment evaluates the proposed Haldon Solar Project, a large-scale photovoltaic solar farm planned for Haldon Station in the Mackenzie District, Canterbury. The project, developed by Lodestone Energy Limited, seeks to support New Zealand's transition to a low carbon economy by harnessing the Mackenzie Basin's tier 1 solar resource. This assessment is intended to inform decision-making under the Fast-track Approvals Act 2024 and provides a comprehensive analysis of the project's economic effects at local, regional and national levels.

The proposed solar farm will occupy a 320-hectare site adjacent to the Haldon Arm of Lake Benmore. It will comprise approximately 360,000 photovoltaic modules, 48 power stations and a substation connected to the National Grid. The site is expected to generate approximately 370 GWh of renewable electricity annually, which can meet the energy needs of around 45,105 households.

The project's construction phase is anticipated to span 14-18 months and will require an estimated capital expenditure of [redacted] of which [redacted] will be spent in New Zealand. Annual operational costs are estimated at [redacted] over the modules' 35-year lifespan.

The economic impacts of the Haldon Solar Project are assessed using a Multi-Regional Input-Output (MRIO) model, capturing direct, indirect and induced effects.

- **Construction Phase Employment**: The project is expected to support approximately 235 - 242 direct jobs, 290 - 291 indirect jobs, and 219 - 220 induced jobs. These figures align with LEL's estimate of 250 - 300 total jobs during construction.
- **Operational Phase Employment:** Approximately 5 - 6 direct jobs per year will be sustained during the operational phase, reflecting ongoing maintenance and monitoring activities. This also aligns with LEL's estimates of 3-4 on-site jobs.
- **Value Added**: The real present value of economic value added is estimated at $134.0 million - $135.4 million (direct + indirect) and rises to $189.0 million - $189.5 million when induced effects are included.

We also conduct additional analysis to show the estimated value of electricity produced each [redacted] Additionally, by displacing fossil fuel generation, the project will avoid significant carbon emissions compared with alternative forms of energy generation.

The Haldon Solar Project aligns strongly with national and regional policy objectives, including:

- **Emissions Reduction Plan:** Supporting New Zealand's goal of achieving net zero carbon emissions by 2050.
- **National Policy Statement for Renewable Electricity Generation (NPS-REG):** Contributing to the Government's aspiration for 100% renewable electricity generation by 2030.
- **Mackenzie District Plan:** Promoting the development of renewable energy generation in the region while minimizing adverse environmental impacts.

- **Energy Security and System Resilience:** Diversifying supply, which is currently dominated by hydroelectric power in the South Island, helps to guard against various energy risks, including natural disasters. Solar generation also offers a natural hedge against drought conditions and fluctuating hydro output by providing consistent daytime generation.

Overall, the proposed Haldon Solar Project is expected to deliver significant economic, environmental and energy system benefits. It will make substantial contributions to local employment, while enhancing energy security and reducing emissions. The project is well-aligned with New Zealand's objectives for economic prosperity and a low carbon future.

1 Introduction

1.1 Background

This report is an Economic Impact Assessment (EIA) of a proposed photovoltaic solar farm on Haldon Station in the Mackenzie District, Canterbury. The project, proposed by Lodestone Energy Limited (LEL), involves the development and ongoing management of the site. This assessment provides an independent analysis of the potential economic effects of the solar farm, supporting LEL's application for approvals under the Fast-track Approvals Act 2024 (FTAA). It outlines the anticipated benefits, costs and broader economic impacts on the local, regional and national economies.

Market Economics Limited (M.E) has been engaged to undertake this EIA. M.E is an independent economic consultancy with extensive experience in renewable energy impact assessments. This report reflects independent analysis and is designed to inform decision-making by the expert module appointed to determine the substantive application for approvals under the FTAA.

1.2 The Application

Lodestone Energy Limited is a New Zealand-based renewable energy company proposing to construct and operate a solar farm in part of a 320 ha site adjacent to the Haldon Arm of Lake Benmore.[1] The project aligns with New Zealand's transition to a low-carbon economy by increasing renewable energy capacity while simultaneously reducing dependence on fossil fuels. The project also seeks to leverage Mackenzie District's tier 1 solar resource and existing transmission infrastructure, enhancing energy security in the region.

Haldon Station is within an area classified as an Outstanding Natural Landscape (ONL) in the Mackenzie District Plan. As such, visual and environmental considerations have been reviewed in line with landscape protection measures to ensure the project is not contrary to regional planning objectives.

At present, the land is unproductive; pest control is the primary activity undertaken on it. The proposed solar farm is designed to generate 220MWdc and 180MWac, which equates to approximately 370 GWh of renewable electricity annually, capable of supplying the energy needs of approximately 45,105 households.[2] It will include approximately 360,000 photovoltaic modules, approximately 48 power stations, and a substation facilitating connection to the National Grid.[3] Modules will be mounted on single axis tracking systems to optimise sunlight capture throughout the day.

The project's construction phase is expected to span 14-18 months.

[1] Haldon Power Station Layout – RatedPower, 2025-02-11

[2] Based on average consumption in Canterbury, 2024 (8203 kWh). Residential consumption league table – Electricity Authority – Te Mana Hiko

[3] Haldon Power Station Layout – RatedPower, 2025-02-11

The project's development plan incorporates several design measures intended to mitigate adverse environmental and visual effects. This includes maintaining setbacks from key roads and utilising existing vegetation to provide screening.

1.3 Data

This assessment is based on data provided by LEL, supplemented by publicly available information, national statistics and economic analysis. Information sources include:

- LEL's technical project documentation, including construction plans, expenditure details and the reports of other experts.
- Statistics New Zealand data on regional employment patterns, GDP and output, sectoral contributions.
- The Treasury's Extended Cost Benefit Analysis (CBAx) model.
- MBIE tourism and tourist spend data.
- The Electricity Authority – Te Mana Hiko data on wholesale energy prices.
- Academic literature and research on energy generation sources, renewable energy's economic impacts and climate resilience.
- Internal M.E analysis.

Where assumptions are required, these are clearly stated. Conservative estimates have been applied to ensure the findings reflect realistic economic outcomes.

1.4 Structure of the report

This report is structured as follows:

- **Section 2** provides an overview of the Mackenzie District's economic context and the role of renewable energy within New Zealand's electricity market.
- **Section 3** outlines the economic effects of the project, including anticipated outputs, employment effects, and additional impacts such as emissions reductions.
- **Section 4** presents conclusions, summarising the economic implications of the Haldon Solar Project.
- **Annexes** include a literature review, regulatory analysis, and details of the economic modelling approach.

2 Project Context

2.1 Economic Context

Haldon Station is located in the southernmost corner of Mackenzie District, near its boundary with Waitaki District and Waimate District. The population of Mackenzie District is relatively small and dispersed, with Twizel, Lake Tekapō, and Fairlie being the primary service centres. At 5,800, its population represents just 0.8% of the Canterbury Region's total (694,400).

Table 1 - Mackenzie District Population

Territorial Authority	2024 population estimate	Share of Canterbury total
Mackenzie District	5,800	0.8%
Waimate District	8,850	1.3%
Waitaki District	25,100	3.6%

Mackenzie District is a predominantly rural economy with a strong reliance on agriculture and tourism. It is known for outstanding natural landscapes, which attract significant visitor activity, supporting local hospitality, retail and recreational services. Nearly half of workers in the District are employed in one of two sectors:

1. Agriculture, Forestry and Fishing
2. Accommodation.

These two sectors are also critical in the neighbouring Waimate and Waitaki Districts. Other than manufacturing in Waimate – which is focused on milk and cheese processing, an activity adjacent to its agricultural output – no other sector constitutes more than 7% of the employment base in any of the three districts. This underlines the dominance of the key sectors.

Table 2 - Local Employment Trends

ANZSIC1D	Mackenzie District	Waimate District	Waitaki District
2024 Employment Count			
Agriculture, Forestry and Fishing	627	1,390	506
Accommodation and Food Services	896	78	172
Share of District Employment			
Agriculture, Forestry and Fishing	19%	42%	49%
Accommodation and Food Services	28%	2%	16%

The Canterbury regional GDP was $47bn in 2023, constituting 12.3% of national GDP and making it the second largest region behind Auckland.[4] Christchurch City, the largest urban and economic centre in Canterbury, contributed 72% of this total ($34bn).[5] Its dominance varies by sector, with only 15% of Agriculture, Forestry and Fishing employment but 68% of Construction employment and over 80% of other sectors' employment.

The construction phase of the Haldon Solar Project is expected to draw on both local and regional labour pools, given the limited size of the Mackenzie District workforce and that of adjacent districts. With Haldon Station located approximately 250km from Christchurch (a travel time exceeding three hours), any reliance on Christchurch-based labour would likely necessitate temporary relocation to the project area.

The extent to which construction labour resides within the Mackenzie District will be a key determinant of the project's local economic impact. This will be influenced by factors such as seasonal labour availability, accommodation capacity, and the relative size of ancillary industries. By contrast, the operational phase will require a substantially smaller workforce dedicated to maintenance and monitoring, thereby generating a more limited but steady local employment impact and associated benefits.

2.2 Tourism in Mackenzie District

Tourism is a significant contributor to the Mackenzie District economy, underpinned by the District's renowned natural landscapes, covering much of its area. Most visitors come to the District for the Aoraki/Mount Cook National Park and Lake Tekapō, with 84% of international visitors travelling only to a combination of these destinations and Twizel.[6] Haldon Station is not what primarily attracts visitors.

Tourist activity in the Mackenzie District follows a distinct seasonal pattern, with visitor numbers peaking during the summer months. This surge is driven by favourable weather conditions and strong demand for outdoor activities such as hiking, cycling and sightseeing. By contrast, there is a notable reduction in visitor volumes during the winter months (May to July), reflecting reduced demand for activities outside the District's smaller ski market.

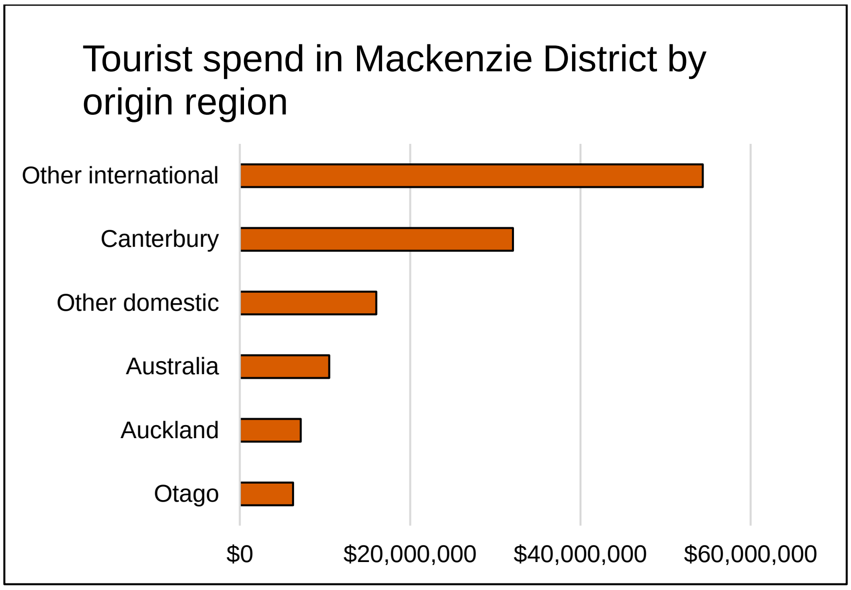
International visitors account for the largest share of spending in the District. These travellers are often drawn to the District's iconic landmarks and tend to engage in higher-value activities such as guided tours, scenic flights and premium accommodation. Domestic tourism also plays an important role, with a significant share of visitors coming from elsewhere in the Canterbury Region.

[4] Regional Economic Tool – MBIE, 2023

[5] GDP by Territorial Authority: Regional Economic Profiles – Infometrics.

[6] New Zealand International Visitor Survey via Te Manahuna Ki Uta / Destination Mackenzie – Mackenzie District Council

Figure 1 - Tourist Spend in Mackenzie District



Tourism activity generates flow-on effects across multiple sectors, including retail, transport and construction. Visitor spending drives demand for infrastructure, property development and support services.

2.3 New Zealand's Energy Market

New Zealand's energy market operates through a combination of regulated transmission and distribution, and a competitive generation and retail market. Electricity is generated from a range of sources. Hydroelectric generation provides for the majority of New Zealand's electricity needs, especially on the South Island, including the Mackenzie District. The Waitaki Power scheme, based in the District, is New Zealand's largest. The national split is shown in Table 3.[7]

[7] Electricity Statistics – MBIE, accessed 19/03/2025. 2023 is the most recent calendar year for which data are available.

Table 3 - New Zealand Electricity Generation (Net GWh)

Generation Source	GWh	Share
Hydro	26,309	60.5%
Geothermal	7,758	17.8%
Gas	4,099	9.4%
Wind	3,206	7.4%
Coal	1,031	2.4%
Wood	408	0.9%
Solar	371	0.9%
Biogas	275	0.6%
Waste Heat	33	0.1%
Oil	4	0.0%

Importantly, this shows the share of electricity generation. Once all energy sources are included (such as fuels for transport etc) only 43% of New Zealand's total primary energy supply comes from renewable energy sources.[8] As consumption patterns shift and the country electrifies further, due to factors such as EV uptake and process heat decarbonisation, there is an opportunity to grow this share with increasing supply coming from renewables.

2.4 Renewable Energy in New Zealand

New Zealand is committed to achieving net zero carbon emissions by 2050. The first Emissions Reduction Plan[9] makes it clear that increasing the share of renewable energy, including solar power, is a key component of this endeavour. Accordingly, the Government also has an aspirational target of 100% renewable electricity generation by 2030.[10]

Solar energy is expected to play a pivotal role, contributing to the country's efforts to reduce greenhouse gas emissions and enhance energy resilience. Transpower forecasts that solar will deliver 9% of New Zealand's electricity in 2050, and that 100% of electricity generation will be from renewables by 2045, up from 87% in 2022.[11] As a growing share of energy is produced renewably and alternative sources are phased out, technologies such as electric vehicles and the associated infrastructure will proliferate. Figure 2 shows that these trends are already underway in wind and solar. Between 2013 and 2023 the number of Gigawatt hours (GWh) produced by solar increased from 7 to 371.[12] This trend has accelerated further in the time since this last data point.

[8] Energy in New Zealand – MBIE, 2023

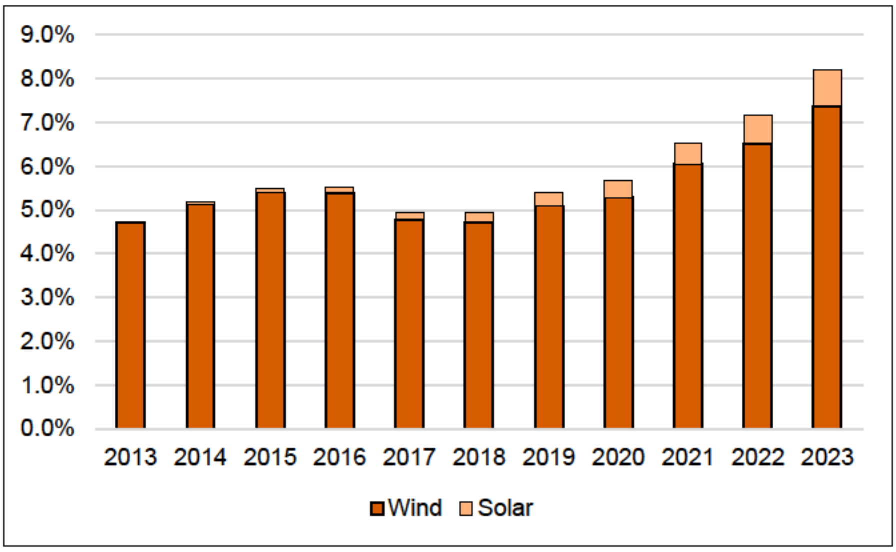
[9] New Zealand's First Emissions Reduction Plan – Ministry for the Environment

[10] Consultation on NPS for Renewable Energy Generation – Ministry for the Environment

[11] Figure 9, Whakaman I Te Mauri Hiko – Transpower (2020)

[12] Annual Electricity Generation Data Tables – MBIE (2023), (accessed 19/03/2025)

Figure 2 - Wind and Solar Shares of Net Generation (GWh) in New Zealand (%)



Global solar installation trends reflect a significant shift in the energy landscape. According to the International Solar Energy Society, solar power is projected to surpass other forms of energy generation in the coming years, including nuclear generation by 2026, wind output by 2027, hydroelectric generation by 2028, gas-fired power plants by 2030 and surpass coal-fired generation by 2032.[13] New Zealand's energy strategy aligns with this global pattern, with solar expected to contribute significantly to its renewable mix. Indeed, if New Zealand aligns with global trends, Transpower's forecast of 9% could be an underestimate

[13] The International Solar Energy Society via The Economist – Solar power is going to be huge. (20/06/2024)

3 Economic Effects

3.1 Approach

This section assesses the economic impacts of the proposed Haldon Solar Project. The assessment quantifies economic effects at local, regional and national levels, focusing on key indicators such as output, employment, and value-added effects.

The evaluation incorporates:

- A "business-as-usual" scenario reflecting no active economic use on the site;
- A "project" scenario reflecting the installation and operation of the proposed solar farm; and
- An assessment of the wider economic benefits, including emissions reductions and energy security improvements.

The assessment employs a Multi-Regional Input-Output (MRIO) model to capture the direct, indirect, and induced impacts associated with the project. Economic effects are presented in both annualised terms and as a cumulative present value over the project's initial 35-year operational life.

3.2 Business-as-usual Scenario

The site currently has no active economic output, and the "business-as-usual" scenario assumes no sheep grazing or other productive agricultural activities. Consequently, there are no direct employment impacts or revenue streams associated with the site in its current state. This scenario assumes that if the solar farm is not consented, the site will remain in its current unproductive state.

3.3 Solar Farm Outputs

The proposed Haldon Solar Project is expected to deliver 220 MWdc of peak capacity and produce an estimated 370 GWh per annum, enough to power approximately 45,105 homes. This generation capacity would contribute significantly to New Zealand's renewable energy goals while reducing reliance on fossil fuel generation.[14]

3.3.1 Electricity Generation Activities

Constructing and operating the solar farm will deliver two strands of quantifiable effects:

- local (domestic) capital expenditure on labour and inputs; and

[14] Based on average consumption in Canterbury, 2024 (8203 kWh). Residential consumption league table – Electricity Authority – Te Mana Hiko

- energy generated by the site, which can subsequently be consumed.

Several additional effects are assessed and discussed in section 3.5, such as those relating to increased energy supply and emissions costs.

Table 4 contains the core inputs for calculating the site's output. EnergyLink provides independent price forecasts for electricity prices in specific locations, which includes a GWAP to TWAP ratio, recognising the price impact of solar generation being concentrated at peak sunlight hours and being highly correlated with other solar generation. This lowers the price received for this electricity.

The GWh produced is estimated as the median statistical value based on a production forecast using a typical meteorological year. We estimate the wholesale energy price using EnergyLink price forecasts, which are adjusted using ratios to recognise that over time solar generation will receive a lower price than other forms because it is concentrated during the middle of the day and highly correlated with other solar. The output value of the electricity generated is estimated as [redacted] based on the average forecasted price for 2025 - 2050. Going forward, we assume that the efficiency of the solar modules will degrade by 0.4% per year[15], which would mean they are still ~85% productive at the end of their anticipated 35-year lifespan.

Table 4 - Electricity Value, Haldon

Description	Point Estimate
Installed capacity (MWp)	220.4
Wholesale electricity price ($/MWh)	$138
Site output per year GWh	370
Electricity value per year	[redacted]

3.4 Economic impact analysis

Next, we calculate the employment and the domestic investment impact of the project. LEL has built a number of solar farms around New Zealand and has other projects in either construction or planning phases. This experience enables LEL to use informed estimates of expected employment and capital outlay, both within New Zealand and internationally.

To calculate how the change in economic stimulus feeds through the economy, we use a bespoke Multi-Regional Input-Output (MRIO) model. The model has been set-up to capture the interplays between sectors in the following geographies:

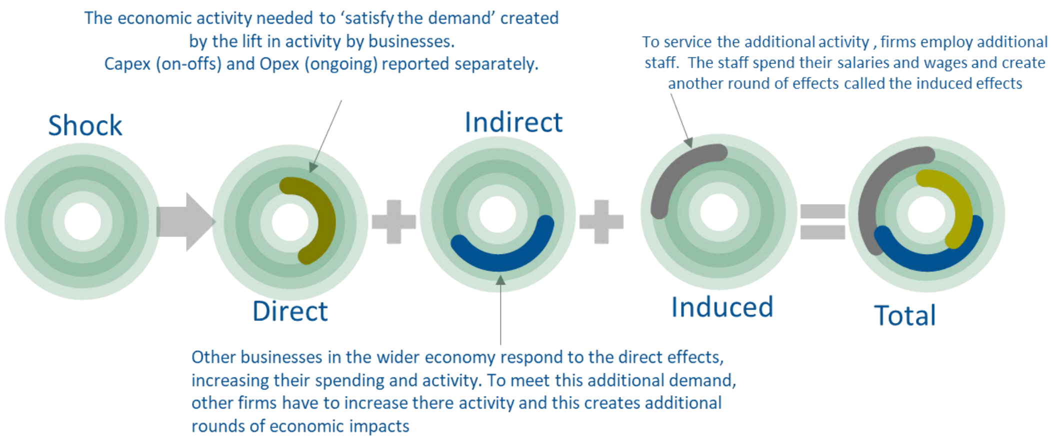
- Mackenzie District,
- Rest of Canterbury Region,
- Otago Region,
- Rest of the South Island, and

[15] Annual power attenuation – Bifactual Dual Glass Monocrystalline Module specification

- North Island.

This structure enables the model to estimate the value added and employment effects generated as transactions propagate through these interconnected economies. The MRIO model tracks how spending in one sector drives further economic activity in other sectors. For example, expenditures on construction materials, professional services, and local labour during the solar farm's development will generate subsequent rounds of economic activity, amplifying the project's overall economic contribution.

Figure 3- Direct, Indirect and Induced Impacts Definitions



The model's outputs are expressed in terms of value added and employment:

- **Value Added**: This measure, similar to GDP, reflects the incremental value created within each geography as a result of project expenditure. This includes wages, operating surpluses and indirect taxes.

- **Employment (MECs)**: Employment impacts are measured by a Modified Employee Count (MECs), which captures both employees and working proprietors to provide a comprehensive view of job creation.

Value added and employment outcomes are calculated for both direct effects (e.g., construction workers and suppliers), indirect effects (e.g., manufacturing inputs) and induced effects (e.g., household spending enabled by wages earned in these sectors). Additional information about IO modelling and its limitations is provided in Annex A1. Introduction to IO Modelling and Caveats.

3.4.1 MRIO modelling parameters

The project has a capital budget [redacted] which is anticipated to be split between material, plant/equipment, subcontracts and labour as shown in Table 5.

Table 5 - Cost Categorisation

Cost Category	Share
Material	0.61
Plant / Equipment	0.1
Subcontract	0.06
Labour	0.23

It is our understanding that the subcontracting and labour costs will be domestic, but nearly all material and plant/equipment will be imported. **This results in estimated domestic capex o**[redacted] Once constructed, there will be operational costs for the project. We focus on local spending, omitting costs such as insurance, administration, levies and rates. This spending is estimated at [redacted] annually.

We run two scenarios with different input configurations. In both models we calculate the effects over the 35-year operational lifespan of the modules. Given the lease agreement, at this time it is expected that these modules will be decommissioned and new modules installed at the conclusion of the period. The new modules could then operate for a further c35 years. Alternatively, the site could be broken down, leaving minimal trace on the visual landscape.

The MRIO model includes 109 economic sectors. The anticipated spending is mapped to the economic sectors that are likely to receive that spending based on the categorisation of activities in LEL's activity cost plans and the associated industries that these jobs fall within. How we allocate the inputs for the MRIO is summarised in Table 6. We supplement the anticipated activities provided by LEL with assumptions about the sectors in which spend would take place based on comparable job codes (ANZSIC06). Using this, we assess the locality in which this spend might occur. This is done by analysing the size and relationships of Mackenzie's economy in the specific sectors relevant to this project.

In scenario 1, we assume that 75% - 85% of construction activity will be serviced by businesses in the greater Canterbury region, with 10 – 20% in Mackenzie and a notional 5% in Otago due to proximity. In scenario 2 we allocate all the construction spend in Canterbury, with the expectation that Mackenzie District can increase its gross output in each construction-oriented sector by 20%. In reality, given the size and structure of Mackenzie's economy, estimating the project's spillover effects on adjacent sectors is challenging. We do not have data on comparable projects in the district to test our assumptions. Much will depend on factors such as whether workers move to the area or commute from proximate Districts, which itself will depend on the accommodation and services in Mackenzie District; how much latent capacity exists in Mackenzie District; and whether materials and equipment can be sourced from nearby or whether a large distribution network is required.

For operational spending, we divide the [redacted] annual spending between

- Non-financial asset leasing (land lease costs),
- Electricity transmission and distribution (Connection costs),
- Electricity generation and on-selling (on-site staff and specialist callouts), and
- Construction services (on-site staff and specialist call outs).

We assume that all this spending occurs within the Mackenzie District. The only difference between the scenarios is that scenario 1 allocates one quarter of the on-site and specialist spending to construction services; in scenario 2, it is one third The individual elements of operational spending are withheld for commercial sensitivity.

Table 6 - MRIO inputs

Sector	Cost assigned	Mackenzie District	Rest of Canterbury Region	Otago Region
Scenario 1				
Construction stage	[redacted]			
Heavy and civil engineering construction	[redacted]	20%	75%	5%
Non-residential building construction	[redacted]	20%	75%	5%
Construction services	[redacted]	10%	85%	5%
Operational stage (annual cost)	[redacted]			
Non-financial asset leasing		100%		
Electricity transmission and distribution		100%		
Electricity generation and on-selling		100%		
Construction Services		100%		
Scenario 2				
Construction stage	[redacted]			
Heavy and civil engineering construction	[redacted]	31%	69%	
Non-residential building construction	[redacted]	12%	88%	
Construction services	[redacted]	7%	93%	
Operational stage (annual cost)	[redacted]			
Non-financial asset leasing		100%		
Electricity transmission and distribution		100%		
Electricity generation and on-selling		100%		
Construction Services		100%		

The two scenarios produce very similar outputs for the construction phase, particularly on value added because the relationship between gross outputs and value added is calculated at a sector level within each region, and most of the changes are between how much Mackenzie can contribute itself compared with the rest of the region. The employment is based on specific employment trends within each geography, meaning these vary more. The total outputs somewhat obscure the distribution of construction jobs compared with operational jobs. These splits are shown in The Annex: A2. MRIO outputs.

Overall, the construction phase is expected to support around 235 – 242 direct jobs, 290 – 291 indirect jobs and 219 – 220 induced jobs. These figures are in line with LEL's own estimates of 250 – 300 jobs through the construction stage. During the operation of the farm, we estimate 5-6 direct jobs per year, which is slightly higher than the 3-4 staff that LEL anticipate will be based on the site full time. This figure also accounts for the aggregation of time spend by specialists and other off-site roles.

Value added impacts are in real present value terms, discounted at 2% per year, in accordance with the Treasury's most recent guidance.[16] This means that employment per unit of value added increases over the operational lifespan of the project.

The real present value of value added is estimated at $134.0m - $135.4m (direct + indirect), rising to $189.0m - $189.5m when including induced effects. Given the lack of economic activity on the site in the BAU scenario, this is also judged as the net present value of the capital and operational expenditure.

Table 7 - Value Added MRIO outputs

Total Value Added ($m)			
Region	Direct	Indirect	Induced
Scenario 1			
Mackenzie District	32.8	15.2	8.3
Rest of Canterbury Region	20.1	38.2	23.9
Otago Region	1.2	5.4	2.4
Rest of South Island	0.0	4.8	1.5
North Island	0.0	17.7	18.0
Total	**54.1**	**81.3**	**54.1**
Scenario 1			
Mackenzie District	33.2	14.1	8.8
Rest of Canterbury Region	21.5	38.6	24.7
Otago Region	0.0	4.5	1.9
Rest of South Island	0.0	4.7	1.6
North Island	0.0	17.4	18.0
Total	**54.7**	**79.3**	**55.0**

[16] Discount Rates – NZ Treasury guidance. Accessed 18/03/2025

Table 8 - Employment MRIO Outputs

Total Employment (MEC years)			
Region	Direct	Indirect	Induced
Scenario 1			
Mackenzie District	232	35	5
Rest of Canterbury Region	393	590	367
Otago Region	29	66	41
Rest of South Island	0	60	32
North Island	0	196	213
Total	**653**	**948**	**659**
Scenario 2			
Mackenzie District	264	36	5
Rest of Canterbury Region	423	611	381
Otago Region	0	50	33
Rest of South Island	0	61	32
North Island	0	194	212
Total	**687**	**952**	**663**

3.5 Additional Impacts

The preceding analysis outlines the primary quantifiable impacts of the project; however, it does not account for several additional effects that are not easily integrated into present value calculations or Input-Output modelling. Despite their exclusion from quantitative assessment, these factors remain important considerations within the broader decision-making framework, particularly given their relevance to regulatory and policy objectives.

3.5.1 Landscape effects

Boffa Miskell has undertaken a landscape assessment of the site, which includes visual and landscape effects. The site is proposed within an Outstanding Natural Landscape, which covers the Mackenzie Basin.

The nearest publicly accessible views are approximately 100m from the site, and the likely viewing audience is deemed to be "campers, recreational visitors, particularly those involved in water sports and fishing, occasional tourists and 4WD enthusiasts".[17] It is notable that Lake Benmore is also characterised by hydroelectricity infrastructure, which reduces the visual contrast between the proposed solar farm and surrounding environment. Consequently, the landscape assessment concluded that the effects on landscape values would be neutral. Potential adverse visual effects are assessed as low to moderate, and no more than minor.

[17] Landscape Effects Assessment – Boffa Miskell (19/03/2025 – p21.)

From an economic perspective, any effects on tourism or visitor amenity are expected to be minimal. The project is unlikely to influence international visitor patterns or spending decisions. While some domestic and local visitors may perceive a change in the landscape, these effects are considered negligible. The site's location largely limits public visibility. As such, the economic implications of landscape effects are deemed insignificant and have not been quantified.

3.5.2 Emissions Abated

Electricity generation from renewable sources carries various environmental implications. The manufacturing and transportation of solar modules and related components generate emissions, as do the installation and construction phases of the project. Additionally, at the end of their operational life, solar modules may contribute to waste unless effective recycling processes are employed. A scoping study from Australia highlights that materials can be recovered from solar modules, and some can be reused, though optimising these processes requires dedicated sites and the report recommends a nationwide gate fee for solar modules to discourage landfill.[18] This infrastructure does not yet exist in New Zealand, though given the trajectory of solar nationwide, it likely will by 2061. Nevertheless, all environmental costs must be considered alongside the benefits of producing clean, renewable energy.

Using the shadow emissions value of CO2 (lower price path, present – 20230) in 2025 prices[19] and estimates for electricity emissions intensity[20] we can calculate the difference in emissions costs between different forms of electricity generation. The shadow price of carbon is the cost of emissions from a given activity because an equivalent volume of emissions which must be abated elsewhere for New Zealand to meet emissions reduction targets. The cost represents the equilibrium price of this abatement process.

Table 9 shows the emissions per GWh generated over the lifetime of infrastructure with carbon capture and storage. These values therefore account for emissions during manufacture, construction and fuel supply. Importantly, the numbers vary based on the technology and location. Solar Modules, for example, vary between 3,000kgCO2e/GWh to 21,000 using the worst technology in the worst location. Hydroelectricity emissions are largely due to rotting organic matter flooded by a dam, which is likely to be less of an issue for New Zealand's hydroelectric infrastructure. Other than Nuclear, each of the alternatives results in my higher emissions, raising the associated costs.

[18] Scoping Study Solar Module End-of-life Management in Australia – Australian Centre for Advanced Photovoltaics, University of New South Wales, NeoEn

[19] Monetised benefits and costs manual v1.7 May 2024 – Waka Kotahi (NZTA). Prices updated from 2023 average to 2024 using RBNZ CPI series.

[20] Understanding future emissions from low-carbon power systems by integration of life-cycle assessment and integrated energy modelling – Pehl et al. (2017)

Table 9 - Energy Generation and Emissions Costs

Generation Source	kg CO_2-e/GWh	Emissions $ per GWh	Emissions cost for 370GWh	Cost relative to Solar PV
Solar PV	6,000	$932	$344,799	$0
Wind	4,400	$683	$252,852	-$91,946
Nuclear	3,500	$544	$201,133	-$143,666
Coal	109,000	$16,929	$6,263,845	$5,919,046
Gas	78,300	$12,161	$4,499,624	$4,154,826
Hydro	97,100	$15,081	$5,579,994	$5,235,195
Bioenergy	98,400	$15,283	$5,654,700	$5,309,902

3.5.3 Energy Supply Composition

Expanding electricity supply through renewable sources such as solar has significant implications for both energy prices and system resilience. Incorporating solar generation capacity in the Mackenzie District and the broader South Island offers several strategic advantages:

- **Diversification of Supply:** Solar energy production occurs during daylight hours, particularly in summer months when regulating the water levels in rivers and lakes becomes increasingly important. While the timing of generation is not critical for seasonal storage, the 370 GWh of annual generation from Haldon directly offsets the need to use 370 GWh of stored hydroelectric energy, preserving valuable water resources for periods of low renewable generation or peak demand.

- **Dry-Year Risk Mitigation:** New Zealand's reliance on hydro makes the system vulnerable to drought conditions. Solar generation provides a natural hedge by maintaining strong output during dry spells, which are often accompanied by clear skies and increased solar irradiance.

Additionally, advances in battery storage technology now enable surplus energy generated during peak solar production periods to be stored for use when sunlight is limited or demand increases. This capability enhances grid stability, reduces reliance on backup generation sources and mitigates the need for costly grid infrastructure upgrades that would otherwise be required to manage peak demand.

These benefits support New Zealand’s transition to a low-emission economy by enhancing the resilience of the national grid and reducing reliance on fossil fuel generation, both now and in the future. The proposed solar farm should not displace any electricity supply that currently contributes to grid stability. Combined with improving battery storage solutions, this ensures that solar generation will integrate effectively with the existing energy system.

3.5.4 Price Effects of Increased Electricity Supply

The equilibrium price effects of increasing energy supply are another relevant consideration within the policy landscape. Increasing the supply of electricity, particularly from a low-cost renewable source like solar, has the potential to reduce wholesale energy prices in some contexts. Solar electricity typically has low marginal costs once the initial capital investment is accounted for, making it a competitive alternative to some alternative generation sources. The New Zealand Emissions Trading Scheme (NZ ETS) further strengthens this dynamic by placing a price on greenhouse gas emissions, which makes fossil fuel-based generation increasingly expensive relative to renewable sources. Assuming these costs are passed on to consumers, expanding solar capacity should improve New Zealand's ability to deliver lower-cost, low-emission electricity.

The dynamics around Mackenzie District must be considered alongside the existing electricity generation infrastructure from hydro sources. Instead of displacing this electricity, there is potential for it to complement it as explained in the previous section. Additionally, as demand for energy increases beyond that which can be serviced by existing hydroelectric generation, sources such as the Haldon Solar Project can help to suppress prices by ensuring sufficiency.

Accurately predicting the magnitude and timing of price changes is inherently complex. The wholesale electricity market is subject to volatility, influenced by multiple factors, including:

- Fossil fuel prices and availability,
- Demand growth patterns,
- The timing and scale of new renewable builds, and
- Investor sentiment and required rates of return. [21]

Despite the ability of sophisticated models to incorporate some of these factors longer term price forecasts, it is beyond the scope of this analysis to assess the precise impact of the Haldon Project on wholesale or retail prices.

[21] Advice on NZ ETS unit limits and price control settings for 2023 – 27 – He Pou a Rangi Climate Change Commission.

4 Conclusion

The proposed Haldon Solar Project represents a significant opportunity to enhance New Zealand's renewable energy capacity while delivering measurable economic benefits at local, regional and national levels. This assessment demonstrates that the project will generate substantial positive impacts across multiple dimensions, including employment, value added, emissions reductions and energy security.

The project's construction phase is expected to provide a meaningful economic stimulus, supporting approximately 235 - 242 direct jobs, alongside additional indirect and induced employment impacts. The operational phase will sustain a smaller but stable workforce over the project's assumed 35-year lifespan, contributing consistent economic value to the Mackenzie District and surrounding regions. We estimate 5-6 direct jobs per year from the operational spending. In total, the project's economic impact is projected to deliver an estimated $134.0m - $135.4m (direct + indirect) of value added, rising to $189.0m - $189.5m when including induced effects.

By introducing a complementary energy source to the Mackenzie District's hydroelectric-dominated energy profile, the solar farm will enhance grid stability and reduce pressure on stored water resources. This diversification will help mitigate risks associated with drought conditions and fluctuating hydroelectric output. Advances in battery storage technology further enhance the project's ability to support peak demand and grid stability. The solar farm is expected to generate approximately 370 GWh of renewable electricity annually, enough to power around 45,105 households.

The project aligns strongly with New Zealand's strategic energy objectives, including the Emissions Reduction Plan, the National Policy Statement for Renewable Electricity Generation (NPS-REG), and the Mackenzie District Plan. By leveraging existing transmission infrastructure and incorporating design measures to mitigate environmental impacts, the project reflects best practice in sustainable energy development.

In summary, the proposed Haldon Solar Project is well-positioned to deliver meaningful economic, environmental and energy system benefits. The project supports New Zealand's commitment to renewable energy expansion, aligns with established policy frameworks, and provides direct economic value to the Mackenzie District and wider Canterbury region. While there is some uncertainty regarding the precise distribution of economic benefits — particularly regarding the extent of spending within the Mackenzie District compared with other parts of Canterbury and the South Island — the project's overall contribution is expected to be positive and substantial.

Annex

A1. Introduction to IO Modelling and Caveats

Input-Output (IO) modelling is widely applied in New Zealand and internationally due to its accessibility and practicality. One of its primary strengths is that the results are straightforward to interpret, making it an effective tool for communicating economic impacts. They are a versatile method for assessing local and regional economic impacts.

Despite its strengths, IO analysis has several limitations that must be considered when interpreting results.

- **Historical Data Dependence:** IO models rely on IO tables derived from recent Supply and Use Tables. While these tables provide a comprehensive snapshot of economic relationships at the time they were created, they may not accurately reflect current sectoral dynamics, particularly if structural changes have occurred in the economy.
- **Spending Allocation Uncertainty:** Estimating the industries in which expenditure will occur — such as for ongoing operations and maintenance — can be challenging. In such cases, assumptions are made based on the best available data. As detailed in the economic impact section, due to Mackenzie District's size, there is some uncertainty around how this project would integrate with existing structures.

In addition to these practical considerations, IO modelling is based on several core assumptions that introduce further limitations:

- **Fixed Input Structures:** IO models assume that the technical relationships between industries remain constant over time. In reality, these relationships evolve in response to technological advancements, relative price changes, product substitution, and the emergence of new industries. As a result, IO models are generally considered most suitable for short-term analysis, where the economic structure is less likely to undergo substantial change. The Supply and Use tables are updated every 4 years by Stats NZ, with the next iteration due soon.
- **Constant Returns to Scale:** The model assumes that input requirements increase in direct proportion to output. For example, a 10% increase in output is assumed to require a 10% increase in inputs. This linear relationship does not account for potential efficiencies or economies of scale that may arise as production expands.
- **No Supply Constraints:** IO models assume that all required inputs are available without limitation. Consequently, the model does not account for potential shortages of skilled labour, materials or other resources that may constrain growth in reality.
- **Static Model Design:** IO models do not account for price changes or dynamic feedback effects. As a result, they cannot capture the interplay between price shifts and demand responses, such as the substitution between labour and capital when input costs change. We attempt to mitigate this somewhat by adjusting for sector-specific price index changes, but this relates to all inputs or outputs in a sector, rather than specifics.

The economic impacts of the project are assessed using two key indicators:

- Value Added: This measure captures all payments to factors of production — land, labour, and capital — while excluding purchases of intermediate inputs. Value added aligns closely with gross domestic product (GDP) at the national level. It reflects the net contribution of economic activities to overall economic growth.
- Employment (Modified Employee Count - MECs): Employment effects are measured in MEC-years, representing the total number of full-time and part-time employees, as well as working proprietors, engaged in economic activity on an annual basis. Importantly, an increase in MEC-years does not necessarily imply that additional individuals are employed. It may instead reflect existing employees working additional hours to meet increased demand.

A2. MRIO outputs

This section contains additional detailed tables from the MRIO modelling

Table 10 - Construction Phase Value Added

Construction Phase Value Added ($m)			
Region	Direct	Indirect	Induced
Scenario 1			
Mackenzie District	3.1	0.8	1.3
Rest of Canterbury Region	20.1	21.4	15.3
Otago Region	1.2	1.9	1.5
Rest of South Island	0.0	1.3	1.1
North Island	0.0	6.1	8.7
Total	**24.4**	**31.5**	**27.9**
Scenario 2			
Mackenzie District	2.9	0.8	1.3
Rest of Canterbury Region	21.5	22.7	16.1
Otago Region	0.0	1.0	0.9
Rest of South Island	0.0	1.2	1.0
North Island	0.0	5.8	8.5
Total	**24.4**	**31.5**	**27.8**

Table 11 - Construction Phase Employment

Construction Phase Employment (MECs)			
Region	Direct	Indirect	Induced
Scenario 1			
Mackenzie District	31	7	1
Rest of Canterbury Region	196	212	135
Otago Region	14	18	13
Rest of South Island	0	12	9
North Island	0	44	62
Total	**242**	**291**	**219**
Scenario 2			
Mackenzie District	24	6	1
Rest of Canterbury Region	212	224	142
Otago Region	0	8	8
Rest of South Island	0	11	9
North Island	0	41	60
Total	**235**	**290**	**220**

Table 12 - Operation Phase Value Added

Operation phase Year 1 Value Added ($m)				Operation Phase Value Added ($m)		
Region	Direct	Indirect	Induced	Direct	Indirect	Induced
Scenario 1						
Mackenzie District	1.2	0.6	0.3	29.7	14.4	7.0
Rest of Canterbury Region	0.0	0.7	0.3	0.0	16.8	8.6
Otago Region	0.0	0.1	0.1	0.0	3.5	0.9
Rest of South Island	0.0	0.1	0.1	0.0	3.5	0.4
North Island	0.0	0.5	0.4	0.0	11.6	9.3
Total	**1.2**	**2.0**	**1.2**	**29.7**	**49.8**	**26.2**
Scenario 2						
Mackenzie District	1.2	0.5	0.3	30.3	13.3	7.5
Rest of Canterbury Region	0.0	0.6	0.3	0.0	15.9	8.6
Otago Region	0.0	0.1	0.1	0.0	3.5	1.0
Rest of South Island	0.0	0.1	0.1	0.0	3.5	0.6
North Island	0.0	0.5	0.4	0.0	11.6	9.5
Total	**1.2**	**1.8**	**1.2**	**30.3**	**47.8**	**27.2**

Table 13 - Operation Phase Employment

Operation phase Year 1 Employment (MECs)				Operation Phase Employment (MEC years)		
Region	Direct	Indirect	Induced	Direct	Indirect	Induced
Scenario 1						
Mackenzie District	5	1	0	201	28	5
Rest of Canterbury Region	0	5	3	196	379	233
Otago Region	0	1	0	14	49	28
Rest of South Island	0	1	0	0	48	23
North Island	0	3	3	0	153	152
Total	**5**	**10**	**6**	**411**	**656**	**440**
Scenario 2						
Mackenzie District	6	1	0	240	30	5
Rest of Canterbury Region	0	5	3	212	387	240
Otago Region	0	1	0	0	42	24
Rest of South Island	0	1	0	0	50	23
North Island	0	3	3	0	153	152
Total	**6**	**11**	**6**	**452**	**661**	**444**

A3. Literature review and analysis of job creation

This section provides a review of academic literature relating to job creation across the various stages of solar farm development: manufacturing, construction, installation, operation, and decommissioning. The purpose of this review is to evaluate and contextualise the employment inputs provided by Lodestone Energy Limited (LEL) and those calculated within the MRIO modelling framework.

It is important to note that none of the reviewed sources specifically address the construction of solar farms in New Zealand. Consequently, they do not reflect the unique characteristics of the New Zealand economy, including its sectoral composition, labour market dynamics, and supply chain structures. As such, these values are used as indicative reference points rather than precise estimates.

Despite the growing number of solar projects worldwide, academic literature on job creation from solar developments remains somewhat inconsistent. This variability is driven by:

- **Project-Specific Factors:** Differences in project size, site conditions and regional economic contexts create inconsistencies in reported employment outcomes. For example, several of the sources are from countries that manufacture modules or parts of them, capturing parts of the supply chain that do not exist everywhere.
- **Temporal and Geographic Variation:** Employment intensities can change over time due to technological advancements, evolving construction methods and differing regulatory frameworks.
- **Commercial Sensitivity:** Detailed cost data, often essential for employment estimates, is commercially sensitive. As a result, some data sources are older than would be ideal for this analysis.

Additionally, methodologies and measurement units vary significantly across studies. While triangulating these sources offers valuable insights, the discrepancies reinforce the need for caution when applying these values to the this project.

Table 14 is a summary table of key values elicited from the literature. These values are then applied to the relevant inputs for the Haldon solar farm. The rightmost column shows the job years (FTE) estimates based on the data from the corresponding source.

The literature breaks down job creation into three broad categories:

1) manufacturing, construction and installation;
2) operations and maintenance; and
3) deconstruction and decommissioning.

A bottom-up approach is commonly employed to estimate direct and some indirect job creation. For other indirect and induced jobs, Input-Output or Computable General Equilibrium (CGE) models are usually applied. The core manufacturing will all occur outside New Zealand. As such, the sources which enable a disaggregation of manufacturing and construction are preferred. Looking across the sources and understanding the logic underpinning the calculations suggests consistency with this project.

Table 14 – Job creation from solar farms, review of existing literature

Stage	Author(s)	Year	Job Type	Unit	Value	Job Years
Stage 1	EPIA and Greenpeace[22]	2006	Construction, Installation and Manufacturing	Job-years / GWh	0.84	311
				Job-years / MWp	1.48	326
	REPP[23]	2006	Construction, Installation and Manufacturing	Job-years / GWh	0.74	274
				Job-years / MWp	1.29	284
	Hondo and Moriizumi[24]	2017	Construction (Direct)	Job-years / GWh	0.59	218
			Construction (Indirect)		1.12	414
	Fragkos and Paroussos[25]	2018	Manufacturing	Job years / GWh	0.13	48
			Installation		0.24	89
Stage 2	EPIA/Greenpeace[26]	2006	Operations and Maintenance	Job-years / GWh	0.57	211
				Job-years / MWp	1	220
	REPP[27]	2006	Operations and Maintenance	Job-years / GWh	0.21	78
				Job-years / MWp	0.37	81
	Hondo and Moriizumi[28]	2017	Operations and Maintenance (Direct)	Job-years / GWh	0.89	329
			Operations and Maintenance (Indirect)		0.23	85
	Fragkos and Paroussos[29]	2018	Operations and Maintenance	Job years / GWh	0.18	67
Stage 3	IRENA[30]	2023	Decommissioning	Proportion of jobs in decommissioning	3.0%	-
Misc.	Arvanitopoulos and Agnolucci[31]	2020	Total jobs	Job-years / GWh	3.5	1295
	Sovacool et al.[32]	2023	Direct Jobs	Job-years / $USD investment	2	104
			Indirect Jobs		0.7	36
			Induced jobs		3.69	192

[22] Solar electricity for over one billion people and two million jobs by 2020, Hoffman and Teske, European Photovoltaic Industry Association (EPIA) and Greenpeace (2006)
[23] Jobs and Renewable Energy Project Final Technical Report, Sterzinger & George, Jobs and Renewable Energy Project and Renewable Energy Policy Project (REPP) (2006)
[24] Employment creation potential of renewable power generation technologies, Hondo and Moriizumi (2006)
[25] Employment creation in EU related to renewables expansion, Fragkos and Paroussos (2018)
[26] Hoffman and Teske (2006) – European Photovoltaic Industry Association (EPIA) and Greenpeach via Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US? – Max Wei, Shana Patadia, Daniel M. Kammen (2009)
[27] Jobs and Renewable Energy Project Final Technical Report – George Sterzinger (2006)
[28] Employment creation potential of renewable power generation technologies: A life cycle approach – Hiroki Hondo and Yue Moriizumi
[29] Job creation related to renewables – Panagiotis Fragkos and Leonidas Paroussos (2018)
[30] International Renewable Energy Agency (IRENA) Annual Review (2023)
[31] The long-term effect of renewable electricity on employment in the United Kingdom, Arvanitopoulos and Agnolucci (2020)
[32] Building a green future: Examining the job creation potential of electricity, heating, and storage in low-carbon buildings, Sovacool et al. (2023). To apply the job years per $USD, several assumptions are used. First, that the ratio between domestic and international spend is the same in the USA as New Zealand, i.e., that the key componentry is also imported in these studies. The first step of the calculation is the nominal value of total spend (using 2% CPI assumption), $133m. This is then converted 2015 USD terms for multiplying the ratios.

A4. Regulatory and Policy Framework

This section outlines the key requirements for the assessment in relation to legislation under the:

- Fast-track Approvals Act 2024 (FTAA)
- Resource Management Act 1991 (RMA),
- National Policy Statement for Renewable Electricity Generation 2011 (NPS-REG)
- Mackenzie District Plan

The Fast-track Approvals Act (FTAA)

The purpose of the FTAA[33] is to facilitate the delivery of infrastructure and development projects with significant regional or national benefits. As per Clause 17 of Schedule 5, the purpose of the FTAA is to be given the greatest weight when considering a consent application. The panel must also take into account the provisions of Parts 2, 3, 6, and 8 to 10 of the Resource Management Act 1991 and the relevant provisions of any other legislation that directs decision making under the Resource Management Act 1991. These provisions are addressed briefly below where they relate to the proposal.

The Resource Management Act (RMA)

The RMA[34] advocates for the sustainable management of natural and physical resources and mandates the consideration of several economically significant factors. Below are some of these factors, selectively abbreviated for relevance.

1. *"[manage] the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being."* [Part 2, section 5(2)]
2. *"[persons managing the use, development, and protection of natural and physical resources] shall have particular regard to—*

   (b) - the efficient use and development of natural and physical resources:

   (g) - any finite characteristics of natural and physical resources:

   (i) - the effects of climate change. [Part 2, section 7]

3. *"When considering an application for a resource consent and any submissions received, the consent authority must, subject to Part 2 and section 77M, have regard to*
   (a) – any actual and potential effects on the environment of allowing the activity [Part 6, section 104]

[33] The Fast-track Approvals Act (2024)
[34] The Resource Management Act (1991)

NPS for Renewable Electricity Generation (NPS-REG)

The NPS-REG[35] outlines objectives and policies designed to promote the adoption and utilisation of renewable energy sources. The proposed solar farm aligns with these goals by contributing renewable electricity to the national grid, thereby supporting several key objectives detailed in the statement. Below, the most relevant sections are summarised to highlight their applicability to this project.

- ***Policy A:*** *"Decision-makers shall recognise and provide for the national significance of renewable electricity generation activities, including the national, regional and local benefits relevant to renewable electricity generation activities….."*
- ***Policy B:*** *"….. c) meeting or exceeding the New Zealand Government's national target for the generation of electricity from renewable resources will require the significant development of renewable electricity generation activities."*
- ***Policy C:*** *"Decision-makers shall have particular regard to the following matters:*
    - *a) the need to locate the renewable electricity generation activity where the renewable energy resource is available;*
    - *c) the location of existing structures and infrastructure including, but not limited to, roads, navigation and telecommunication structures and facilities, the distribution network and the national grid in relation to the renewable electricity generation activity, and the need to connect renewable electricity generation activity to the national grid;*
- ***Policy E1:*** *"Regional policy statements and regional and district plans shall include objectives, policies and methods (including rules within plans) to provide for the development, operation, maintenance, and upgrading of new and existing renewable electricity generation activities using solar…."*

The Mackenzie District Plan

The Mackenzie District Plan[36] establishes objectives, policies and rules to manage land use and development while balancing environmental protection and economic growth. The proposed solar farm aligns with several key provisions in the District Plan, particularly those relating to renewable energy generation, land use in rural areas, and landscape protection.

- ***ATC-4, Renewable Electricity****: "The local, regional and national benefits of the District's renewable electricity generation and electricity transmission activities and assets are recognised and their development, operation, maintenance and upgrade are provided for and reverse sensitivity effects on those activities and assets are avoided."*
- ***NE01, Natural Environment****: "The values of the natural environment, including those that make the District unique, contribute to its character, identity and well-being, or have significant or*

[35] National Policy Statement for Renewable Energy Generation (2011) – Ministry for the Environment. Accessed 16/07/2024
[36] Mackenzie District Plan – Mackenzie District Council

outstanding intrinsic values, are recognised and provided for, and where appropriate protected and enhanced."

- ***REG01, Renewable Energy Generation**: "The output from renewable electricity generation activities in the District for national, regional and local use is increased to support achievement of the New Zealand Government's national target for renewable electricity generation."*
- ***REG02, Renewable Energy Generation**: "The adverse effects of renewable electricity generation activities are managed in a way that recognises and provides for the national significance of renewable electricity generation activities."*