

Climate Change Related Disclosure Meridian Energy Limited FY21

Prepared in accordance with the
recommendations of the
Taskforce on Climate-related
Financial Disclosures (TCFD)

AUGUST 2021



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Disclaimer

Quantifications in this report of financial impacts of climate change (both positive and negative) are estimates only and are not intended to constitute earnings guidance. No representation is made as to their accuracy, completeness or reliability. These risks and opportunities may not eventuate and if they do the actual impact may differ materially from these estimates.

1. Governance

TCFD requirements

- Describe the board's oversight of climate-related risks and opportunities.
- Describe management's role in assessing and managing climate-related risks and opportunities.

Meridian's Board of Directors is responsible for overseeing the management of risks, including those related to climate change. The Audit and Risk Committee supports the Board in this function by performing reviews of Meridian's primary business risks and its Risk Management Policy. The Audit and Risk

Committee meets on a quarterly basis, with committee proceedings reported back to the Board. The different levels of responsibilities and the supporting Risk Management Policy that governs the management of climate-related risks at Meridian are illustrated in Figure 1.

Meridian's Risk Management Policy provides the overarching framework for assessing, monitoring and managing climate-related risk. This policy meets ISO 31000 Risk management – Guidelines (Second edition 2018-02).

At an operational level, Meridian's executive management team assesses and monitors climate-related risks and opportunities in accordance with the level of risk assigned through the Risk Management Policy (risk categorisations are shown in Figure 2).

Figure 1. Governance of climate-related risks at Meridian Energy Limited



2. Risk Management

TCFD requirements

- Describe the organisation's processes for identifying and assessing climate-related risks.
- Describe the organisation's processes for managing climate-related risks.
- Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organisation's overall risk management.

Within the bounds of Meridian's overarching Risk Management Policy, we have used on the recommendations of the Taskforce on Climate-related Financial Disclosure (TCFD) for identifying and assessing climate-related risks and opportunities. Meridian staff, including sustainability, strategy, energy modelling and risk specialists, together stay up-to-date with the latest climate-related research, conduct relevant risk assessments, ensuring any required mitigating actions are embedded into the business, performing climate-related scenario analysis and ensure our strategic choices are resilient under these scenarios. Meridian's climate scenario modelling and analysis uses inhouse analytical models, inputs based on expert climate science advice, and applies long-term scenarios of supply-and-demand balance in the New Zealand electricity system.

Our climate change related disclosure process considers scenarios across a 30-year time horizon to 2050.

We believe this mid-century horizon is appropriate to align with our long-term business planning and risk management timeframes, which are defined as: Short-term 1 to 5 years; Medium-term 5 to 10 years; and Long-term 10 to 30 years. We regularly review the appropriateness of these time horizons in our disclosure process based on emerging and relevant context, including climate science..

The inputs used to inform our scenario analysis and modelling include projected changes in precipitation, wind, temperature and extreme weather events, coupled with generation and electricity market data. The outputs allow us to analyse a range of potential future scenarios and explore implications for Meridian's assets, operations, financial plans, and strategic choices.

In accordance with Meridian's Risk Management Policy, we assess the significance of each identified climate risk using a likelihood and consequence matrix. This allows us to determine the appropriate level of response for each issue identified. Levels of risk are categorised as either extreme, high, medium or low (Figure 2 provides further details on the levels of risk categorisation and corresponding management response as determined by Meridian's Risk Management Policy). Risks are reviewed on an annual basis to ensure they reflect material changes in our knowledge, business strategy, and operating environment.

Through the processes described above, we have identified over 50 climate-related risks and opportunities. An overview of the top physical and transition financial impacts is summarised in Tables 1 & 2¹. All additional risks and opportunities are documented and managed within Meridian.



¹ There are changes to our top reported impacts for FY21. Our full risk and opportunity register captures all risks (for example, negative demand disruption from emissions intensive industries), however, this year we have chosen to highlight some emerging, relevant impacts for which Meridian can take more direct management action on.

Figure 2. Level of risk categorisation and response as determined by Meridian's Risk Management Policy

Risk rating	Low	Medium	High	Extreme
Ownership	Manager or subject matter expert	General Manager (GM) together with their direct report	GM	CEO
Resourcing	Staff and resources applied based on risk/reward assessment	Staff and resources applied based on to risk/reward assessment	Priority focus of staff and resources at reducing risk and building mitigation in response	High priority focus with significant organisational effort directed at moving risk out of the Extreme rating
Reporting	Business units oversee and review actions	Risk review process with GM and their direct reports to ensure adequate assessment of risk and treatments are in place	Bi-annual formal reporting to Audit & Risk Committee meeting	Monthly reporting to the Board
Monitoring	Business units monitor improvement initiatives via quarterly review	Monitoring undertaken by peers or self-monitoring as appropriate	Risk owner (GM) to select most appropriate monitoring (peer or external) to ensure the steps we are taking are necessary and sufficient	Risk owner (CEO) needs to consider whether we need independent advice to provide assurance that the steps being taken are necessary and sufficient



3. Strategy

TCFD requirements

- Describe the climate-related risks and opportunities the organisation has identified over the short, medium, and long term.
- Describe the impact of climate-related risks and opportunities on the organisation's businesses, strategy, and financial planning.
- Describe the resilience of the organisation's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario.

Climate impact definitions

Physical impacts

Physical climate impacts arise from extreme weather events (e.g. storm, flood, drought) or from the longer-term shifts in climate patterns (e.g. increasing temperatures and changes to hydro lake inflows).

These changes may result in financial risks or opportunities due to the direct and indirect impacts they can have on business operations, assets, markets or supply chains.

Transition impacts

Transitional climate impacts refer to risks and opportunities resulting from the policy, legal, technology and market changes occurring in the transition to a low carbon economy.

Depending on the nature, speed, and focus of these changes, transition impacts may pose varying levels of financial and reputational risk or opportunity.

Source: Based on Recommendations of the Taskforce on Climate-related Financial Disclosures

It is clear that the impacts of climate change in New Zealand and globally will be devastating without strong climate action by both government, business and society more broadly. The recent Intergovernmental Panel on Climate Change (IPCC) report "[Climate Change 2021: the Physical Science Basis](#)" reinforces the need for strong, rapid and sustained greenhouse gas reductions if limiting global temperature rise to 1.5°C is to stay within reach. Our analysis of climate change impacts on our business is undertaken out to 2050, as this is the time horizon we use for making decisions on new investments. Within this time horizon, the physical impacts of climate change on our business in a 2°C or 4°C world are not significantly different. However, a 4°C warmer world in 2100 would present significant challenges, both in terms of the potential physical impacts on our dam structures, but also in terms of the uncertainties as to how our society will function in those circumstances, and what an electricity business may look like as a result.

We have utilised two central scenarios to explore the strategic and operational implications of climate change for our business:

Evolution: This is a "business as usual" scenario in which the world is on track to warm by more than 4°C this century. Under this scenario, no major policy changes have been enacted, no disruptive regulatory constraints have been placed on New Zealand's electricity market, and there have been no significant industry disruptions. It describes moderate improvements in energy efficiency, a moderate increase in demand due to population growth, and a moderate increase in demand from the electrification of transport and industrial heat conversion.

Revolution: In contrast, our 2°C scenario assumes substantial regulatory intervention to rapidly decarbonise transport and process heat in New Zealand. Under this scenario, demand grows at an unprecedented and potentially disruptive rate but may be

offset by contractions in agriculture and international tourism.

We also have supporting scenarios to both test our strategic choices, support the identification of climate-related risks and opportunities, and enable financial quantification where relevant. The scenarios include:

Lower electricity demand: This version of our Evolution scenario is intended to explore the potential impact on electricity demand should there be a significant disruption to industry as a result of physical or transition-related impacts of climate change (for example, the dairy industry phasing out in New Zealand over a 10 year period).

No climate change: This version of our Evolution scenario removes the physical impacts of climate change on both supply and demand.

Thermal counterfactual: This scenario imagines a New Zealand where energy security is prioritised above the other factors, affordability and sustainability, in the energy

trilemma. Here, gas remains in the electricity generation mix to provide some flexibility and energy security. An underpinning principle is that a 100% renewable electricity target is deprioritised with a new focus on an economy wide renewable energy target, allowing gas to remain in the electricity generation mix.

All scenarios above assume the same level of temperature increase between now and 2050, as the physical impacts of climate change (including the availability of water and wind energy) are much the same within this time horizon regardless of which temperature increase scenario is chosen from the Intergovernmental Panel on Climate Change (the IPCC). However, the market and regulatory contexts and assumptions between each scenario are notably different, for example electric vehicle demand outlooks under Evolution and Revolution scenarios are markedly different and we believe more consistent with 4°C and 2°C pathways respectively.

Physical risks

As an electricity generator from natural resources, the physical impacts of climate change present risks and opportunities. Our modelling indicates that we are likely to get more water in our hydro catchments, with a change in seasonality to better match demand, and that demand is likely to increase with higher temperatures. However, higher temperatures will also increase the likelihood of extreme rainfall events.

We continue to consider the physical impacts from climate change on our business more broadly, such as those on the local electricity system as a whole, and those on our global supply chain and how those would then impact our business.

For example, locally higher temperatures may impact the carrying capacity of the transmission and distribution networks, and those networks may also be disrupted by increased frequency and severity of extreme weather events. There may also be increasing competition for water, for example from increasingly frequent East Coast droughts (particularly in the Canterbury region). In our supply chain, the sourcing of goods and services internationally, may impact us locally via supply chain disruptions.

The identified physical impacts of climate change most material to Meridian are described below.

Extreme rainfall in hydro catchments - risk

Climate change is likely to increase the severity of extreme rainfall events, and consequent flood events, across New Zealand, which then poses a potential increased risk of physical damage to our dam and hydro assets in the Waiau and Manapōuri catchments and risks to surrounding communities. Meridian's 2021 Corporate Governance Statement captures the catastrophic events risk including flooding and current mitigations in place to reduce the impact of such an event.

The safety criteria for extreme flood events is defined in the NZSOLD Dam Safety Guidelines as "Probable Maximum Flood (PMF) – an estimate of a hypothetical flood (peak flow, volume and hydrograph shape) that is considered to be the most severe "reasonably possible" scenario for a particular catchment". The PMF values for our hydro systems were updated in 2016 for Waitaki catchment and 2017 for the Waiau catchment, and are subject to expert independent review. These PMFs then inform our dam safety approach, which follows best practice in that all of Meridian's high potential impact category dams are required to be assessed, maintained, and managed to remain safe even under extreme flood and seismic loads.

The assessment of PMF is highly conservative. While we consider it to be highly unlikely that an extreme flood larger than the PMF event would occur in the short-term, there is a possibility that the PMF may need to be raised in the next several decades, as a result of increases in global and regional

atmospheric temperatures and changes to atmospheric circulation leading to increases in the severity of extreme rainfall events.

This leads us to consider two risk impact scenarios;

Firstly, it is foreseeable that the PMF values that we are required to manage to assure the safety of our dams could rise which could potentially have a substantive financial impact on our business, as an increased PMF would require us to increase the flood capacity of our dams, starting at some point in the next 30 years. This could be achieved through either modification of dam structures, spill outlets, or by reducing the maximum operating water level to allow for more flood storage capacity, or a combination of these measures. The most likely options currently considered include reducing the maximum control level in Lake Pūkaki in the Waitaki system, which could have an ongoing earnings cost of up between \$4m-8m per annum by 2050, and for the Waiau catchment, physical changes to lake control structures with a one off cost of up to \$30m, which we have considered on an annualised basis to be \$3m/yr. Taken together, the ongoing earnings cost and lake control structure cost, combine to an annualised indicative financial impact of - \$7 to-\$11m per annum.

To manage this risk we plan to re-evaluate the PMFs every decade.

We are also advocating to independent external consultants responsible for PMF calculations that they take into account the ongoing scientific research in relation to how extreme rainfall events affect our catchments, and the extent to which climate change will contribute to that going forward. And we are likely to invest in future rainfall-runoff modelling to ensure the risk is better understood. The cost of this management approach is considered business-as-usual and not related to any additional risk of extreme rainfall events due to climate change, and therefore this cost is not included.

Secondly, if an extreme rainfall event of a scale sufficient to damage our structures were to occur in the shorter term, the potential consequence to Meridian includes damage to the dam and/or hydro structures and business interruption (restrictions on our generation operations for a period of time) but not dam failure. We're exposed to this risk in both our catchments but not both simultaneously, as it is 'exceptionally unlikely' that an extreme flood would occur in both catchments in the same timeframe. The impact in the Waitaki system may be in the order of \$60m to \$80m and in the Waiau catchment between \$55m and \$80m. In the event of material damage and business interruption losses, Meridian holds insurance for both physical damage and lost generation after 30 days resulting from damage to generation assets which would reduce the financial impact by potentially up to \$35m. We consider this risk very unlikely to occur due to our extensive dam safety management approach, and as such have not included this potential financial impact in our summarised financial impact estimate (table 1).

Changes to hydro inflow profile - opportunity

Projected changes to Meridian's hydro inflow profiles in the Waiau and Waitaki catchment areas are likely to better match anticipated changes in New Zealand's electricity demand profile.

There is not likely to be any increase in drought risk to our hydro catchments under 2° or 4°C scenarios. To the contrary, average annual rainfall is projected to increase by approximately 5-15% by 2055². This would have a positive impact on our revenues through increased production of hydroelectricity. Meridian's 2021 Corporate Governance Statement captures the risk – Adverse hydrological conditions. Should hydro inflows profile change as modelled, this risk will reduce somewhat.

Changes in seasonal rainfall are projected, with winter rainfall in Meridian's hydro catchments predicted to increase more than summer rainfall over the next few decades. Approximately half of the Waitaki summer inflows come from snow melt³. Rising snowlines and the resulting reduction in summer snow melt is projected to contribute to increased winter inflows and decreased summer inflows.

These seasonal changes in inflow profile are likely to improve alignment between our generating capacity and electricity

demand. Current demand peaks in winter, whereas current hydro lake inflows peak in summer, requiring significant storage use planning. In the future these two variables are expected to align more. In addition, rising annual average temperatures are likely to have a direct impact on heating and air conditioning, with less electricity required in winter for heating and more in summer for cooling, also improving the correlation between electricity demand and supply.

Increased correlation between inflows and seasonal demand will allow Meridian to increase production of hydroelectricity on an annual average basis. The potential annualised financial impact ranges \$12-\$58m. This is calculated assuming an increase in Meridian's price participation⁴ in future years of the order 2-10% by 2050, aligned with Revolution and Evolution scenario outlooks respectively. The price participation improvement would be a result of Meridian's electricity supply and demand better aligning during wholesale market trading – largely hydroelectricity assets would be expected to achieve higher returns as a result of the changes to hydro inflow profile from climate change. Note that there is significant uncertainty to this calculation.



² NIWA 2020: Our future climate New Zealand website: <https://ofcnz.niwa.co.nz/>

³ Kerr, T, 2013: The contribution of snowmelt to the rivers of the South Island, New Zealand. Journal of Hydrology (NZ) 52 (2): 61-82 201

⁴ Price participation = Generation Weighted Average Price / Time Weighted Average Price (GWAP/TWAP)

Transition impacts

The transition impacts of climate change (such as impacts caused by strong climate action policy or changing customer behaviour), are also a mix of risks and opportunities for our business. Climate action in New Zealand is expected to increase renewable electricity demand, from electric vehicle uptake, and the transition of some industrial heat processes from coal to electricity. Climate action internationally also has potential impacts. As a risk, the increasing pace and scale of numerous international climate commitments, put new demand on regional-specific resources – ensuring sustainable and managed development occurs may come with increased sourcing costs as a result of seeking increased supply chain transparency. As an opportunity, international climate commitments could create new markets, for example, through the export of hydrogen to enable the decarbonisation of other countries.

We rely on a wide range of government, industry, and academic sources to assess the potential impact of New Zealand's transition to a low-emissions economy on our business model, operations and revenues.

The transition impacts most material to Meridian are described below.

New electricity demand - electrification of industrial heat and transport - opportunity

The New Zealand Climate Change Commission's final advice to Government includes numerous recommendations, many of which, if adopted in large part by Government in the setting of the first emission budgets and Emissions Reduction Plan, will create material new sources of electricity demand. For example, a recommendation is made to increase

renewable energy consumption to 50% by 2035, which could enable the large-scale electrification of transport and industrial heat. Ambitious emissions budgets and enabling policies, could enable Meridian to grow our electricity generation and retail businesses.

Under our Evolution scenario, we anticipate a moderate increase in electricity demand due to population growth and the slow but steady electrification of both industrial heat processes and transport. We consider this scenario as a reasonable representation of a lower boundary on decarbonisation achieved via electrification.

Under our Revolution scenario, we anticipate a significant increase in electricity demand driven by substantive electrification to decarbonise multiple sector, driven by transport and process heat.

The estimated potential annualised financial impact of this opportunity ranges \$10-43m.

This estimate is calculated from assumed new electricity demand by 2050 in the Evolution and Revolution scenarios, associated with process heat and transportation. An assumed margin range has also been applied to these potential new sources of demand. The lower margin/demand outlook and upper margin/demand outlook together provide the annualised financial impact range over this time horizon. Note that there is significant uncertainty to this calculation.

Meridian is positioned to monitor the emergence of key trends indicating an abrupt transition trajectory and will ensure additional capacity is made available in order to ensure resilience is maintained. To respond to the potential requirement for new renewable generation Meridian maintains a pipeline of development options, and recently committed to invest in a new wind farm, Harapaki. Additionally, Meridian has taken action to advance this opportunity as evidenced in recent announcements to develop a national EV charging network and offer a South Island process heat electrification solution⁵.

Meridian's 2021 Corporate Governance Statement captures the current demand risk, specifically as it relates to the closure of Tiwai Point, and current mitigations in place to reduce the impact of such an event.

Supply chain costs - risk

A multitude of climate commitments have been made around the world to meet global climate targets. According to the International Energy Agency, there will be orders of magnitude of new demand for key minerals used in the manufacture of items such as solar panels, wind turbines and electric car batteries⁶. In order to scale renewable energy development congruent with high environmental and social standards, a range of complimentary efforts will be required such as scaling repurposing and minerals recovery/recycling efforts, and ensuring for example, that fair labour practices are embedded at associated mines and factories. The risk identified for Meridian is that in pursuit of bringing new renewable generation to market to support New Zealand's decarbonisation ambitions, procurement consistent with our purpose and values, could result in higher costs.

In the first instance, we estimate that to build on our in-house capability for responsible sourcing, in a manner that is consistent with our generation growth ambitions, additional resource will be required to conduct the necessary sourcing due diligence and provide sufficient transparency of our supply chain.

Based on an assumed generation development outlook, this could come to an approximate OPEX cost of \$2m. In the short-medium term, as the global renewable supply chain develops, based on an outlook of relevant possible generation assets, if sufficient supply chain transparency cannot be achieved, a preferential-supplier approach could be adopted to ensure a procurement commitment aligns with our policies and standards. Again, based on an assumed renewable generation outlook and applying a sole sourcing cost premium range to the relevant materials, there is a risk of possible \$32m - \$40m CAPEX cost. Annualised over the relevant development outlook period, together these costs combine to an annualised \$3m - \$4m. We note that should all market participants choose to invest in similar levels of supply chain due diligence and transparency efforts, this would not be a relative cost increase to Meridian, as all participants would potentially be impacted.

⁵ <https://www.meridianenergy.co.nz/news-and-events/meridian-to-launch-nationwide-ev-charging-network> and <https://www.meridianenergy.co.nz/business/sustainability/process-heat-electrification-programme> and <https://www.meridianenergy.co.nz/who-we-are/our-power-stations/wind/harapaki>

⁶ <https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions>

To mitigate this risk, Meridian is investing in building business guidance and procurement capability, targeted at the unique risks presented by the rapid scale up of minerals sourcing to meet growing global renewable development demand. Meridian released its first Modern Slavery Statement in 2020⁷, which outlines action taken and planned next steps, to assess and address modern slavery risks in our supply chain. Meridian actively pursues options to re-use, re-purpose and re-cycle materials across our business – relevant to minerals, Meridian is actively trialling second-life solutions for EV batteries.

Power system flexibility - risk

Energy security is a fundamental part of a balanced energy system and recent power outages experienced by some New Zealanders remind us of the absolute imperative to ensure there is flexibility in the power system. As New Zealand increases its share of renewable generation it is likely that this will lead to higher levels of electricity spot price volatility. Thermal generation in New Zealand currently plays a significant role in responding to periods of reduced renewable supply such as dry periods in the hydro catchments. It is likely that much or all of this thermal plant will be replaced by renewable energy options over time. The Government's 100% renewable electricity generation target by 2030 remains a stated commitment. Meridian's submission on the NZ Climate Change Commission's advice to government, highlighted support of the Commission's advice to focus on a renewable energy target and consider a renewable electricity target as aspirational. Whilst thermal retirement could occur in response to regulatory change, it could also be as a result

of more economic renewable generation options replacing ageing thermal plant. The Market Supply risk in Meridian's 2021 Corporate Governance Statement overall risk faced in moving to 100% renewable electricity including the eventual increase in electricity spot price volatility as identified here.

NIWA⁸ predicts no change to drought depth or duration in coming decades in Meridian hydro catchments. However, in a future with a high proportion of renewable generation, cold winters with high peak loads that coincide with low hydro, wind and solar generation could result in high peak prices as available generation runs short. These factors could increase electricity price volatility relative to today and in the absence of sufficient generation flexibility being available in the electricity supply mix. This could impact the volatility of Meridian's earnings, and increase the costs of managing Meridian's electricity portfolio through increased procurement of risk instruments.

This risk will grow in increments over the next 5-10 years, increasing due to possible factors such as each large coal and gas generation station retiring and being replaced by renewables.



A potential financial impact of \$20-80 million has been derived as a high-level annualised cost, informed by applying a risk instrument cost assumption to an estimate of a potential range of change to electricity spot price volatility. The risk instrument cost assumptions represents two components: an estimated yearly hedging cost to protect against increased electricity spot volatility in the event that the wholesale electricity market becomes significantly more volatile than it is today, and an annualised CAPEX figure, representative of new investment made to provide potential alternative flexible demand options.

Managements mitigation actions to this risk involve both the investigation of tangible alternatives to provide supply flexibility, and a contribution to public policy thinking. In the first instance, Meridian is actively investigating the role that options like hydrogen could play in a dry year scenario (more detail in the proceeding section of this report), and also a possible 100MW battery. In the public policy area, Meridian remains supportive of the Climate Change Commission's advice to government that a renewable energy consumption target of 50% by 2035 be a focus, and that 100% renewable electricity generation be considered an aspirational goal for New Zealand, thereby prioritising decarbonisation focus on lower carbon abatement cost options in the near term such as transport and process heat.

⁷ https://www.meridianenergy.co.nz/assets/Sustainability/MER0117-Modern-Slavery-Statement-8_0.pdf

⁸ NIWA 2020: Our future climate New Zealand website: <https://ofcnz.niwa.co.nz/>

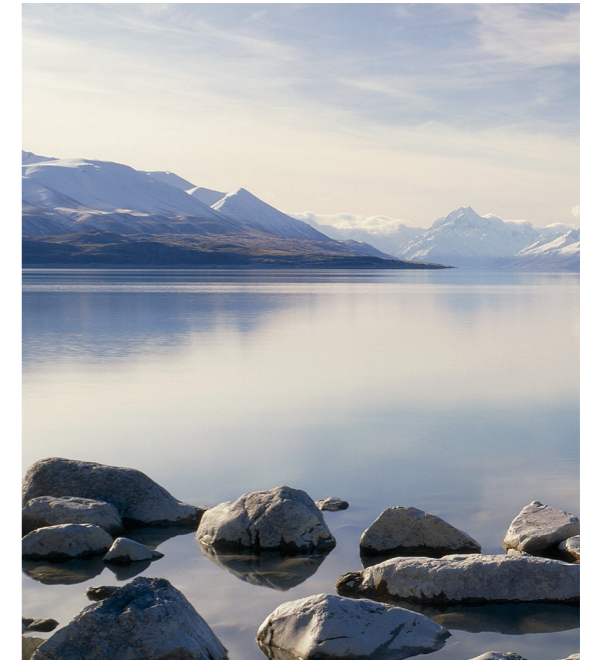
New markets – hydrogen - opportunity

The growing and substantive climate change commitments around the world, have impelled regulators, investors, and consumers to decarbonise. Green hydrogen and green hydrogen-derived chemicals are being increasingly recognised as key enablers of the transition from fossil fuel-based to zero-carbon energy. This is particularly true for countries with few domestic renewable generation options (e.g. Japan and South Korea) and for sectors that have few or no feasible low-carbon alternatives. These 'hard-to-abate' sectors include chemical manufacturing, petroleum refining, steel manufacturing, heavy transport, shipping, air travel, high-temperature industrial heat, and heat for buildings. As a result, interest in hydrogen is accelerating⁹.

New Zealand's renewable electricity generation resources provide a platform on which green hydrogen production could be established. The announcement by New Zealand's Aluminium Smelter (NZAS) in 2020 to end operations at Tīwai Point, presents a unique opportunity to redeploy a large volume of existing high-capacity factor renewable electricity (5TWh pa) to green hydrogen production. At this scale we have an opportunity to secure an early position and deliver some of the first large scale green hydrogen to the international market. This export opportunity could underpin the investment in a New Zealand based green hydrogen production facility, which would in turn provide a solid platform to develop the domestic hydrogen economy. In addition, analysis suggests that a green hydrogen production facility could be configured to provide electricity demand response back to the electricity system during dry-years, when inflows to hydro lakes are low as outlined in the adverse hydrological conditions risk in Meridian's 2021 Corporate Government Statement.

To investigate this opportunity, Meridian has committed to co-funding a Green Hydrogen feasibility study which will be completed in 2021. Meridian is yet to decide how it would participate in a green hydrogen project and whether it would commit to more than being a supplier of electricity. To quantify this opportunity, it is assumed that Meridian involvement is limited to supplying electricity, and that the NZAS electricity is redeployed to a green hydrogen project at improved prices immediately following closure of Tīwai Point. It also assumes that the green hydrogen facility provides demand response during dry-years. The incremental net revenue benefit of this opportunity has a wide range, with an estimated midpoint of \$95m per annum. There is significant uncertainty in this estimate.

To capitalise on this opportunity, several challenges and uncertainties need to be overcome. These will be further assessed and analysed as the joint Green Hydrogen study completes, and through the course of approaching the market (Registration of Interest) and engaging with potential partners across the hydrogen supply chain.



⁹ The New Zealand Hydrogen Opportunity, McKinsey & Co. 2021, <https://www.southernhydrogen.co.nz>

Table 1. Top climate-related financial risks for Meridian Energy





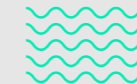

Top Risks			
Risk drivers	 Extreme rainfall in hydro catchments	 Supply chain costs	 Power system flexibility
Type	Physical	Transitional	Transitional
Scale	Medium	Medium	High
Likelihood	About as likely as not	About as likely as not	Likely
Timeframe	Long-term (30 years)	Medium-term (5-10 years)	Medium-term (5-10 years)
Impacts	Increasing intensity of extreme rainfall events in hydro catchments.	Global demand for renewables puts pressure on supply chain for minerals, possibly risking other environmental and social standards.	As New Zealand increases its share of renewable generation, it may lead to higher levels of electricity spot price volatility.
Financial implications	Increase in intensity of extreme rainfall events may require the lowering of dam water levels (reducing assets' generating capacity) and/or the strengthening of dam structures.	Investment in supply chain transparency and possible cost premiums from relevant sole sourcing, results in increased OPEX and CAPEX cost.	Increased costs of commodity risk management due to increases in the percentage of grid-connected renewable electricity generation and CAPEX costs associated with investing in new flexibility options.
Quantification	-\$7 to-\$11 million per annum	-\$3 to -\$4 million per annum	-\$20 to-\$80 million per annum
Methodology	Estimated potential financial impact is an annualised figure over a 30 year time horizon of estimated civil construction costs and negative revenue impacts.	Annualised over 10 years – sole sourcing premium applied to potential minerals in possible renewable development supply chain and accounting for the costs associated with a responsible sourcing capability build and due diligence activity.	Estimated potential financial impact is a high-level estimate, an annual cost, and informed by actual costs of current risk instruments and internal views on magnitude of potential changes to electricity spot price volatility and investments that may be required to provide flexibility.
Management response	Probable Maximum Flood values are reviewed once every ten years to incorporate climate change, or more frequently if warranted circumstances arise.	Commitment to build procurement capability, advance Modern Slavery Statement actions, invest in supply chain transparency and take action in minerals re-purposing, re-cycling and recovery initiatives.	Meridian has a mature commodity risk framework that includes specific limits for allowable exposure to spot electricity price risk. Within that framework the cost of mitigation is traded-off against the impact of accepting the risk. Meridian is also actively investigating new options to provide flexibility in place of that provided by thermal, such as hydrogen and large scale batteries.

Table 2. Top climate-related financial opportunities for Meridian Energy

Top Opportunities			
Opportunity	 Changes to inflow profile	 New markets - hydrogen	 Electrification of industrial heat and transportation
Type	Physical	Transitional	Transitional
Scale	Medium	High	Medium
Likelihood	More likely than not	More likely than not	Likely
Timeframe	Long-term (30 years)	Long-term (30 years)	Long-term (30 years)
Impacts	Annual and seasonal changes in inflow profile are likely to improve alignment between our generating capacity and projected changes in electricity demand.	Increasing mandate from regulators, investors, and consumers to decarbonise. Green hydrogen and green hydrogen-derived chemicals are being increasingly recognised as key enablers of the transition from fossil fuel-based to zero-carbon energy.	The transition to a low-carbon future presents market opportunities for Meridian, including a projected increase in demand for renewable electricity driven by the electrification of industrial heat and transportation.
Financial implications	Projected changes to inflow profile are likely to align to projected changes in electricity demand.	Opportunity to redeploy the current NZAS load following closure of the Tiwai smelter. Green hydrogen to also provide electricity demand response.	Increased electricity demand may enable Meridian to grow our electricity generation and retail businesses.
Quantification	+\$12 to +\$58 million per annum	\$95 million (mid point) per annum	+\$10 to +\$43 million per annum
Methodology	Estimated potential financial impact is an annualised figure modelled over a 30 year time horizon. This is calculated using an assumed increase in price participation of Meridian generation assets and the relative margin uplift under Revolution and Evolution demand outlooks. There is significant uncertainty to this calculation.	Assumes 600 MW of generation is deployed to a Green hydrogen facility, following closure of the Tiwai smelter. Assumes that contract price exceeds current NZAS contract price. Also assumes that demand response is provided by the green hydrogen facility, which negates requirement for Meridian to establish ongoing thermal hedge contract.	Estimated potential financial impact is an annualised figure modelled over a 30 year time horizon. This is calculated using assumed new electricity demand profiles for these use cases under Evolution and Revolution scenarios and applying a possible margin range. There is significant uncertainty to this calculation.
Management response	Wholesale market team manages the changing inflow profile using a market optimisation approach informed by weekly inflow forecasts and analysis of short- to medium-term weather patterns.	Complete the joint Southern Green Hydrogen feasibility study and market approach (Registration of Interest).	Pursuing alternative forms of electricity demand across workstreams focussed on electrification of industrial heat and transport. Maintain a pipeline of development options, new generation build committed.

4. Metrics and Targets

TCFD requirements

- Disclose the metrics used by the organisation to assess climate-related risks and opportunities in line with its strategy and risk management process.
- Disclose Scope 1, Scope 2, and, if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks.
- Describe the targets used by the organisation to manage climate related risks and opportunities and performance against targets.

Measuring what matters

Monitoring of risks and opportunities

In order to identify changes and inform decision-making processes, Meridian measures and monitors:

- Frequency and intensity of extreme rainfall events in the Waiau and Waitaki catchments
- Electricity demand
- Price volatility
- Regulation/policy changes, including signals and consultations (submitting where appropriate)

In FY21, we started our journey to begin systematically monitoring our internal systems, policies and processes for managing climate-related risks, building resilience, and capturing commercial opportunities and we plan for further maturing in the coming financial year.

GHG emissions

We monitor our Scope 1, 2 and 3 greenhouse gas (GHG) emissions in-line with the GHG Protocol to allow aggregation between business units and benchmarking against peers. Our annual emissions inventories are audited and publicly reported (refer to the [Meridian Group greenhouse gas inventories](#)).

Setting bold targets

Decarbonising Meridian

As a 100% renewable energy generator with no fossil fuel combustion for electricity generation, we recognise that our biggest impact will come from the continued investment in further renewable energy generation to enable further decarbonisation, and having an operational GHG target that is focused on our supply chain (scope 3). Therefore, we set ourselves some ambitious commitments from a FY19 baseline year, knowing that >95% of our operational GHG footprint is in our supply chain:

- Halving operational GHG emissions across the Meridian Group by FY30 vs. FY19 baseline
- Going net carbon neutral across our value chain from FY19 onwards.

We are once again carbon neutral, this year through purchasing and surrendering Gold Standard Voluntary Emission Reduction certificates from wind farms in India. We are also investing in our [Forever Forests](#) programme to create our own voluntary offsets, in partnership with Ekos and a range of third parties. These credits will be independently verified as NZUs (New Zealand Units). We are planting 1.5 million trees across the country, and have started with land near Meridian's hydro stations and wind farms, planting the first seedlings in late 2019. The planted trees are a mix of natives and exotics. Mixed planting is the most productive way to plant, with exotics being the carbon 'engine' pulling carbon down from the atmosphere in a hurry. They then create a canopy to protect the natives in their early days so they can flourish later in life. In the long term, the natives will take over, leaving a lasting legacy for future generations. So far, we've planted 60,000 trees over 45 hectares, approximately 4% of our Forever Forests target. We aim to plant another 80,000 trees in the coming financial year.

Meridian has a number of decarbonisation initiatives underway, aligning with the Meridian Group goal of halving operational GHG emissions by 2030. Within our business with have focused on:

- At least 50% air travel reduction. We got very close to achieving this target with a 46% reduction in air travel emissions compared to FY20. From an FY19 baseline, our emissions are 63% lower
- Energy efficiency audits at our hydro asset sites and a wind site were completed in FY21. Identified findings have been entered into the asset management plan for consideration and prioritisation.
- Full electrification of the vehicle fleet. An interim milestone of 100% conversion of the light passenger fleet was achieved in early 2021. Active investigation is underway to complete the conversion of the remaining light commercial fleet by the end of 2025
- Developing a business case for the electrification of Meridian's boat at Manapōuri
- We continue to support our staff to work remotely, including offering financial assistance for home office furniture if needed. Remote working/working from home enables the avoidance of some emissions from employee commuting. In FY22 we will investigate options to further support our staff in taking climate action.

We also continue a focus on our supply chain given the bulk of our carbon footprint is associated with this (>95% of our FY19 baseline). In this vein we have:

- Continued our supplier engagement plan, aligning with our Half by 2030 reduction goal. After identifying our high impact suppliers for sustainability, we commenced engagement with those suppliers to understand their plans to actively reduce their carbon footprint. In FY22, we plan to build on this and develop our roadmap and framework, under which we will focus and organise our efforts to ensure we reach out target.
- Deepened the sustainable procurement capability of our own staff and will complete in-house training including an eLearning module and workshops focussing on goods and services procured for Meridian's operations. We are also in the process of developing sustainability infrastructure development guidance, consistent with the principles of United Nations Sustainable Development Goal 12 – Responsible Consumption and Production. This is consistent with an outlook for an increased scale on investment to support decarbonisation efforts, such as those in our renewable development pipeline.

Decarbonising Aotearoa

In support of top risks and opportunities identified in this disclosure report, such as hydrogen, process heat and transport electrification, and power system flexibility, we have a range of project-specific targets in place, such as:

- We expect that we might need to invest in a new wind farm (or generation equivalent) every three years, based on the current demand outlook. As a step towards this in FY21, we announced our the commencement of a 176MW wind farm, Harapaki, which is expected to take 3 years to construct. As a part of the design process, reviews also resulted in a reduction in the amount of concrete and steel required in construction, reducing the overall carbon footprint of the project by over 30 percent. Our renewable development team are actively investigating 7+ projects, including a 100MW battery.
- To advance the hydrogen opportunity, in FY22 we will complete a joint Southern Green Hydrogen feasibility study and market approach (Registration of Interest), to determine next steps/targets.
- In support of the transport and process heat electrification opportunities, Meridian has targets to roll out >250 AC EV charging stations nationally within the next three years and is actively pursuing opportunities to scale process heat electrification in the South Island with current potential projects totalling 171GWh per annum.

More broadly, in FY21, a [Climate Action Toolbox](#) was launched, which was developed and launched in a collaborative multi-organisational partnership. Meridian has committed to a second year of investment and collaboration to further scale the toolbox. The Toolbox is a free tool for small to medium business to help them take climate action in a way that meets their business needs. This Toolbox will be a valuable tool to relevant businesses both in our supply chain, our customer base and broader SMEs in Aotearoa.

Progress on Half by 2030 goal

