

Climate Risk Disclosures Meridian Energy Limited FY19

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

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Meridian.

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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 are responsible for overseeing the management of risk, 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. Different level 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 New Zealand standard AS/NZS ISO 31000 Risk Management—Principles and guidelines. At an operational level, Meridian's management team assess

and monitor 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.

In addition to Meridian's overarching Risk Management Policy, we apply the recommendations of the Taskforce on Climate-related Financial Disclosure (TCFD) as guidelines for identifying and assessing climate-related risks. Meridian staff, including climate scientists, energy modelling and risk specialists, are tasked with staying up-to-date with the latest climate-related research, conducting regular risk assessments and performing detailed climate change analysis. This involves undertaking climate scenario modelling and analysis using our inhouse analytical models and maintaining long-term scenarios of the supply and demand balance in the NZ electricity system.

Our climate scenario modelling applies a two-degree equivalent scenario approach for both physical and transitional impacts, extending across a 30-year time horizon to 2050.

From a risk management perspective, we believe this is appropriate for identifying physical risks, as the range of uncertainty in estimations of inflow, wind, and demand over the next 30 years is greater than any discernible differences between low-mid (2 degree) and high (4 degree) emissions scenarios. The time horizon of our scenario modelling also aligns with our long-term

business planning and risk management timeframes, which are defined as: Short-term 1-5 years; Medium-term 5-10 years; and Long term 10-30 years. We regularly monitor whether climate science requires us to reassess this approach.

The inputs used to inform our climate modelling include projected changes in precipitation, wind and temperature, coupled with generation and electricity market data. The outputs allow us to analyse a range of potential future pathways, and the implications for Meridian.

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).

As a result of the processes described above, we have identified 20 specific climate change risks relevant to Meridian. An overview of our highest rated physical and transition climate related risks are contained in our Strategy disclosures, as shown in Tables 1 & 2.



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	GM together with their direct report	GM	CEO
Resourcing	Staff and resources applied based on risk/reward assessment	Staff and resources applied based on 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 A&R 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

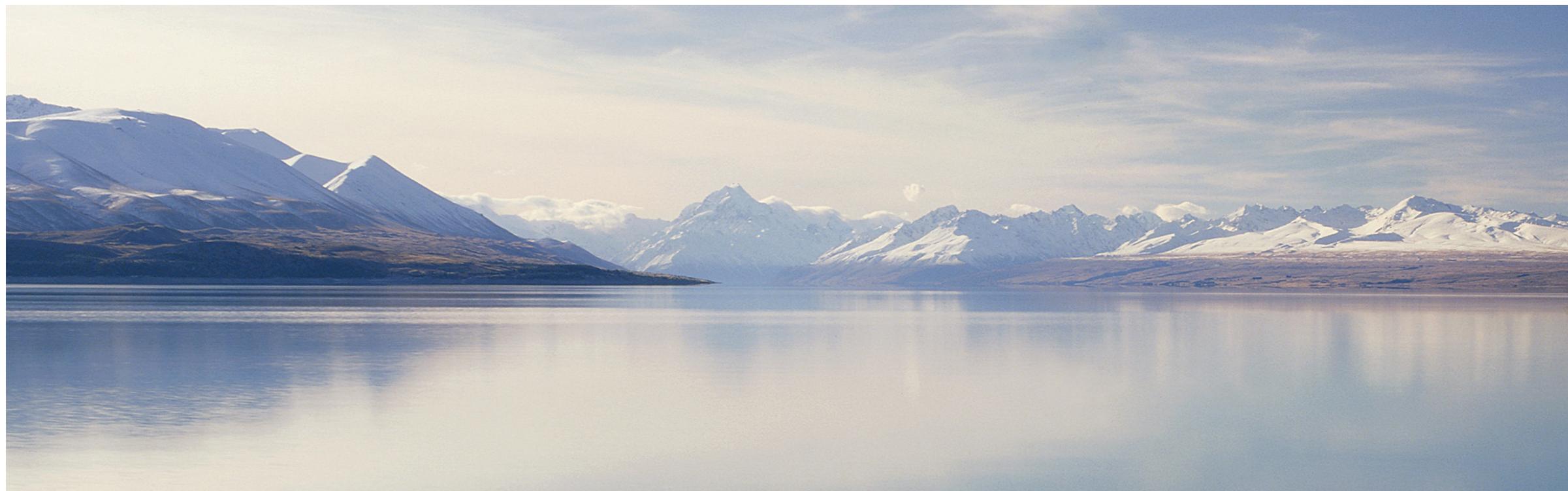
changes may result in financial risks or opportunities due to the direct and indirect impacts they can have on business operations, assets, markets or supply chains.

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



Physical risks

We conduct analysis to identify the potential physical impacts from climate change (including analysis of changes in market demand, water and wind energy availability, and recalculation of the Probable Maximum Flood (PMF) values) using estimated changes

to future temperatures that are relatively similar in both two and four-degree scenarios out to 2050. We don't model beyond a 30-yr timeframe due to the uncertainty in the models, and also because changes in physical risks beyond that timeframe are not

financially material to our current decision-making (for example, decisions as to whether to build a new wind power station are based on a first-life time period, typically 25yrs) or don't require action to be taken until closer to the time of increased risk (for example,

strengthening a dam). An overview of the key impacts to Meridian from physical changes are summarised in Table 1.

Table 1. Top physical climate risks for Meridian Energy

Physical risks			
Risk drivers	Hydro inflows	Change in demand	Damage to generation assets
Risk rating	Medium	Medium	High
Modelling timeframe	Long-term – 30 years		
Physical changes	<ul style="list-style-type: none"> Changes to annual and seasonal rainfall in Meridian's catchments 	<ul style="list-style-type: none"> Increasing population due to migration Increasing agriculture flows as precipitation decreases in East Higher electricity demand in summer for cooling Lower electricity demand in winter for heating 	<ul style="list-style-type: none"> Increasing extreme storm events
Operational impacts	<ul style="list-style-type: none"> Risk of increased fuel volatility Potential smoothing of demand/supply profiles 	<ul style="list-style-type: none"> Risk of higher water outflows to support agriculture Potential higher demand for electricity and smoothing of demand/supply profile 	<ul style="list-style-type: none"> Risk of extreme flood event causing significant damage to Meridian's generations assets
Management response	<ul style="list-style-type: none"> Projections of changes to water inflows and wind energy incorporated in internal modelling out to 2050, and impacts on electricity system examined 	<ul style="list-style-type: none"> Projections of changes to market demand due to physical impacts of climate change incorporated in internal modelling out to 2050, and impacts on electricity system examined 	<ul style="list-style-type: none"> Probable Maximum Flood (PMF) assessed at least every 10 years to ensure it aligns to most current climate information, and impacts on infrastructure closely monitored
Measures & metrics	<ul style="list-style-type: none"> Mid to long-term water inflow and wind energy scenario modelling 	<ul style="list-style-type: none"> Mid to long-term market demand scenario modelling Mid to long-term water inflow and wind energy scenario modelling 	<ul style="list-style-type: none"> Probable Maximum Flood assessments

Hydro inflows

Our modelling under both a two and four-degree scenario indicates that, by 2055, average annual rainfall into Meridian's catchments could increase by approximately 5-15%.

Seasonal rainfall changes are also projected, with winter rainfall in Meridian's hydro catchments predicted to increase more than summer rainfall. Rising snowlines and the resulting reduction in summer snow melt also contributes to seasonal changes in our inflow profile. Changes to seasonal inflows are projected to better match electricity demand in the future. Increases in temperature and predicted stronger wind speeds will result in higher rainfall totals from storm events in Meridian catchments. Although no increase in drought incidence is predicted in the headwaters of Meridian hydro catchments, this predicted increase in inflow volatility translates into a commercial generation risk.

Managing inflow volatility caused by droughts, floods and snow melt is already a key part of Meridian's business. For example, current medium-term weather patterns (for example the El Nino-Southern Oscillation, which swings from one phase to another on a 2-7 year cycle) already shift our inflow regime by 10% to the wet or dry. Our wholesale market team manages these risks using a market optimisation approach which is informed by weekly inflow forecasting and analysis of short to medium term weather patterns. Our approach to managing this risk is to continue to closely monitor climate model projections for hydro inflows and adapt our risk management practices as required. Our view is that this does not pose a significant financial risk as the scale of this risk can be appropriately managed.

Changes in demand

The physical impacts of climate change are predicted to have a significant effect on the way that households and businesses consume energy. For example, projected increases in average temperatures are likely to have a direct impact on electricity demand for heating and air conditioning with demand predicted to reduce in winter and increase in summer. Furthermore, the projected increase in the frequency of droughts on the east coast, particularly in the Canterbury region, will likely impact energy and water requirements for agricultural irrigation. It is also possible that climate change could lead to large-scale international migration as globally regions become uninhabitable, leading to possible population increases in New Zealand. For Meridian these changes, if they occur as a step change rather than a gradual increase, impact the ability of Meridian and other parties to invest in new generation quickly to manage the balance of electricity generation and demand. There is also a risk that these changes in demand will influence electricity market prices.

To mitigate these demand side risks, Meridian maintains a pipeline of development options. Again, our view is that this does not pose a significant financial risk as the scale of this risk can be appropriately managed.

Damage to generation assets

More volatile inflow and rain episodes are projected across the country. This presents the risk of damage to Meridian's generation assets. Whilst Meridian's hydro assets are well placed to manage flood events much larger than the current historical high and are designed to safely pass a probable maximum flood event there remains the risk that some damage may occur in extreme flood events.

Meridian has a Dam Safety Policy which sets out the expectations that Meridian will maintain and manage the safety of its dams consistent with best practice in order to assure the safety of the public and protect the value of Meridian's assets. Meridian's Dam Safety Assurance Programme sets out the practices and activities that are required to meet our obligations set out in the Dam Safety Policy. Included in the Dam Safety Assurance Programme is a programme of Structural Safety Evaluations which are undertaken for all hydraulic structures. The evaluations assess the dam's structural performance against a current understanding of extreme seismic and flood loads. Accordingly, our Generation and Natural Resources team regularly review the modelled Probable Maximum Flood for the purposes of dam safety assurance and closely monitor forecast inflow events and wind patterns. The safety criteria for all high potential impact category dams is that they will not fail under extreme flood or seismic loads. All of Meridian's dams meet this safety criteria.

Our Generation and Natural Resources team also maintain a 20-year strategic asset management plan, which incorporates any investment that might be required to ensure the ongoing safety of our dams over their life time. As a priority risk, responsibility rests at a General Manager level within management and bi-annual formal reports are made to the Audit and Risk Committee. Our management and the design and conditions of our assets make such a risk significantly unlikely, and Meridian has significant insurance in place to cover material damage and business interruption losses. However, it is possible that this won't be enough should a single catastrophic event occur, or multiple catastrophic events occur in succession, or where insurers contest or delay paying insurance claims.

Transitional risks

We research the latest literature to inform our view of the potential impacts to our business from transition changes. Based on this information we have developed three different electricity demand scenarios (note that in all these scenarios the physical impacts on water and wind energy availability are the same, as the range of uncertainty in estimations of inflow, wind, and demand is greater than any discernible differences between low-mid (2 degree) and high (4 degree) emissions scenarios in the timeframe considered in our scenarios (out to 2050)):

Evolution: This scenario represents electricity market demand over the next 30 years using current trends, including moderate improvements in energy efficiency, demand increases from population growth, and a moderate increase in electrification of transport and industrial heat conversion. This scenario is more or less “business as usual” and represents a world in which no major policy changes have been enacted that would create significant industry disruption or regulatory constraints on the electricity market.

Revolution: This scenario represents electricity market demand over the next 30 years where greater steps are taken to decarbonise transport and process heat, and assumes significant increase in climate-related policy, in order to achieve a 2°C world. This scenario is viewed as a high-demand stress test.

NZAS exit: This is a version of the Evolution scenario, and is a good approximation of the impact on demand should there be significant disruption to industry leading to a significant reduction in demand (similar to

the impact of New Zealand Aluminium Smelter exiting the market) which could also occur from climate change or climate change mitigation actions.

These scenarios are updated regularly in response to new information or as required by our Risk Management Policy. An overview of the key impacts to Meridian from transition changes are summarised here.

Table 2. Top transitional climate risks for Meridian Energy

Transitional risks			
Risk drivers	Industry disruption	Technology	Policy & legal
Risk rating	High	Medium	Medium
Modelling timeframe	Long-term – 30 years		
Physical changes	<ul style="list-style-type: none"> Agriculture, industrial and other emission-intensive sectors transition 	<ul style="list-style-type: none"> Changes in technology costs Uncertainty around future technology developments 	<ul style="list-style-type: none"> Changes to regulations Legal precedents
Operational impacts	<ul style="list-style-type: none"> Risk of reduced electricity demand caused by industry disruption Opportunity for increased demand due to electrification of transportation and industrial heat processes 	<ul style="list-style-type: none"> Risk of unsuccessful investment decisions Risk of increased costs (direct and indirect) from the transition to lower emissions technology 	<ul style="list-style-type: none"> Risk of market constraints and market price increases due to increasing regulations Risk of statutory change reducing Meridian's access to water should there be reduced water availability
Management response	<ul style="list-style-type: none"> Updating market demand forecasts for each scenario, based on the most recently available market information and data Pursuing alternative forms of electricity demand across two workstreams focussed on: electrification of transport, electrification of industrial heat 	<ul style="list-style-type: none"> Maintain up to date marketplace information on technology cost curves Continue to monitor cost of generation from other energy sources 	<ul style="list-style-type: none"> Continue to engage with climate change regulatory processes Continue to examine how the electricity industry might best approach 100% renewable Continue to engage with Resource Management Act processes and maintain iwi relationships
Primary measures & metrics	<ul style="list-style-type: none"> Market demand forecasts for each scenario Progress against workstream action plans 	<ul style="list-style-type: none"> Levelised cost of electricity (LCOE) for technology types Economics of full pipeline of potential investment opportunities 	<ul style="list-style-type: none"> Mid to Long-term carbon price assumptions Relevant government policy & regulatory updates

Industry disruption

The transition to a low carbon future presents several market opportunities for Meridian, including a projected increase in demand for renewable electricity driven primarily by the electrification of transportation and industrial heat processes. In both Evolution and Revolution scenarios, positive demand growth should support long term value increase for the business on the back of the need for new renewable generation.

In addition, there is a key reputational opportunity for Meridian associated with the industrial transition to a low emissions future. This comes through playing a proactive role in supporting industries in the decarbonisation process by providing them with relevant advice and expertise. For example, we have developed a tool to help our commercial customers assess the economic viability of converting their vehicle fleets to electric vehicles. The uncertainty around what climate action related solutions might emerge in the medium to long term makes it difficult to quantify the potential size of this opportunity.

There are also many uncertainties concerning how emissions intensive industries, such as agriculture and tourism, will successfully transition towards a low emission future. For Meridian, this uncertainty brings a level of risk in terms of trying to understand what the future electricity market might look like following this disruption. We use a scenario aligned with the withdrawal of the New Zealand Aluminium Smelter (which represents approximately 12% of total NZ electricity demand) as a proxy to examine the impacts of industry disruption, which could cause a significant reduction in electricity demand. For example, NZAS can consume around 40% of Meridian's generation output in any year. A closure of the smelter, or any other significant reduction

in demand, would likely result in a near term reduction in Meridian's revenue, as a period of oversupply (which would likely be reflected in lower short-term wholesale prices) would result as the market adjusts. The severity of the impact on Meridian would depend on a number of variables, including removing transmission constraints, and the response of other electricity generators (eg. thermal generation may be mothballed or retired which would reduce supply and moderate any reduction in wholesale electricity prices). A similar situation could occur should climate change related policies reduce demand from emissions intensive industries, although the resulting impacts would be less if the disruption was more gradual.

Combined, these projected scenarios provide us with a broad view of potential market outcomes, which are used to inform our business decisions.

Technology

There are many transition uncertainties that pivot around changes in technology costs. The principle risks relative to Meridian's operations include making unsuccessful investments in new technologies. This may also bring significant opportunity if prices of evolving technologies continue to fall. Based on current trends we expect technologies such as solar, wind and batteries to continue to decrease in cost over time. In the immediate term, we are continuing to invest in existing technologies, such as wind power, as we expect these to continue to be economic over the next 30 years.

To manage these uncertainties, Meridian engages in knowledge sharing events and invests resources in reviewing current and forecast technology costs to understand the financial impacts of developments in new technologies. This includes modelling the range of potential projected costs and capabilities of technologies such as solar, wind and batteries over a medium to long-term timeframe. We combine this information with our market demand forecasting and the likely retirement schedule of existing generation assets. This provides us with an informed view to assess future investment opportunities. We update this information based on external drivers such as changes in policy or supply chain costs, or as other relevant information becomes available.

Policy & legal

Changes to public policy have the potential to significantly impact Meridian's business. For example, there is a risk that regulatory constraints may be placed on electricity pricing, impacting spot and wholesale electricity market prices. Regulatory changes such as these will impact on our vertically integrated business model.

To manage this, we remain engaged with regulatory processes. We also closely monitor the potential future pathways that the NZ electricity industry may take to become 100% renewable, and the potential regulatory mechanisms that may be put in place to assist with the last few percent of that transition.

For example, our scenario modelling assumes a long-term price of carbon at around \$50 - \$100 (NZD) per tonne of GHG emitted. This is based on current estimates and trends of international carbon pricing. We use this carbon price range to model the marginal cost of abatement for thermal electricity generation in NZ.

We also manage the risk from statutory change or legal precedents that could reduce Meridian's access to water. Such a reduction may come from direct government policy change (eg imposition of environmental taxes or other forms of water charging) or from local Resource Management Act (RMA) processes going through to the environment court. To manage this, we continue to engage with RMA processes and a variety of stakeholders who also have strong interests in water issues in New Zealand.

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 our direct impacts

Greenhouse gas (GHG) emissions

We monitor our direct climate-related impacts using a variety of models, metrics and calculations. In addition, we report our annual Scope 1, 2 and 3 greenhouse gas emissions (audited Meridian Group greenhouse gas inventories are [available online](#)).

For the 2019 financial year, we will be net Zero Carbon for our Group operational greenhouse gas emissions across our value chain, through purchasing and retiring Gold Standard Voluntary Emission Reduction certificates. In the medium term, we aim to be using credits we have generated ourselves through forestry projects, the first of which will begin planting in late 2019.

From FY13 to FY18 we had a target to reduce our corporate emissions by 10% per FTE, and exceeded this target, reducing by 17%. We continue to pursue carbon reductions through implementing energy efficiency measures (for example reducing our business travel) and continuing to expand our fleet of electric vehicles (we have a target of 90% of our passenger vehicles to be 100% battery electric by the end of 2020, and are currently over 80%).

We have investigated the use of applying a Science Based Targets in our approach towards reducing our emissions profile. However, as a 100% renewable energy generator with no direct emissions from generating electricity, we found that we are already below the proposed emissions intensity target for the electricity sector (0.03 tCO₂e/MWh by 2050, whereas we have zero Scope 1 emissions from generating electricity), and therefore this methodology is not relevant to our operations.

We have instead chosen to take a bold approach to carbon reduction, and despite our low levels of emissions, we have set an absolute target across the Group of halving our operational greenhouse gas emissions by 2030.

Measuring our indirect impacts and opportunities:

Meridian acknowledges its role as a key player in the transition to a low-emissions economy and assisting New Zealand in meeting its international climate change commitments. We view this as a strategic opportunity to grow our business in three areas: grid-level renewable energy; electric vehicles; and large-scale solar electricity.

Grid level renewable energy

As a 100% renewable energy generator, we acknowledge that the electricity system is currently unable to serve all of New Zealand consumers without some reliance on the 15% of fossil fuel power that is currently included in the electricity generation mix, to ensure security of supply and affordability. Therefore, our aspiration is to support the NZ electricity system as a whole in reaching 100% renewable. We remain confident that the current market structure and increasing carbon prices will create the investment incentives needed to achieve at least 95%. We also closely monitor future pathways that the NZ electricity industry may take to achieve the last few percent of that transition.

Electric vehicles

New Zealand's transport sector currently contributes approximately 20% of New Zealand's total GHG emissions. We see this as a large opportunity for Meridian and the electricity sector, as passenger and light duty vehicles transition to EVs. Our targets include: supporting New Zealand's electrification of transport goals, increasing the number of Meridian customers who own electric vehicles, and our own internal electric vehicle fleet targets.

Solar electricity

Solar technology is rapidly reducing in cost, and may be cost-competitive with existing utility scale technologies in the next 5-10 years. Already we are providing business customers with large solar arrays, and we have a partnership to provide solar systems to residential customers. Our target is to increase the number of large solar arrays we have provided under our Power Purchase Agreement (PPA) model.