Māori economy emissions profile

Climate change mitigation impact on the Māori economy

Hōngongoi 2021

berl

Making sense of the numbers

Land Use Capability Assessments

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Executive summary

Māori economy overrepresented in New Zealand's emission profile

In 2018, the Māori economy gross greenhouse gas (GHG) emissions were 8.1 million tonnes of carbon dioxide equivalent (Mt CO_2-e). This accounts for 11.2 percent of New Zealand's total emissions profile. Taking a split-gas approach, the Māori economy makes up 8.9 percent of New Zealand's long-lived GHG emissions, and is 13.8 percent of total short-lived GHG emissions (i.e. methane). However, the Māori economy's share of New Zealand's gross domestic product (GDP) is 6.4 percent. As such, the Māori economy is overrepresented in New Zealand's emissions profile. This overrepresentation is in terms of both long-lived GHG emissions and methane emissions, although long-lived GHG emissions are overrepresented to a lesser extent. The overrepresentation in methane emissions is largely due to the Māori economy's activities in the agriculture sector.

Areas of risk in the Māori economy for the transition to low emissions economy

- Māori collectives (this includes both collectives constituted under Te Ture Whenua Māori and iwi) are heavily invested in agriculture, especially sheep and beef, and dairy. Since collectives are responsible for managing assets for the benefit of their members, challenges they face in the transition to a low emissions economy may negatively impact Māori whānau
- Land use characteristics of Māori freehold land mean that these landowners may have more limited options and face challenges in terms of land use change
- Māori freehold land has high forest coverage, but a large portion was planted before 1990, rendering this land ineligible for earning emissions trading units. The land owner is also likely to be liable to pay carbon credits if deforestation occurs and the area is not replanted into forest. The implication is that it may be expensive to change the land use of pre-1990 forest land
- Māori are overrepresented in lower-skilled jobs, which are likely to be lower-income. This may provide a barrier for transition to the low emissions economy
- Māori SMEs make up almost all of the Māori asset base for transport, construction, and manufacturing. The transition towards a low emissions economy is likely to require significant capital expenditure for these Māori SMEs, which also face access to capital barriers.

However, climate change also brings opportunities

Based on the composition of the Māori economy, there are opportunities for:

- Reducing emissions from high emissions industries, (i.e. primary sector, manufacturing, and transport)
- Expanding low emissions industries (i.e. education and training, and health and social sector)
- Creating and growing industries that are transition-aligned (i.e. ETS, bioeconomy, renewable and distributed energy, low emissions food, manufacturing using circular economy principles, blue economy, and sharing economy).

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1 Introduction

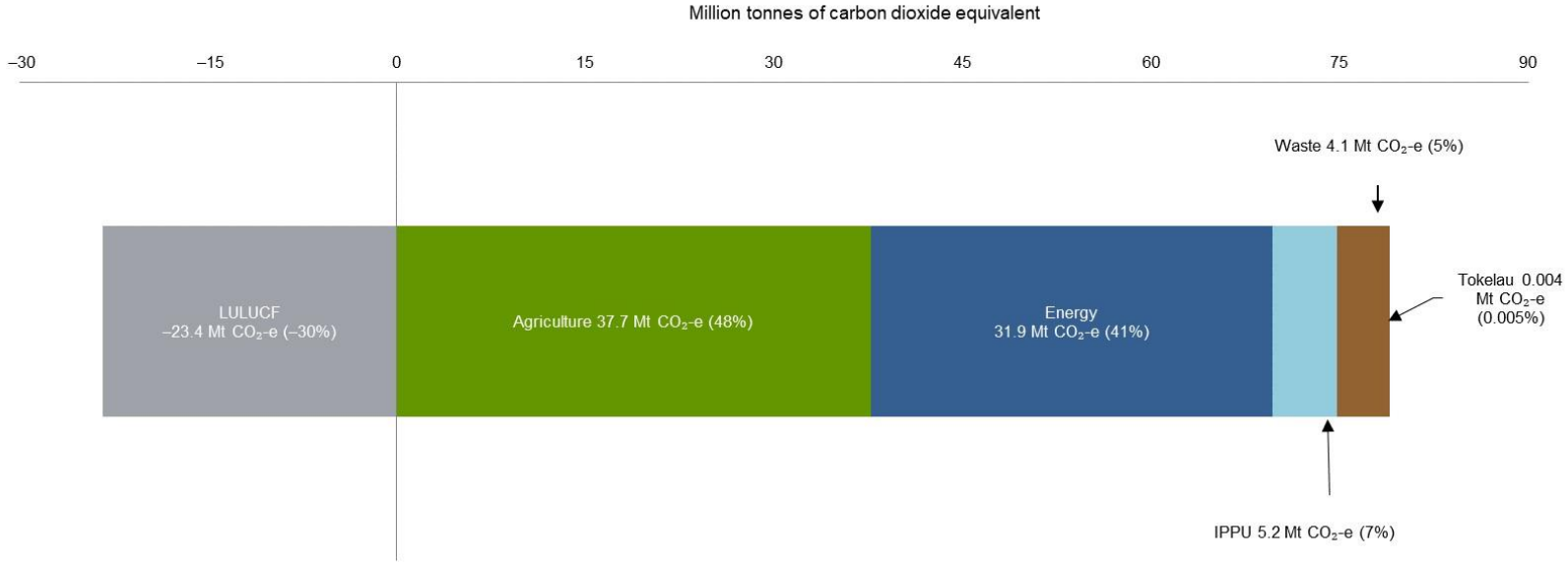
Business and Economic Research Limited (BERL) and Land Use Capability (LUC) Assessments were commissioned by the Ministry for Primary Industries (MPI) and Ministry of Business, Innovation, and Employment (MBIE) to create an emissions profile for the Māori economy. The aim of the project was to help MPI and MBIE understand vulnerabilities and opportunities for the Māori economy in the transition to a low emissions economy.

1.1 Climate change mitigation background

1.1.1 New Zealand's emissions profile

In 2018, New Zealand's gross greenhouse gas (GHG) emissions were 78.9 million tonnes of carbon dioxide equivalent (Mt CO_2-e) (Ministry for the Environment, 2020a). As shown in Figure 1, the agriculture sector and the energy sector, which includes transportation, were the biggest contributors to GHG emissions; responsible for 48 percent and 41 percent of gross emissions, respectively. The Land Use, Land-Use Change and Forestry (LULUCF) sector offset 30 percent of gross emissions, with emissions of -23.4 Mt CO_2-e.

Figure 1 New Zealand's emissions profile in 2018



Source: Ministry for the Environment – New Zealand's Greenhouse Gas Inventory, 1990 – 2018

1.1.2 Emissions reduction targets

The global international target in the Paris Agreement 2015 is to hold the increase in the global average temperature to below 2.0 degrees above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5 degrees above pre-industrial levels. The Paris Agreement requires all signatories to put forward their best efforts through 'nationally determined contributions' (NDC). New Zealand's NDC commits to a 30 percent reduction below 2005 emissions (or 11 percent below 1990 emissions) for the period 2021-2030. New Zealand's domestic emissions reduction targets are set out in the Climate Change Response (Zero Carbon) Amendment Act 2019. These are:

i) Net zero emissions for all greenhouse gases other than biogenic methane by 2050

ii) 24 to 47 percent below 2017 biogenic methane emissions by 2050, including 10 percent below 2017 biogenic methane emissions by 2030.

1.1.3 Climate change mitigation policies

The Zero Carbon Act (2019) provides the framework to develop and implement climate change mitigation policies. It does this by:

- Establishing a system of emissions budgets to act as stepping stones towards the long-term target. Each emissions budget covers a period of five years
- Requiring the Government to develop and implement policies for climate change adaptation and mitigation
- Establishing a new, independent Climate Change Commission (the Commission) to provide expert advice and monitoring to help keep successive governments on track to meeting long-term goals.

The Commission delivered *Ināia tonu nei: a low emissions future for Aotearoa* to the Minister of Climate Change on 31 May 2021. The advice in the report detailed the paths Aotearoa can take to meet its agreed emissions reduction targets. The report also advises the Government on its first three emissions budgets (2022–2025, 2026–2030, and 2031–2035), and provides advice on the policy direction required for an emissions reduction plan to meet these budgets. The Government will respond with its first three emissions budgets, and a policy plan to achieve the first budget, by 31 December 2021.

The advice report provided key elements for policy direction, including:

- Working in partnership with Iwi/Māori, and with local government, to ensure the transition to a low emissions economy is firmly rooted in the principles of Te Tiriti o Waitangi/The Treaty of Waitangi
- Supporting a Māori-led approach to an equitable transition for Iwi/Māori and the Māori economy.

1.2 Māori economy background

Over the past 15 years, significant research, information, and effort has gone into establishing the concept and context of the Māori economy within New Zealand. This effort has included understanding the composition and contribution of the Māori economy. Consequently, the Māori economy is a widely used concept and accepted in government and the business sector.

In 2012, the *Asset Base, Income, Expenditure and GDP of the 2010 Māori Economy* report was published (BERL & Te Puni Kōkiri (TPK),

2012). This report estimated the size of the Māori economy, and illustrated the relationships between the Māori economy and the wider New Zealand economy.

In 2015, this report was updated and expanded to present an overview of the 2013 Māori economy based primarily on 2013 Census data (BERL & TPK, 2015). This provided further valuable information and findings about the landscape of the Māori economy, such as highlighting that the Māori economy GDP arose from an asset base totalling $42.6 billion. This information has been widely used throughout government to inform policy, and by Māori entities to understand their position within the broader Māori economy.

Te Ōhanga Māori 2018 report showed that since the *Māori Economy Report 2013*, there has been a significant step change in the Māori economy. The report highlighted that there has been significant growth in the Māori population and labour force, as well as significant growth and diversification of the Māori asset base. It found that the Māori economy consists of activity and enterprise that is far beyond Te Tiriti settlements. The research also showed the increasing prominence of Māori employers.

Other research has shown that the Māori economy is a fast growing economy. Value added GDP by Māori enterprises grew 9.2 percent between 2013 and 2018, compared to six percent in non-Māori enterprises (BERL & Climate Change Commission, 2021). The average annual growth rate across individual post-settlement governance entities between 2013 and 2018 ranged between four percent and 15 percent (TDB Advisory, 2020). Should these rates continue, there will be a significant increase in assets and contribution to the economy by 2050.

Climate change poses risks and challenges for the Māori economy, as it does for the New Zealand economy and the global economy. However, climate change also brings opportunities. Strategic planning can help these opportunities be realised. This report draws upon Māori economy data to estimate the Māori economy emissions profile on a sector and rohe (regional) basis. The combination of emissions data and economic data is used to identify vulnerabilities to climate mitigation and to identify opportunities.

1.3 Methodology

The scope of this report was to combine and analyse economic and environmental data sets to create a Māori economy emissions profile, and to identify the key insights. To do this, the research took a macro-economic approach to establish a Māori economy emissions profile. This approach used the Māori gross domestic product (GDP) data from the *Te Ōhanga Māori 2018* report data sets, together with sector-based emissions data from Statistics New Zealand. The report includes comparisons between the Māori economy and the economy of all New Zealand. All New Zealand includes the Māori economy, unless otherwise explicitly stated. It is likely that the differences highlighted in this report would be more pronounced if the Māori economy were compared to the non-Māori economy. Please note the difference in horizontal scales for some of the graphs throughout the report.

1.3.1 Definitions

Māori business

Defining a Māori business is complicated, as businesses do not record ethnicity as part of business registration. Changes to the National Business Number register to enable companies to self-identify as a

Māori business are relatively recent.[1] However, Census data collects information about the ethnicity of business owners. For the purposes of measuring the Māori economy, a Māori business was deemed to be when a business, individually or collectively, was owned by someone identifying as Māori.

Māori freehold land

Te Ture Whenua Māori Act 1993 (the Māori Land Act), decrees that all land in New Zealand shall have a status, which may be:

- Māori customary land – land held by Māori in accordance with tikanga Māori, not transferred into freehold land or ceded to the Crown
- Māori freehold land – land that has remained in Māori control and ownership as determined by the Māori Land Court
- General land owned by Māori – land owned by a Māori individual or owned communally by a group of persons, where the majority are of Māori descent. This land is not Māori land under Te Ture Whenua Māori. This includes land owned by iwi and land that is privately owned by Māori individuals
- General land – land that is not Māori land, general land owned by Māori or Crown land
- Crown land – state owned land
- Crown land reserved for Māori – state owned land that has been set aside for the use or benefit of Māori (Federation of Māori Authorities Inc. (BERL & FOMA), 2019).

Te Ture Whenua Māori Act 1993 defines Māori land as Māori customary land and Māori freehold land. There are approximately 1.4 million hectares of Māori land, which is 5.7 percent of New Zealand (BERL & FOMA, 2019). Almost all Māori land is freehold; there are only 1,204 hectares of customary land. Section 2.4 of this report provides insights into carbon dioxide (CO_2) removals by the Māori forestry sector. Due to data limitations, this analysis only covers Māori freehold land.

Māori land and general land owned by Māori have a range of governance structures, such as incorporations and Māori trusts.

Collectives

Collectives include iwi, incorporations and Māori trusts.

Iwi

A post-settlement governance entity (PSGE) must be established before an iwi receives Treaty settlement assets. Once those assets are passed on to the PSGE, the trustees of the PSGE have the power and ability to do as they please with those assets (in accordance with the law and the trust deed). PSGEs are generally set-up as trust holding entities. This is because trusts are generally considered the best type of entities for safe-guarding the assets on behalf of members of the iwi, ensuring accountability back to members of the iwi, and promoting good governance.

Group holdings are the commercial 'arm' of iwi, connected to their governance board. There are approximately 85 iwi in New Zealand, investing in a diverse range of sectors including: fishing, agriculture, forestry, horticulture, property, tourism, education, healthcare, and managed funds. Examples of commercial entities that have been set up by iwi are Ngāi Tahu Holdings and Tainui Group Holdings. These

[1] https://www.mbie.govt.nz/about/news/maori-business-identifier-goes-live/

entities are responsible for managing the commercial portfolio, including a substantial asset base, for the benefit of iwi members.

Trusts/Incorporations

Te Ture Whenua Māori Act 1993 establishes five types of trusts aimed at making the administration and management of Māori land easier. These are: Ahu Whenua trust, Whenua Tōpū trust, Whānau trust, Pūtea trust, and Kaitiaki trust. Most land is held in an Ahu Whenua trust. The purpose of the trust is to manage the land itself for the benefit of the owners and gives the flexibility for commercial use of the land.

A Māori incorporation is a structure similar to a company, and can be established over any Māori land. Te Ture Whenua Māori Act 1993 outlines that Māori incorporations have power to do everything a body corporate can do.

Pre-1990 forest land and post-1989 forest land

The Emissions Trading Scheme (ETS) has a specific definition of forest land. Within this definition, forest land is classified differently depending on when it was first established: pre-1990 or post-1989. Post-1989 forests are forests first established after 31 December 1989 and can earn carbon credits. Pre-1990 forest land is land that was forest land on 31 December 1989 and it cannot earn carbon credits. The land owner is likely to be liable to pay carbon credits if deforestation occurs and the area is not replanted into forest. The implication is that it may be expensive to change the land use of pre-1990 forest land.

1.3.2 Data sources

This report used the following data sources (see Appendix A for references):

- Economic data
  - Data underlying *Te Ōhanga Māori 2018* report by BERL (2020)
- Emissions data
  - Greenhouse gas emissions by region (industry and household): Year ended 2018. Statistics New Zealand Tatauranga Aotearoa
- Land Use, Land Use Change and Forestry data on Māori freehold land
  - Māori Land Court Land GIS Layer
  - LUCAS New Zealand Land Use Map.

This report uses 2018 GHG emissions data to be consistent with the other data sources used for this report, (i.e. *Te Ōhanga Māori 2018* report).

It is unlikely that the Māori economy emissions profile would be significantly different if 2019 data was used instead. New Zealand's gross GHG emissions increased by two percent between 2018 and 2019 (Ministry for the Environment, 2021). The energy sector was the main driver behind the increase. The other sectors (Agriculture, Industrial Processes and Product Use, and Waste) only changed by a small amount.[2]

[2] In New Zealand's Greenhouse Gas Inventory, emissions and removals are categorised into six sectors: Energy (e.g. road transport and electricity production), Industrial Processes and Product Use (IPPU) (e.g. production of metals and chemicals, and use of refrigerants), Agriculture (e.g. livestock digestive systems, fertiliser and manure), Waste (e.g. landfills), Land Use, Land-Use Change and Forestry (LULUCF) (e.g. forests, crops and pasture) and gross emissions from Tokelau.

1.3.3 Assumptions

A central assumption underlying this report is that emissions intensity (GHG emissions per unit GDP) is the same for the Māori economy as for the entire economy. The emissions for each sector of the Māori economy are calculated from the emissions from that sector for the entire economy multiplied by the Māori share of GDP within that sector. This analysis does not include household emissions. We have also assumed that the emissions intensity is the same across the following service sectors:

- Information media and telecommunications
- Financial and insurance services
- Rental, hiring and real estate services
- Professional, scientific and technical services
- Administrative and support services.

The national emissions data from Statistics New Zealand provided a single aggregate value for these sectors. This assumption allowed us to estimate emissions based on the national and Māori economic data that was disaggregated to this level.

1.3.4 Limitations

This report explores the opportunities and vulnerabilities to the Māori economy of the transition to a low emissions economy. The approach taken in this report was to analyse the industry composition of the Māori economy asset base, GDP and workforce. This was done by classifying industries as high, moderate or low based on the industries emissions intensity. This approach is helpful for exploring how different industries may be impacted by climate change mitigation, but it does have limitations. Firstly, the narrow focus on industry composition does not provide a full picture of how the Māori economy will be affected by climate change mitigation. Secondly, classifying the industries it is not an exact science, and as such professional expertise was used to decide upon the categories of high, moderate or low emitting industries. Further explanation of our methodology is outlined in Appendix B.

Lastly, this report uses data that has taken a production (or supply-side) approach to measuring emissions, and deals with the industry component of those emissions but not the household component. While this approach is appropriate for a joint economic/environmental analysis focusing on sector-based emissions, this approach fails to capture emissions associated with the use of goods and services by households.

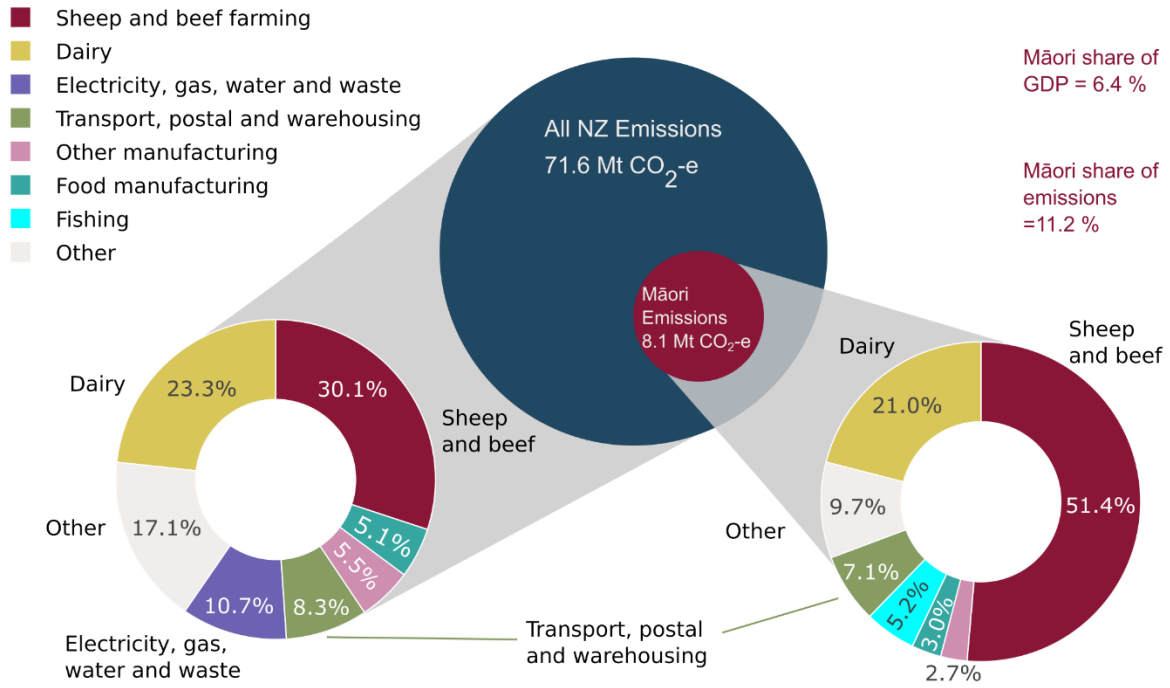
In terms of the net emissions analysis, CO_2 removals by the Māori forestry sector are only calculated for Māori freehold land (and do not include removals by forests owned on general title land by iwi PSGEs, for example). The calculation is based on the relative amounts of pre-1990 and post-1989 forests on Māori freehold land (based on the Ministry of Justice Māori Land Court spatial layer).

2 Māori economy emissions profile

2.1 National level analysis

In 2018, gross GHG emissions from the Māori economy were 8.1 million tonnes of carbon dioxide equivalent (Mt CO_2-e) and were 11.2 percent of New Zealand's total emissions profile. The Māori economy's share of New Zealand's GDP is 6.4 percent. A significant proportion of the New Zealand emissions profile is from the sheep and beef industry (30 percent), and from the dairy industry (23 percent). This is more pronounced for the Māori economy. As shown in Figure 2, over half of the Māori economy emissions are from the sheep and beef industry (51 percent), and 21 percent are from the dairy industry. Together these make up 72 percent of the Māori economy emissions profile which translates to 8.2 percent of New Zealand's profile.

Figure 2 New Zealand and Māori economy emissions profile by industry

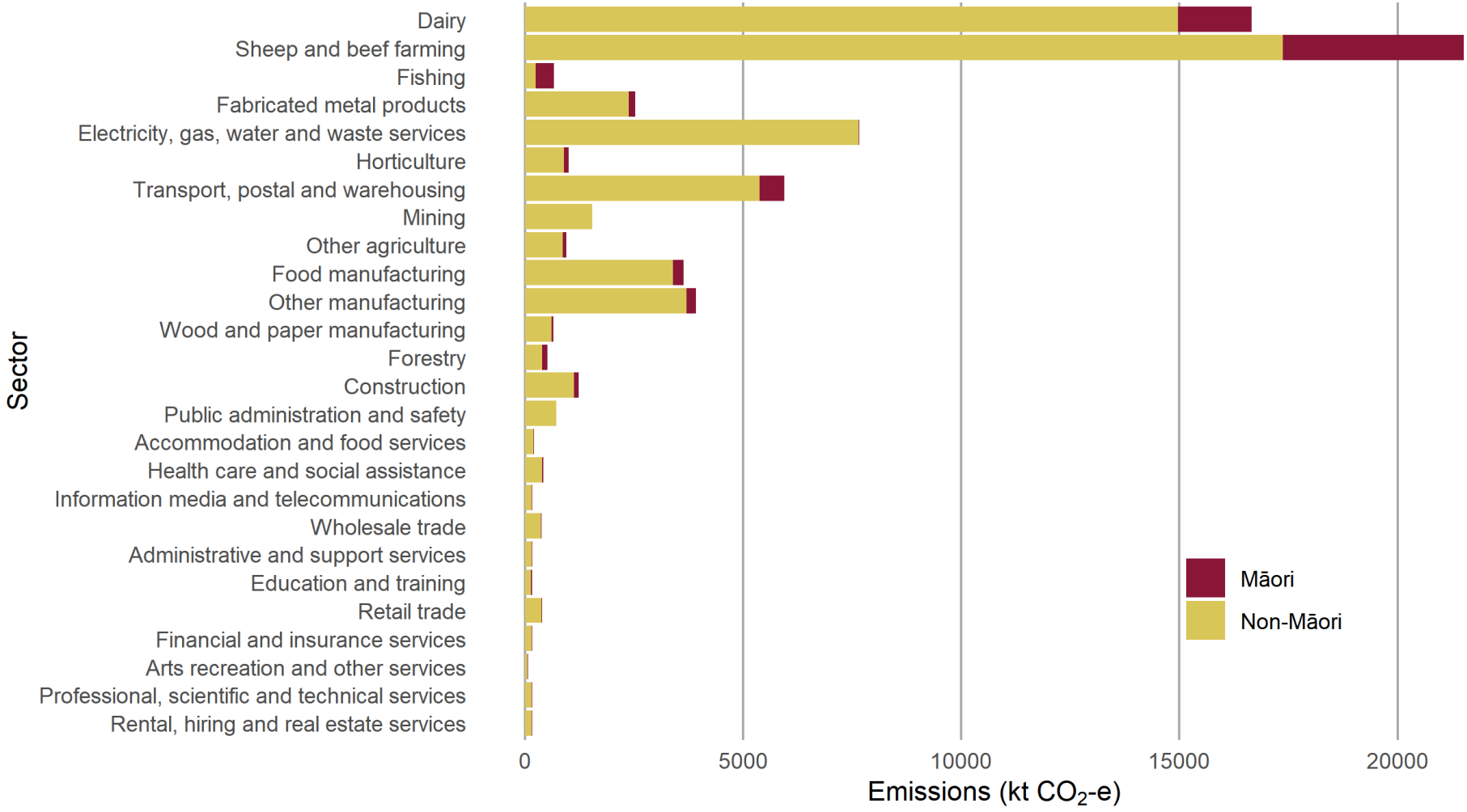


Source: Statistics New Zealand, BERL, and LUC Assessments analysis

Figure 3 provides both the total New Zealand emissions profile and the Māori economy emissions profile by industry. This data highlights the following:

- New Zealand's emissions profile is dominated by sheep and beef, and dairy, and that the Māori economy emissions profile is even more dominated by these industries
- Electricity, gas, water, and waste services is the next biggest contributor to the total New Zealand emissions profile. For Māori entities that own assets across multiple industries where the asset value per industry could not be assigned, BERL assigned the total asset value across the industries based on other entities information. This had the unintended consequence of pushing Māori asset values towards industries with large Māori asset bases and away from industries with smaller Māori asset bases, but ensured that BERL did not overstate the value of industries with smaller numbers, such as electricity, gas, water, and waste. In addition, the quality of the data available on electricity, gas, water, and waste, as well as mining, meant that no private business assets were able to be calculated for these industries
- Other industries that are large contributors to the Māori economy emissions profile are transport, manufacturing, construction, and other primary sector industries
- The Māori economy has a significant share of the fishing industry's emissions. This is because Māori are estimated to own 40 percent of the country's fishing quota through iwi, Moana New Zealand (Aotearoa Fisheries Limited), and other entities. However, fishing overall accounts for less than one percent of New Zealand's total gross emissions.

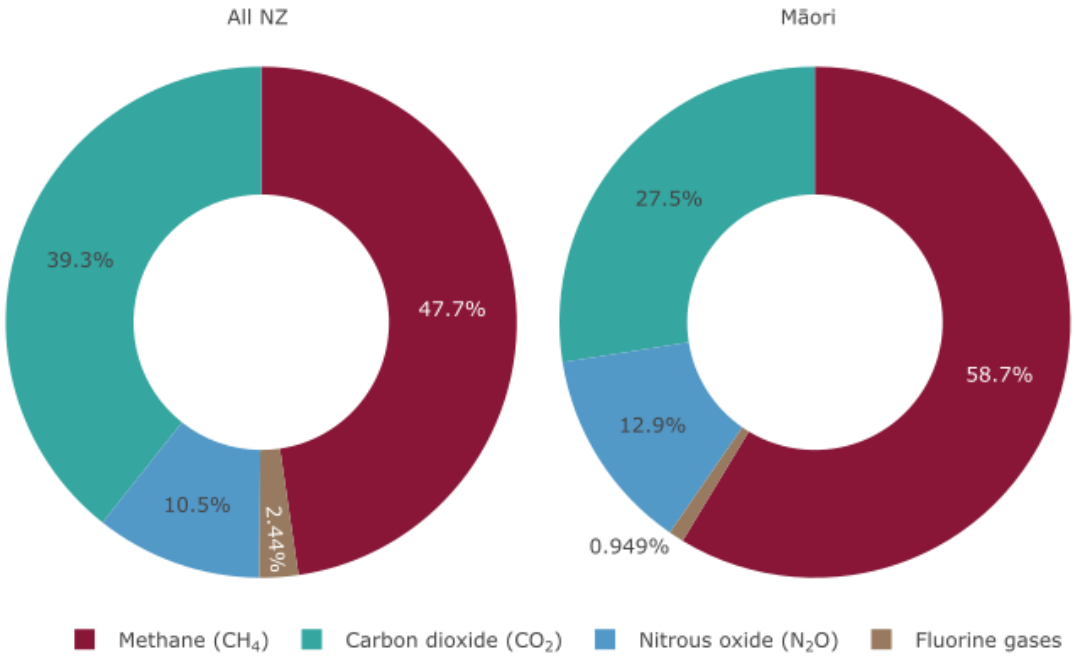
Figure 3 New Zealand and Māori economy gross emissions by industry



Source: Statistics New Zealand, BERL, and LUC Assessments analysis

The overrepresentation of the primary sector in the Māori economy emissions profile is reflected in the GHG emissions breakdown (see Figure 4). Nearly 60 percent of the Māori economy emissions profile comes from methane (CH_4), compared to 48 percent of the New Zealand emissions profile. The Māori economy also has a greater percentage (12.9 percent) of nitrous oxide (N_2O), compared to the total New Zealand emissions profile (10.5 percent). Again, this is because the Māori economy has a greater investment within the primary sector compared to total New Zealand (and nitrous oxide is predominantly produced by agriculture). The heavy investment in livestock agriculture is mainly responsible for the high CH_4 and N_2O emissions.

Figure 4 New Zealand and Māori economy emissions broken down by gas



Source: Statistics New Zealand, BERL, and LUC Assessments analysis

2.2 Rohe level analysis

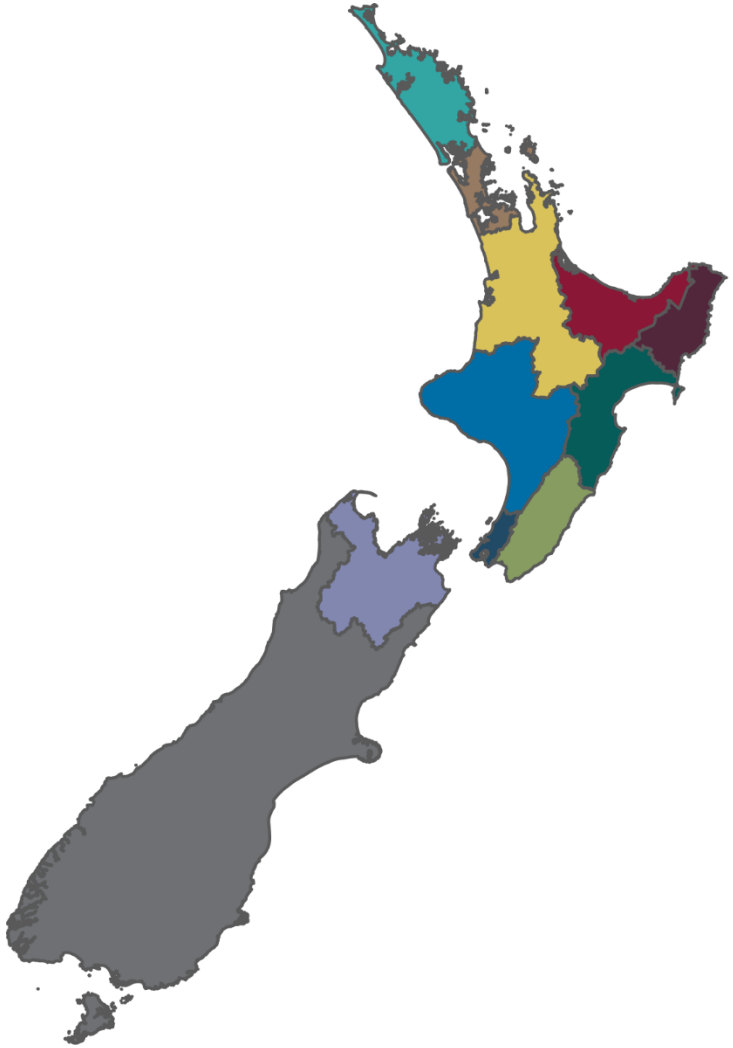
In New Zealand, the Māori population increased from 598,602 in the 2013 Census to 775,836 in the 2018 Census. Furthermore, Māori increased from 15 percent of the total population to 16.5 percent. This is a growth rate of 30 percent. There are rohe where the Māori population is higher. In particular, Māori are over half of the population in Tairāwhiti.

Figure 5 provides a rohe map, presenting Māori population data and emissions data (total and Māori share of rohe emissions).

It is important to note the following:

- For emissions analysis, Kurahaupō is included in Te Whanganui ā Tara rather than being separate. This is due to the greenhouse gas emissions data being in an accordance with the local government boundaries. Kurahaupō is a separate rohe for the economic analysis
- Waikato rohe includes Taupō. This is because the map has been based on statistical areas to align with the data
- Waitaha, which is most of the South Island, is much larger in size than other rohe.

Figure 5 Rohe map, detailing total emissions from the Māori economy in that rohe, Māori share of overall rohe emissions, and Māori population



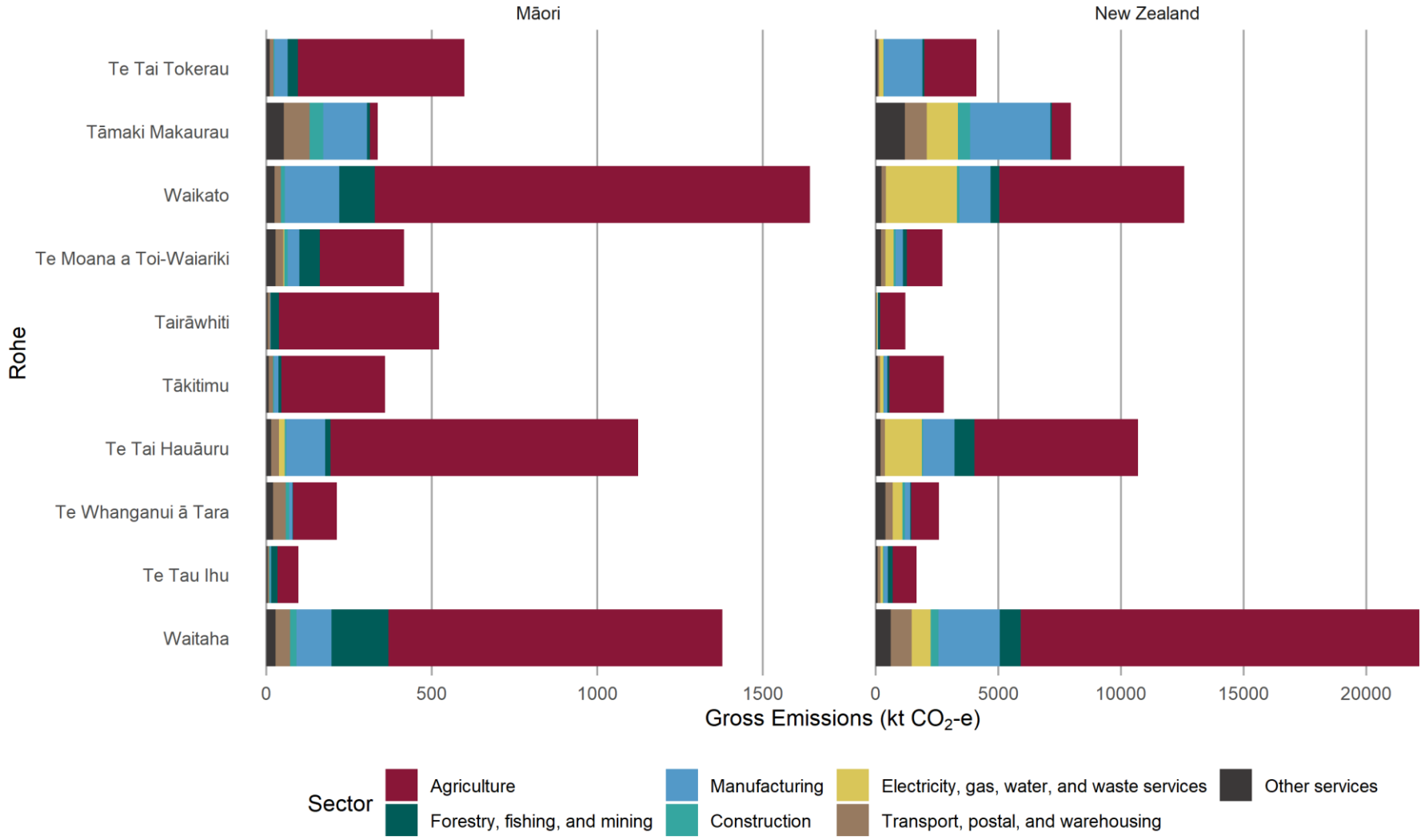
Rohe	Emissions (kt CO2-e)	Māori share of rohe emissions (%)	Māori population count and proportion (%)
Te Tai Tokerau	597	14.6%	64,461 (36.0%)
Tāmaki Makaurau	337	4.2%	181,194 (11.5%)
Waikato	1,642	13.1%	108,609 (23.9%)
Te Moana a Toi-Waiariki	415	15.3%	90,666 (29.1%)
Tairāwhiti	522	42.8%	25,572 (53.1%)
Tākitimu	359	12.9%	44,913 (27.0%)
Kurahaupō	-	-	12,588 (19.9%)
Te Tai Hauāuru	1,123	10.5%	73,434 (21.7%)
Te Whanganui ā Tara	212	8.2%	64,083 (13.9%)
Te Tau Ihu	96.2	5.8%	16,311 (10.8%)
Waitaha	1,377	6.2%	93,987 (9.9%)

Source: Statistics New Zealand, BERL, and LUC Assessments analysis

As discussed, agriculture is a significant proportion of the Māori economy emissions profile. Figure 6 shows that most rohe have agricultural emissions, however the dominance of agricultural emissions varies. Tāmaki Makaurau has low agricultural emissions, both in absolute terms and as a portion of overall rohe emissions. Conversely, Waikato has both large absolute and relative emissions. Furthermore, in some rohe, emissions are almost exclusively from agriculture, while other rohe have a more diverse emissions profile. Emissions from the Māori economy within less urban areas are significantly more dominated by agriculture (e.g. Waikato, Waitaha and Te Tai Hauāuru). Accordingly, the challenges regarding climate change mitigation will differ between rohe. For example, rural areas that are involved in land-based activity may require assistance to mitigate emissions or change land use. Whereas in urban areas, it may be more important to focus on supporting a transition to renewable energy for industrial heat and transport.

Waitaha, which is most of the South Island (as shown in Figure 5), is the rohe with largest area of agricultural land. Accordingly, it accounts for a substantial share of total New Zealand's emissions (31 percent), compared to other rohe. However, the Māori economy emissions from Waitaha are more closely aligned with other rohe and only accounts for 17 percent of the Māori economy's emissions profile. This is because the Māori economy's GDP and asset base in Waitaha is of similar size to those of other rohe.

Figure 6 New Zealand and Māori economy gross emissions, broken down by sector and rohe

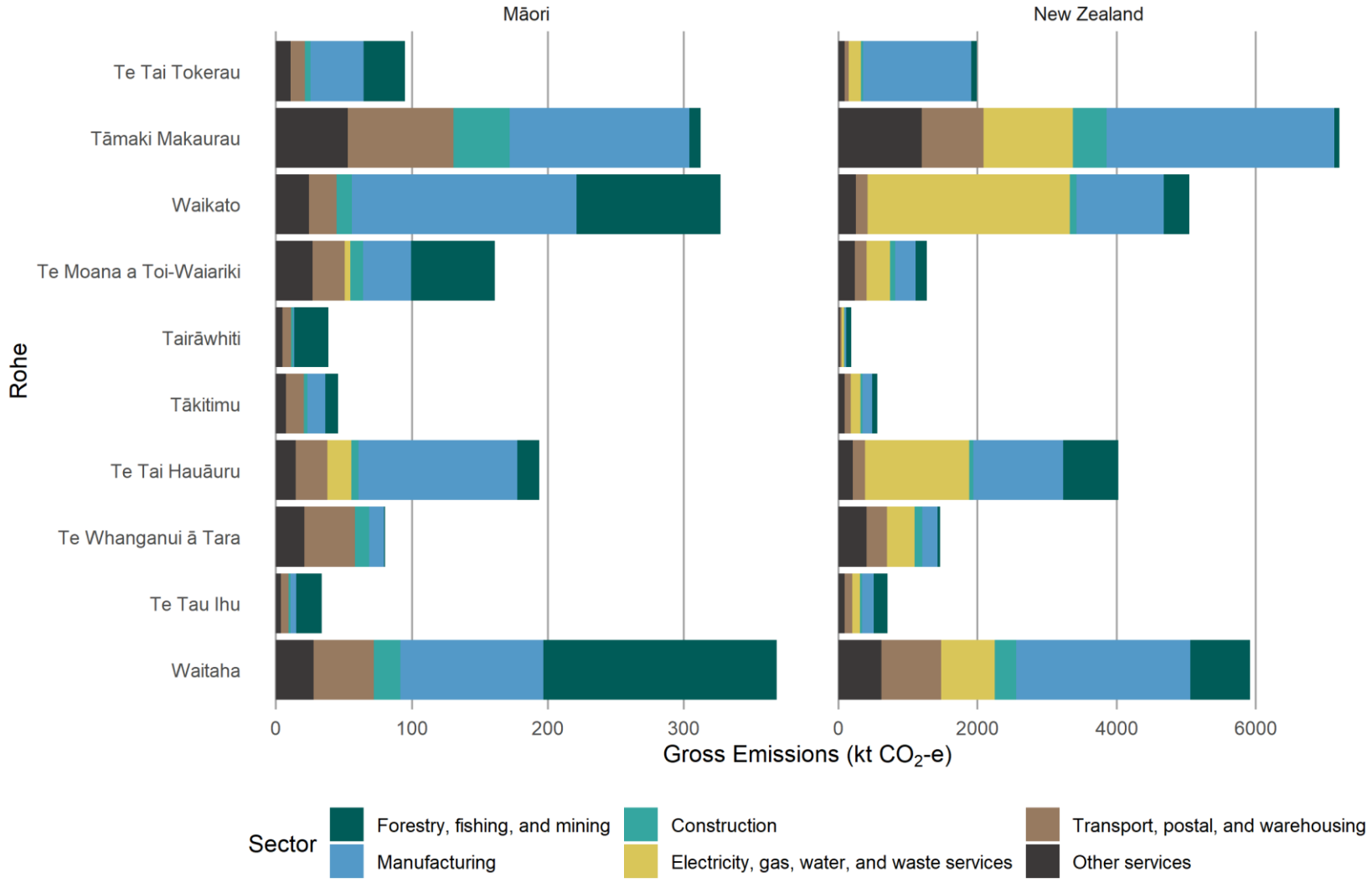


Source: Statistics New Zealand, BERL, and LUC Assessments analysis

Figure 7 provides an expanded view of emissions from sectors without the dominating influence of the agricultural sector. These data highlight the following:

- Manufacturing is the second largest source of emissions. It is especially dominant in Tāmaki Makaurau and Waikato. In Tāmaki Makaurau, other manufacturing and fabricated metal products dominate the manufacturing industry. While dairy processing and other manufacturing are significant percentages of manufacturing in Waikato. This is further discussed in section 3.3
- Māori are relatively more active in transport compared to total New Zealand. This is evident across just about all rohe. Tāmaki Makaurau has the highest portion of transport emissions, while transport emissions are underrepresented in Tairāwhiti and Te Tau Ihu. This is likely representative of a greater concentration of transport businesses in larger urban areas, compared to more rural rohe
- Compared to the other rohe in the Māori economy, construction is a bigger portion of emissions in Tāmaki Makaurau. This is likely driven by construction being a larger portion (30 percent) of the Māori economy asset base in Tāmaki Makaurau. While it is only nine percent (on average) in other rohe. As shown in section 3.2, 80 percent of the construction asset base in Tāmaki Makaurau is owned by employers, while 20 percent is owned by self-employed. Construction is also a larger percentage of the Māori economy emissions profile in Tāmaki Makaurau, compared to the total New Zealand emissions profile in Tāmaki Makaurau
- The electricity, gas, water, and waste services sector is a significant source of emissions at the national scale but is a minor source in the Māori economy emissions profile. Although there is some Māori ownership of resources used to generate electricity (e.g. geothermal and water), their role within this sector of the Māori economy emissions profile is small due to the methodology used (discussed in section 2.1). Currently the majority of Māori assets in the electricity, gas, water, and waste industry comes from Māori freehold land that is used for either water supply or generic utility uses
- The forestry, fishing, and mining sector is more important for the Māori economy gross emissions profile, compared to the New Zealand gross emissions profile. Māori are not generally involved in the mining industry, however they are significantly invested in fishing and forestry. As discussed, Māori own 40 percent of the country's fishing quota. Māori also own 40 percent of New Zealand's forestry (Climate Change Commission, 2021). The Commission's advice report outlined that a significant amount of Māori collectively-owned land is in production forestry, for example, Central North Island Forest, Lake Taupō Forest Trust, and Lake Rotoaira Forest Trust.

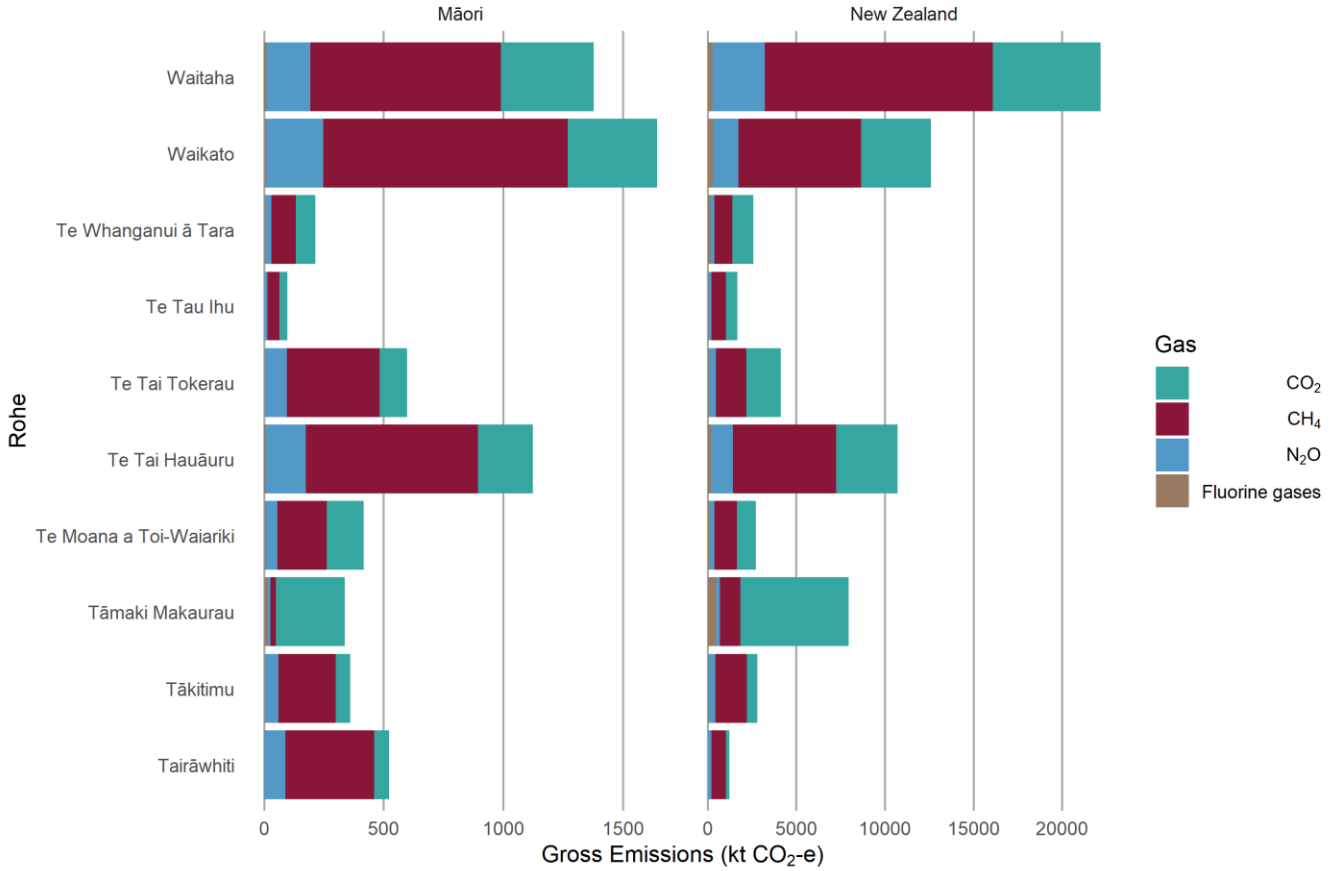
Figure 7 New Zealand and Māori economy gross emissions, broken down by sector and rohe (excluding agriculture)



Source: Statistics New Zealand, BERL, and LUC Assessments analysis

Methane (CH_4) is a significant proportion of New Zealand's and the Māori economy's emissions profile. Figure 8 shows that the Māori economy proportionately generates significantly more CH_4 than the New Zealand economy across most rohe. In particular, Waikato, Waitaha, and Te Tai Hauāuru have a significant amount of CH_4 emissions. This reinforces Figure 6, which showed that Waikato, Waitaha and Te Tai Hauāuru are heavily dominated by agriculture.

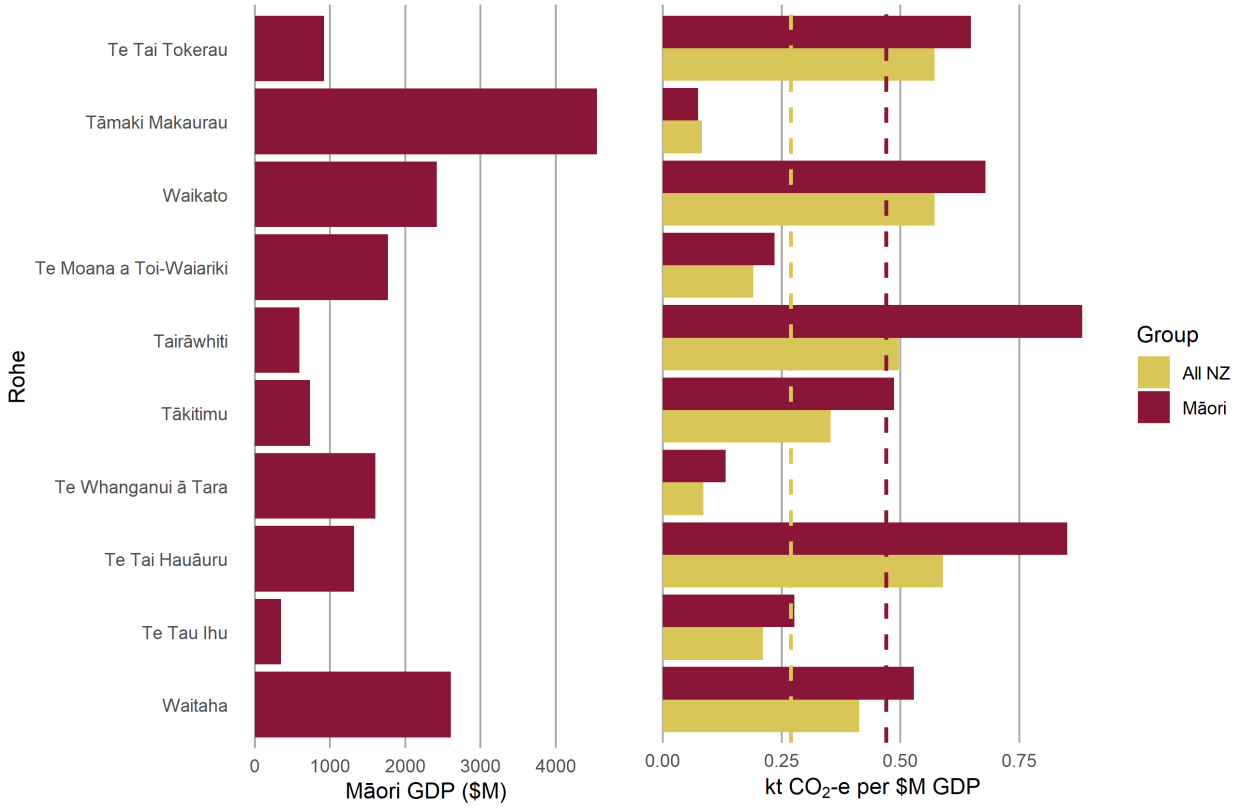
Figure 8 New Zealand and Māori economy emissions profile, broken down by GHG and rohe



Source: Statistics New Zealand, BERL, and LUC Assessments analysis

Emissions intensity is the emissions rate of GHG emissions relative to the intensity of an industry, and is calculated by dividing the volume of emissions by GDP. Emissions intensity is important because it highlights the volume of emissions that are created relative to GDP. Emissions intensity is higher in the Māori economy, compared to New Zealand. The Māori economy emissions intensity is 0.47, and the New Zealand emissions intensity is 0.27 (shown by the dotted line in the right panel of Figure 9). This is consistent with previous figures that show that the Māori economy is overrepresented in agriculture, which has a high emissions intensity. Figure 9 shows how rohe that are heavily invested in agriculture have higher emissions intensities. The low emissions intensities in Tāmaki Makaurau and Te Whanganui ā Tara are due to a high amount of activity in low or moderate emission intensity industries (as opposed to agriculture).

Figure 9 Māori GDP (left panel) and GDP-based emissions intensity (right panel), broken down by rohe

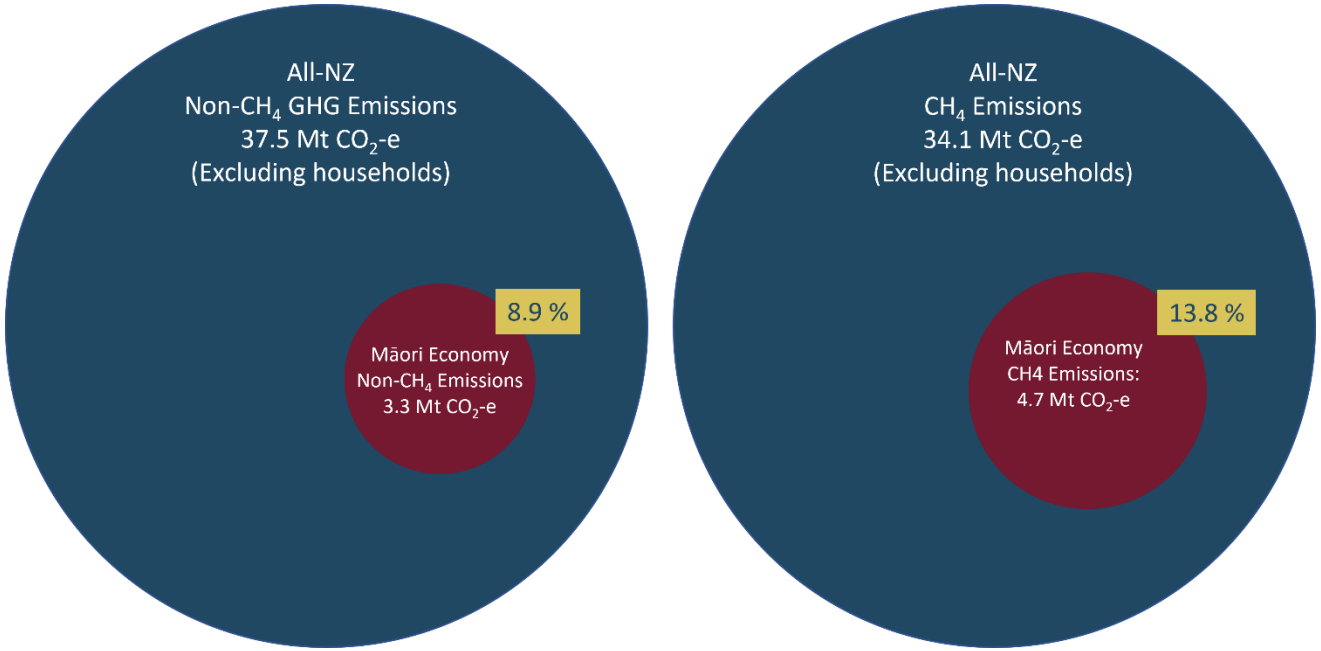


Source: Statistics New Zealand, BERL, and LUC Assessments analysis

2.3 Split gas analysis

Short-lived GHGs (i.e. methane, CH_4) and long-lived GHGs (carbon dioxide, CO_2, and nitrous oxide, N_2O) have different atmospheric lifetimes and impact the climate system differently. Due to the different impact of short-lived GHGs and long-lived GHGs, New Zealand's domestic target takes a split-gas approach. Figure 10 highlights that emissions from the Māori economy make up 8.9 percent of New Zealand's Mt CO_2-e, and 13.8 percent of total Mt CH_4. However, the Māori economy's share of New Zealand's GDP is 6.4 percent. The Māori economy is therefore overrepresented in Mt CH_4 and Mt CO_2-e. This is due to a large proportion of the Māori economy being situated in agriculture, which involves significant CH_4 and N_2O (a long-lived gas included in Mt CO_2-e).

Figure 10 Mt CH4 and Mt CO2-e for New Zealand and the Māori economy



Source: Statistics New Zealand, BERL, and LUC Assessments Ltd

2.4 Carbon dioxide removals by Māori forestry

2.4.1 Overview

Forestry plays a critical role in New Zealand's GHG emissions profile. Thirty percent of gross GHG emissions in New Zealand were offset by forestry activities in 2018. Forestry also plays a large role in the Māori economy; the Māori forestry asset base was $4.3 billion in 2018 (BERL & Reserve Bank of New Zealand (RBNZ), 2021). There are substantial Māori investment ventures in plantation forestry (Miller et al., 2005). In addition, over 10,000 hectares of Crown forests are on Māori land (MPI, 2020).

This research has found that the Māori economy is disproportionately invested in land-based industries that are associated with high gross GHG emissions. However, the analysis so far has only considered gross emissions rather than net emissions. The ability of the Māori forestry to sequester atmospheric CO_2 plays a key role in determining the net emissions profile for the Māori economy. Additionally, afforestation and reforestation opportunities on non-forested Māori-owned land have important implications for the net emissions profile of the Māori economy.

The New Zealand Emissions Trading Scheme (ETS) is an important policy response to climate change and provides forest owners with the opportunity to earn New Zealand units or other emission units. Each unit is equivalent to one metric tonne of CO_2 and can be traded or sold through the New Zealand Emissions Trading Register. The ETS presents both economic opportunities and risks to Māori forest owners and landowners, depending on the mix of forest classes and other types of land cover.

Under the ETS, forest land is classified depending on when it was first planted. Forests planted before 1990 are considered part of New Zealand's baseline emissions and are referred to as 'pre-1990 forest land'. They cannot earn units in the ETS for the carbon storage. Forests planted after 1989 are considered as new carbon sinks and can be registered in the ETS so that they can earn units for the carbon storage. These are referred to as 'post-1989 forests'.

The relative area of pre-1990 and post-1989 forest is important for Māori economy forestry as it affects the available range of future land use options. Pre-1990 forests are not eligible for credits in the ETS and carry no liability if they are harvested and replanted in forest. However, pre-1990 forests are subject to payment of ETS units if they are deforested and then used for another land use type, such as sheep and beef farming. Understanding the portion of forests that are pre-1990 within the Māori forestry, relative to the overall forestry sector, is important since they are associated with a reduced flexibility for land use options, compared with post-1989 forests.

The ETS also has implications for non-forested, Māori land. The possibility of afforestation on low productivity grasslands — either through natural regeneration or through deliberate planting — represents an important carbon sequestration opportunity (West et al., 2020). Grasslands with woody biomass also represents a sequestration, depending on vegetation and management (Ministry for the Environment, 2020b). However, it does not meet the definition for forests under the ETS.

Due to data constraints, it is beyond the scope of this study to comprehensively estimate the CO_2 removals from Māori forestry. However, it is possible to perform spatial analysis to determine the mix of land cover types on one class of Māori-owned land — Māori freehold land — and consider the opportunities and risks afforded by the ETS.

The analysis provides the relative quantity of different forest and grassland types on Māori freehold land and compares it to general title land (all land excluding Crown land and Māori land). The distinction between forests planted before 1990 and after 1989 on Māori land is important to determine the liability or opportunities for Māori under the ETS and other government emissions reductions programmes.

2.4.2 Methodology

This section outlines the methodology used to quantify land use classes on Māori freehold land and calculate a net emissions value. The analysis was conducted by quantifying the areas of various land cover classes on Māori freehold land and general title land. The land cover data was accessed from the Land Use and Carbon Analysis System (LUCAS) Land Use Map (LUM). The LUCAS LUM is a national spatial and temporal database of land use and land use change compiled by Manaaki Whenua Landcare Research. It underpins the national reporting of GHG emissions within the LULUCF sector. The composition of land cover was determined for Māori freehold land and general title land using the most recently updated LUM map in the database (nominally 2016). Māori freehold land was determined using the Māori Land Court geospatial layer. General title land was determined as all other land excluding LINZ-managed Crown land and DOC-managed protected areas. The analysis was performed at the level of each territorial authority and aggregated to a rohe and national level.

The 'Land Use, Land Use Change and Forestry (LULUCF)' chapter of the New Zealand Greenhouse Gas Inventory provides a comprehensive analysis of CO_2 emissions and removals by forests nationally. A key feature of this analysis is that it is largely based on a spatial analysis whereas emissions from other sectors are largely based on economic activity within that sector. This creates challenges in determining the net emissions from Māori forestry specifically, due to the complex nature of Māori ownership of land. The challenge is compounded by the fact that the land can be separately owned from the forest. It was beyond the scope of this study to do a comprehensive analysis of the net emissions from the Māori portion of forestry. However, a preliminary analysis was conducted to determine the forest cover on Māori freehold title land.

To calculate the emissions from forestry on Māori freehold land, we assumed that the emissions per unit area for the three different forest types (pre-1990 natural, pre-1990 planted, post-1989 (natural and planted)) were the same for both Māori freehold and for forests at the national scale. At the national level, emissions per hectare were calculated by the area-specific value of net emissions for each forest type reported in the 2018 National Greenhouse Gas Inventory (Ministry for the Environment, 2020a). These area-specific rates were then multiplied by the areas of forest on Māori freehold land (estimated by the analysis described above) to estimate net emissions.

For example, Table 1 shows that post-1989 forests have an area-specific net emissions of -21.14 tonnes CO_2 per hectare (a negative value indicates a net removal of CO_2 from the atmosphere). The spatial analysis indicated that there was 42 kilohectare (kha) of post-1989 forests on Māori freehold land. Multiplying these two values gives a total net emission from Māori post-1989 forests of 898 kiloton (kt) CO_2.

Thus, net emissions from Māori land per unit area differ from forests at a national level purely due to differences in the relative proportions of pre-1990 and post-1989 forest. It is important to note that for this analysis, the Māori forest emissions were compared to emissions for all New Zealand forests, rather than being compared to general title.

Several caveats are important for the interpretation of this data. First, this analysis is not a comprehensive analysis of the Māori forest economy because it only includes the portion that occurs on Māori freehold land but excludes Māori forest enterprises that occur on general title land.

Significant Māori-owned forestry enterprises occur on general title land, such as the large forestry blocks controlled by Ngāi Tahu holdings. The conclusions drawn here have most relevance for rohe with large areas of Māori freehold land.

Second, this analysis is based on spatial data obtained from 2016 and net emissions data obtained from 2018 GHG inventory. As such, the results represent a snapshot in time and further analysis would be required to provide an estimate of CO_2 removals by Māori forestry for multiple year time scales. The age-distributions of pre-1990 and post-1989 forests differ markedly, and the large area of post-1989 planted forest has recently reached harvest age and is predicted to be a net source of emissions from 2024 to 2030 (Ministry for the Environment, 2020b).

Finally, it should be noted that the analysis excluded accounting for harvested wood products.

2.4.3 Composition of land use classes on Māori freehold land

The relative areas of each land cover class for Māori freehold land and general title private land within each rohe are shown in Figure 11. The much higher proportion of natural forest cover on Māori freehold land compared to general title land is immediately apparent. Natural forest accounts for 41 percent of Māori freehold land but only accounts for 15 percent of general title land.

Forest on Māori freehold land accounts for seven percent of the New Zealand total forested area. The composition of the forest on Māori freehold land is:

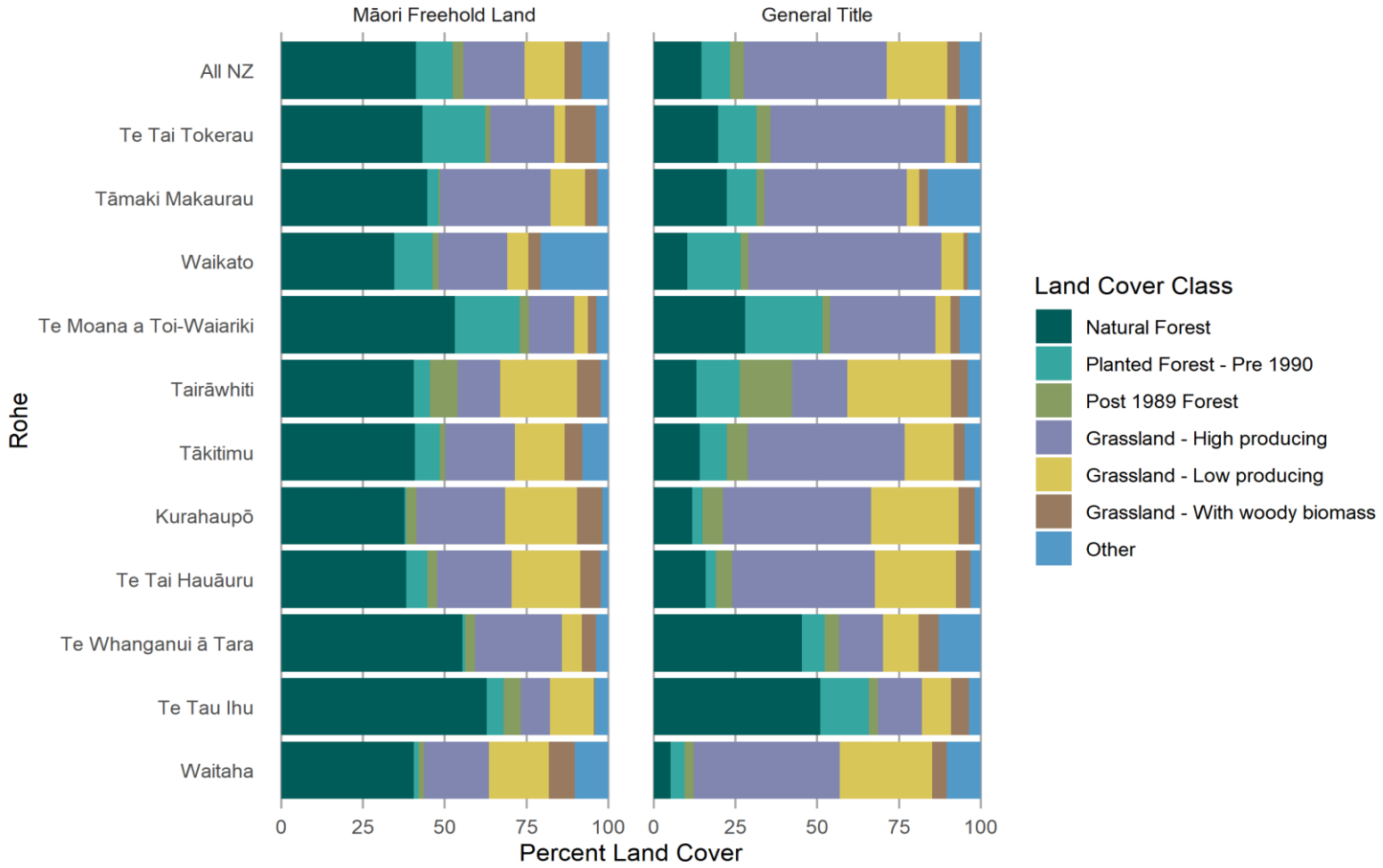
- 74 percent pre-1990 natural forest
- 20 percent pre-1990 plantation forest
- 6 percent post-1989 natural and plantation forestry.

By contrast, forest on the general title land accounts for 36 percent of the New Zealand total forested area. The composition of the forest on general title land is:

- 53 percent pre-1990 natural forest
- 32 percent pre-1990 plantation forest
- 15 percent post-1989 natural and plantation forestry.

The proportions of land cover types (Figure 11) should be viewed within the context of the absolute areas of Māori freehold land (Figure 12), which vary widely among rohe. Four rohe, Waikato, Te Moana Toi-Waiariki, Tairāwhiti, and Te Tai Hauāuru, each have areas of Māori freehold land of more than 200 kha. Five others, Tāmaki Makaurau, Kurahaupō, Whanganui ā Tara, Te Tau Ihu, and Waitaha, each have less than 50 kha. Te Tai Tokerau and Tākitimu each have about 110 kha.

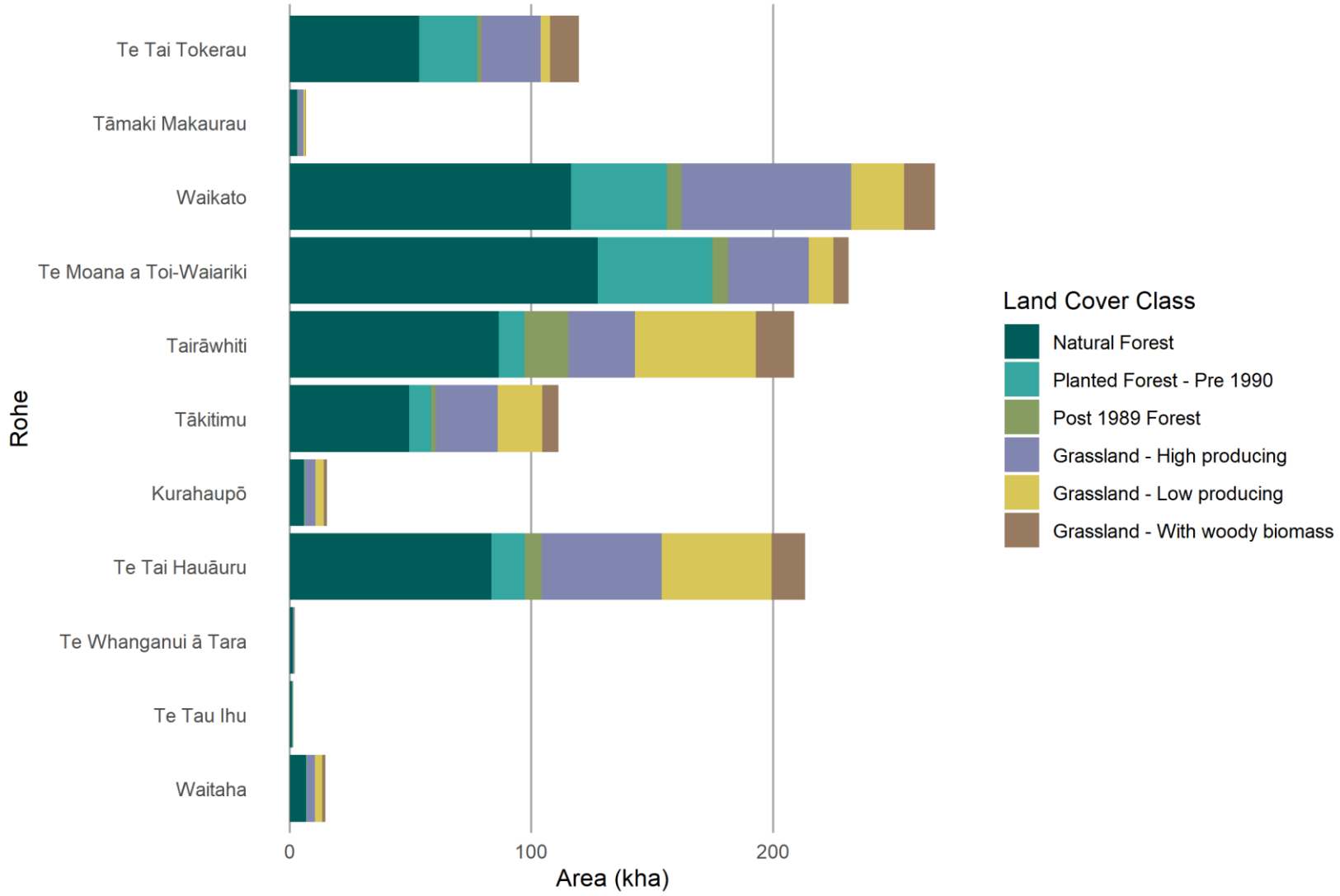
Figure 11 Proportions of different land cover classes on Māori freehold and general title land for all New Zealand and each rohe[3]



Source: LUCAS LUM, BERL, and LUC Assessments analysis

[3] According to the LUCAS 2016 Land Use Map. Māori forest enterprises on general title land are included in the right panel.

Figure 12 Areas of forest and grassland on Māori freehold land



Source: LUCAS LUM, BERL, and LUC Assessments analysis

2.4.4 Estimate of net emissions of Māori freehold land compared to general title land

The areas of different forest classes on Māori freehold land can be used together with the estimates of net emissions from forests at a national scale to estimate net emissions from forests on Māori freehold land. Table 1 provides the areas of different forest types for all New Zealand and those areas for Māori freehold land estimated in this study. The 2018 National Greenhouse Gas Inventory reported that New Zealand forests were responsible for a net removal of -16,977 kt CO_2. The analysis conducted here indicates that forests on Māori freehold land accounted for 7.3 percent of the national forest area but only six percent of the net CO_2 removal. This is due to a lower area-specific rate of net CO_2 removal: -1.39 kt CO_2/ha across all forests on Māori freehold land compared to -1.71 kt CO_2/ha across all forests at the national level (Table 1). The lower area-specific rate of removal results from the greater proportion of pre-1990 forests on Māori freehold land (20 percent) compared to that proportion at the national level (15 percent).

Table 1 Net emissions on New Zealand and Māori freehold land

Forest Type	*Area in all NZ*	*Net emissions 2018*	*Area-specific net emissions*	*Māori freehold land area 2016*	*Net emissions 2018*	*Area-specific net emissions*
	kha	*kt CO_2*	*t CO_2/ha*	*kha*	*kt CO_2*	*t CO_2/ha*
Pre-1990 Natural	7,757	-2,685	-0.35	534	-187	-0.35
Pre-1990 Planted	1,446	563	0.39	146	57	0.39
Post-1989 (Natural and Planted)	703	-14,855	-21.14	42	-898	-21.14
Total	9,905	-16,977	-1.71	723	-1,235	-1.39

Source: Ministry for the Environment (2020a), BERL, and LUC Assessments analysis

2.4.5 Opportunities and risks

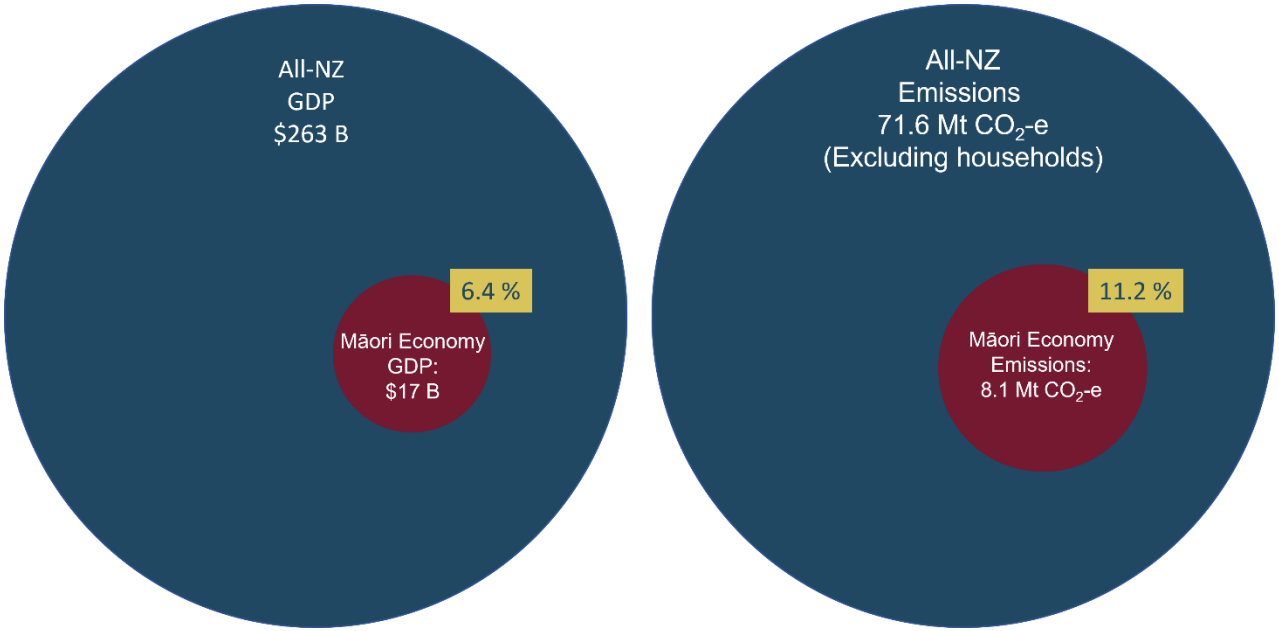
The greater proportion of pre-1990 planted forest on Māori freehold land might imply a greater vulnerability to emissions policy due to non-eligibility of pre-1990 forests in the ETS, and the associated lack of flexibility in land use decisions following harvest. However, in terms of the overall sensitivity of Māori land use to emissions policy on Māori freehold land there are two opportunities worth noting. First, the amount of low productivity grassland on Māori land provides a measure of afforestation opportunities. Furthermore, in rohe with large areas of low producing grassland, such as Te Tai Tokerau, Tairāwhiti, and Te Tai Hauāuru, there are opportunities for earning carbon units by a full retirement from grazing. Second, only around half of eligible forests have been registered with the ETS, so there are potential opportunities for maximising the benefit of ETS for post-1989 forests that have not yet been realised.

3 Māori economy – vulnerabilities to climate mitigation

3.1 Overview

The Māori economy's share of New Zealand's gross domestic product (GDP) is 6.4 percent, while the Māori economy's share of New Zealand emissions is 11.2 percent (as shown in Figure 13). This overrepresentation in emissions is due to the role of agriculture in the Māori economy.

Figure 13 Māori share of New Zealand's GDP and Māori share of New Zealand's emissions



Source: Statistics New Zealand, BERL, and LUC Assessments analysis

Transitioning to a low emissions economy will likely result in the creation of new industries, the elimination of others, and the substitution or transformation of some industries (International Labour Organization (ILO), n.d.). This section discusses the ways in which the Māori economy may be vulnerable to climate change mitigation policy because of its industry composition. For example, on how different industries may be disrupted by the transition to the low emissions economy due to emissions intensities.

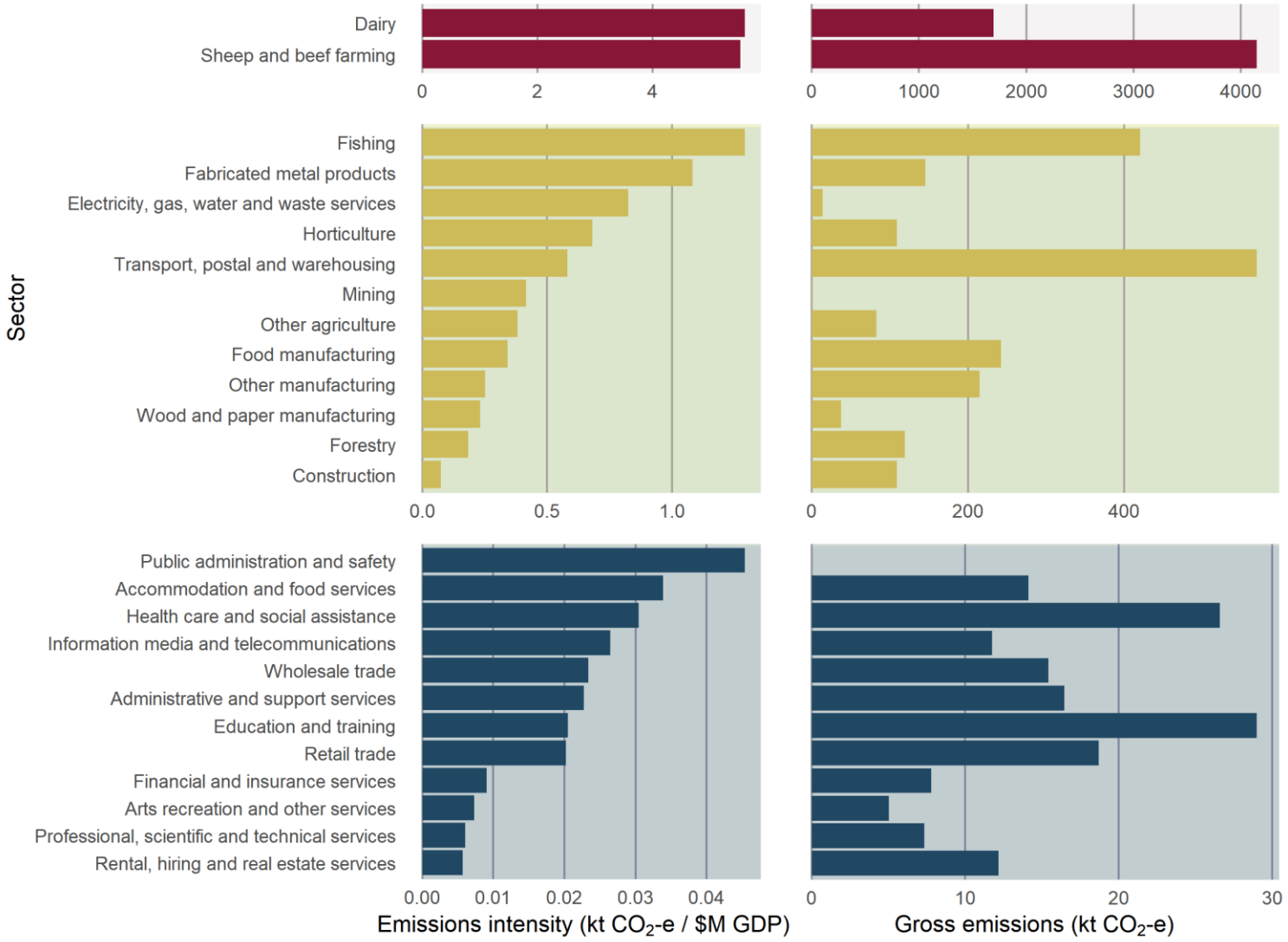
The industry composition of the Māori economy asset base, GDP and workforce is analysed to understand the vulnerability of the Māori economy. This is done by classifying industries as high, moderate or low based on the industries emissions intensity. It is important to note that there are factors, other than emissions intensity, that will affect the vulnerability of an industry and the Māori economy as a whole. For example, changing consumer preferences might also drive vulnerabilities for industry.

Figure 14 outlines the Māori economy industries emissions intensity in 2018 on a GDP basis (left panel). The right panel shows the gross emissions from the Māori economy industries. The sectors categorised as "High" emitting are those with a GDP-based emissions-intensity exceeding 1.5 kT CO_2-e/$M GDP. The sectors categorised as "Moderate" emitting are those with a GDP-based emissions-intensity between 0.05 to 1.5 kT CO_2-e/$M GDP. The sectors categorised as "Low" emitting are those with a GDP-based emissions-intensity below 0.05 kT CO_2-e/$M GDP. Appendix B provides further details of the methodology for the three-tier ranking.

This report explores the vulnerability of the Māori economy to the transition to a low emissions economy. This research could be conducted in many ways. The approach taken in this report was to analyse the industry composition of the Māori economy asset base, GDP and workforce. This was done by classifying industries as high, moderate or low based on the industries emissions intensity. This approach is helpful for exploring how different industries may be impacted by climate change mitigation, but it does have limitations.

Firstly, the narrow focus on industry composition does not provide a full picture of how the Māori economy will be affected by climate change mitigation. Secondly, classifying the industries it is not an exact science, and as such professional expertise was used to decide upon the categories of high, moderate or low emitting industries. Further explanation of our methodology is outlined in Appendix B. Lastly, this report uses data that has taken a production (or supply-side) approach to measuring emissions, and only deals with the industry component of those emissions but not the household component. While this approach is appropriate for a joint economic/environmental analysis such as this, this approach fails to capture emissions embodied in the use of goods and services.

Figure 14 Māori economy emissions intensity on a GDP basis and gross emissions in 2018[4,5]



Source: Statistics New Zealand, BERL, and LUC Assessments analysis

Table 2 ranks the industries into high, moderate, and low according to their emissions intensity level.

Table 2 Ranking of industries

High	Moderate	Low
• Sheep and beef farming	• Mining	• Wholesale trade
• Dairy farming	• Fishing	• Retail trade
	• Food manufacturing	• Accommodation and food services
	• Other manufacturing	• Information media and telecommunications
	• Fabricated metal products	• Financial and insurance services
	• Electricity, gas and waste services	• Rental, hiring and real estate services
	• Transport, postal and warehousing	• Professional, scientific and technical services
	• Construction	• Administrative and support services
	• Horticulture	• Public administration and safety
	• Other agriculture	• Education and training
	• Wood and paper manufacturing	• Health care and social assistance
	• Forestry (gross emissions only)	• Arts and recreation services

[4] Note differences in horizontal scale.
[5] Coloured shading indicates ranking of sector by emissions intensity (red = high, yellow = moderate, blue = low). This is applied to some of the graphs below.

3.2 National level analysis

Highlights from the Māori economy asset base shown in Figure 15 include:

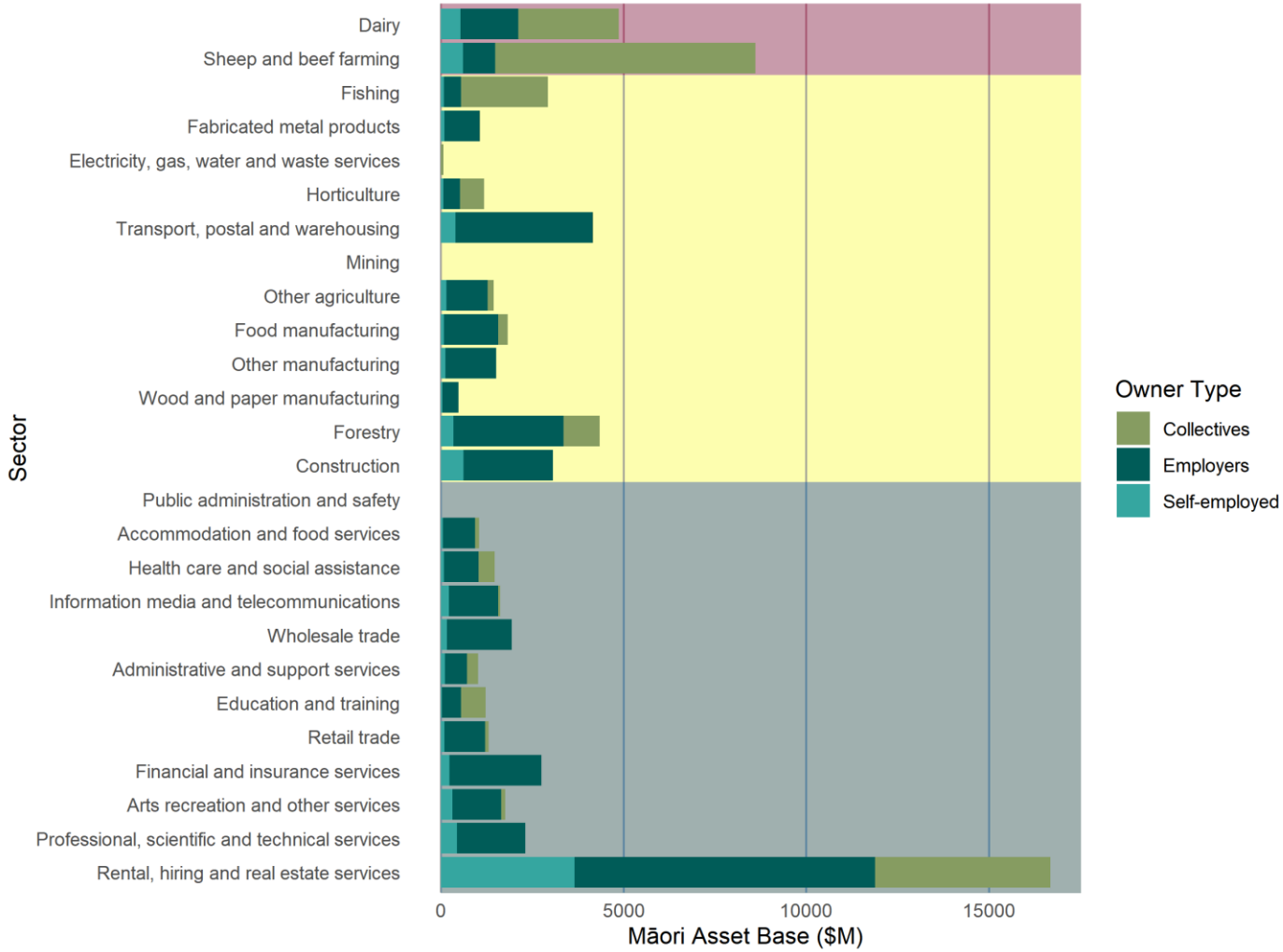
- The Māori economy is heavily invested in land-based activity (i.e. agriculture and real estate). Furthermore, $24 billion of the $69 billion asset base is in agriculture, forestry, and fishing; $16.7 billion is in rental, hiring, and real estate services; $4.9 billion is in manufacturing
- Collectives (as discussed in section 1.3.1) own a significant portion (60 percent) of the Māori economy's primary sector asset base. In particular, the Māori sheep and beef farming asset base is mostly owned by collectives (83 percent)
- Māori employers and self-employed make up almost all of the Māori asset base for transport, construction and manufacturing.

There is a significant difference between owner type (collectives, employers, and self-employed) in different industries, and each will likely face different risks and challenges in the transition to a low emissions economy. Collectives are highly invested in the high emissions industries, and as such, will be significantly impacted by the challenge of reducing agricultural emissions. This vulnerability poses risks because collectives are responsible for managing assets for the benefit of its members. Furthermore, the policies could result in lowering financial revenue and the value of the entities asset base. If this were the case, the entity may have less assets, such as cash, to operate their commercial arm or its other activities, such as paying dividends to its members, providing social services, or offering scholarships. As such, the challenges that collectives face in the transition to a low emissions economy may negatively impact the collective, and therefore Māori whānau.

In New Zealand, 97 percent of all businesses are classified as small or medium enterprises (SMEs). Small businesses may face different challenges and may require more assistance in the transition to the low emissions economy. In terms of the Māori economy, Māori employers and self-employed, which are most likely SMEs, may face different barriers to the transition than collectives. The transport, construction, and manufacturing Māori economy asset base is primarily owned by Māori employers and self-employed. These are more likely to be capital intensive industries, i.e. they require investment vehicles, tools, machinery, infrastructure, technology, etc. The transition towards a low emissions economy is likely to require replacing some assets with lower emissions assets, requiring significant capital expenditure. Access to capital is already a challenge for Māori businesses, independent of climate policy (BDO, 2019). This is therefore a risk for Māori SMEs in the transition to a low emissions economy.

Rental, hiring, and real estate services are a significant proportion of the Māori asset base. This is partly reflective of many Māori entities acquiring commercial properties as well as leasing their land, e.g. Huntly Power Station sits on land leased from Waikato Tainui. Land for farming is often also leased from Māori landowners, however land leased to pastoral farming is included in the primary sector asset base. Some Treaty settlements also stipulate leasing arrangements. The transition to a low emissions economy may affect the relative value of different land, as such some land uses might go up in value and some might decline, which will impact the Māori economy asset base.

Figure 15 Māori economy asset base, broken down by sector and employment status[6]



Source: Statistics New Zealand, BERL, and LUC Assessments analysis

[6] Coloured shading indicates ranking of sector by emissions intensity (red = high, yellow = moderate, blue = low).

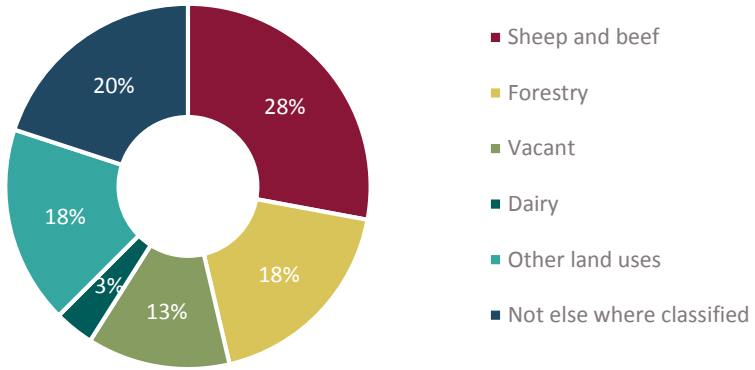
The Māori economy land use composition has been shaped by historic causes. Māori freehold land is 1.4 million hectares, based on CoreLogic data, which is approximately five percent of New Zealand's total land area. Forced land sales and confiscations shaped the characteristics of Māori freehold land. One consequence of forced land sales and confiscations is that Māori land is often isolated, and is hilly or marginal land. This has locked the Māori land owners into particular land uses, and consequently specific industries (BERL & Climate Change Commission, 2021). As shown in Figure 16, 28 percent is used for sheep and beef and 18 percent of Māori freehold land is used for forestry. The land use characteristics of Māori freehold land mean that these landowners may have more limited options and face challenges in terms of land use change, independent of climate policy. These more limited options and challenges will need to be considered in the transition to lower emissions land uses.

There are a range of other interlinked issues around Māori land. Including the following barriers identified by Te Puni Kōkiri:

- Collective ownership – potential difficulties with obtaining agreement about land use and development
- Access to finance – multiple owners makes it difficult to use land as security when seeking finance for land development
- Governance/Management issues – a lack of expertise to plan and make decisions about administration
- Access to information – costly to obtain information on potential use of Māori land
- Access to land – much Māori land is landlocked, reducing the options available for its use and/or lease
- Rating of Māori land – rating valuations do not allow for single unit rating to the same extent as other land, and owners of multiple houses on Māori land cannot access Rates Rebates Scheme (Controller and Auditor-General, 2004).

The implications of these barriers is that Māori land owners may be more likely to have limited choices in the transition to the low emissions economy, compared to total New Zealand. Government policy may be required to reduce barriers so Māori are able to decide how to use the land.

Figure 16 Share of Māori freehold land by main land use[7]

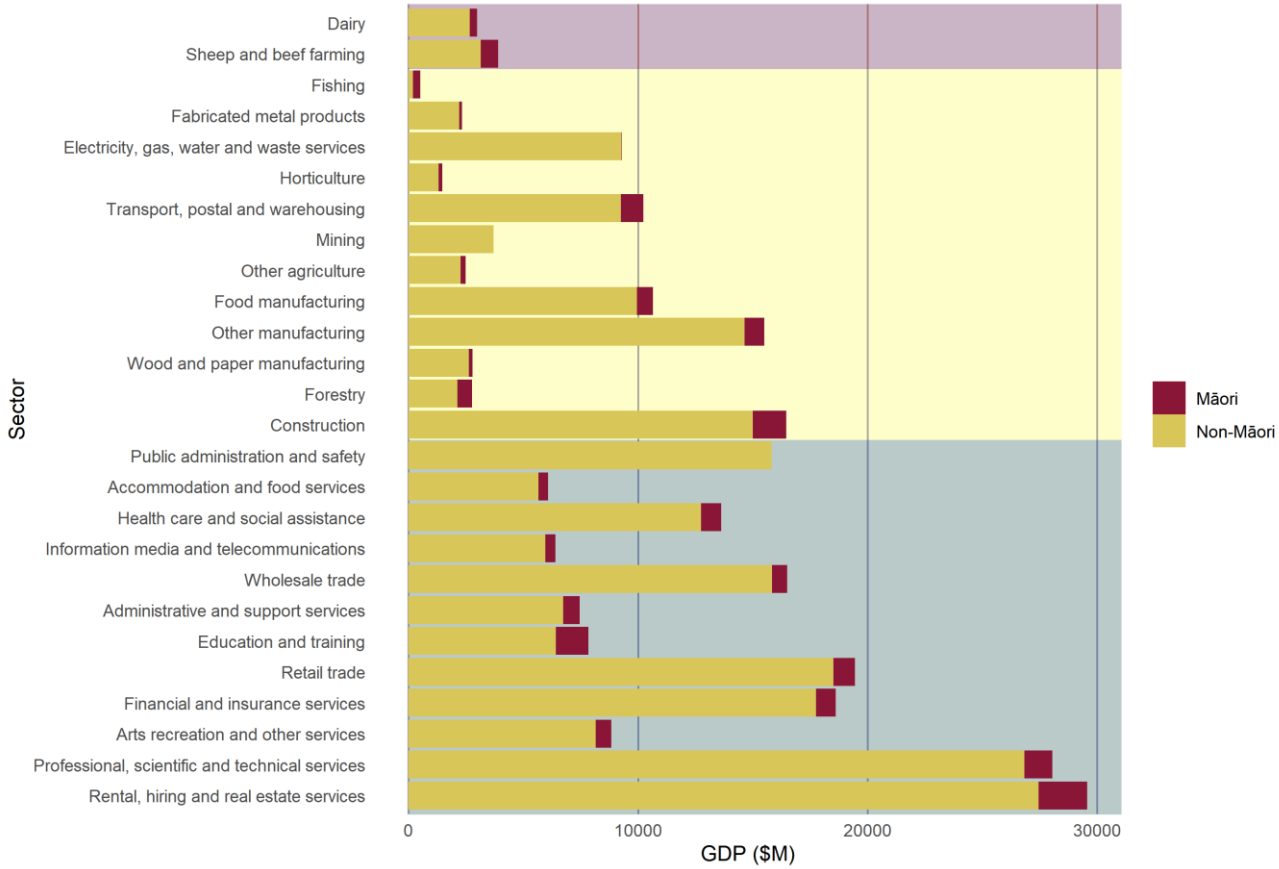


Source: Climate Change Commission and BERL - Emissions Reduction Plan Impact on the Māori economy

[7] Not elsewhere classified land is land with an unknown land use, while other land uses include the following: Burial grounds, lifestyle blocks, community service, and commercial, industrial or residential property.

Another way to view the vulnerability of the Māori economy is through the sectoral composition of GDP. Figure 17 shows that a key difference between total New Zealand GDP and the Māori economy GDP is that the Māori economy is more involved in sheep and beef farming, and dairy farming. The Māori economy is also proportionately more involved in construction, forestry, fishing, education, and transport. With the exception of education, these industries will all be significantly affected by climate change mitigation.

Figure 17 New Zealand and Māori economy GDP, broken down by sector

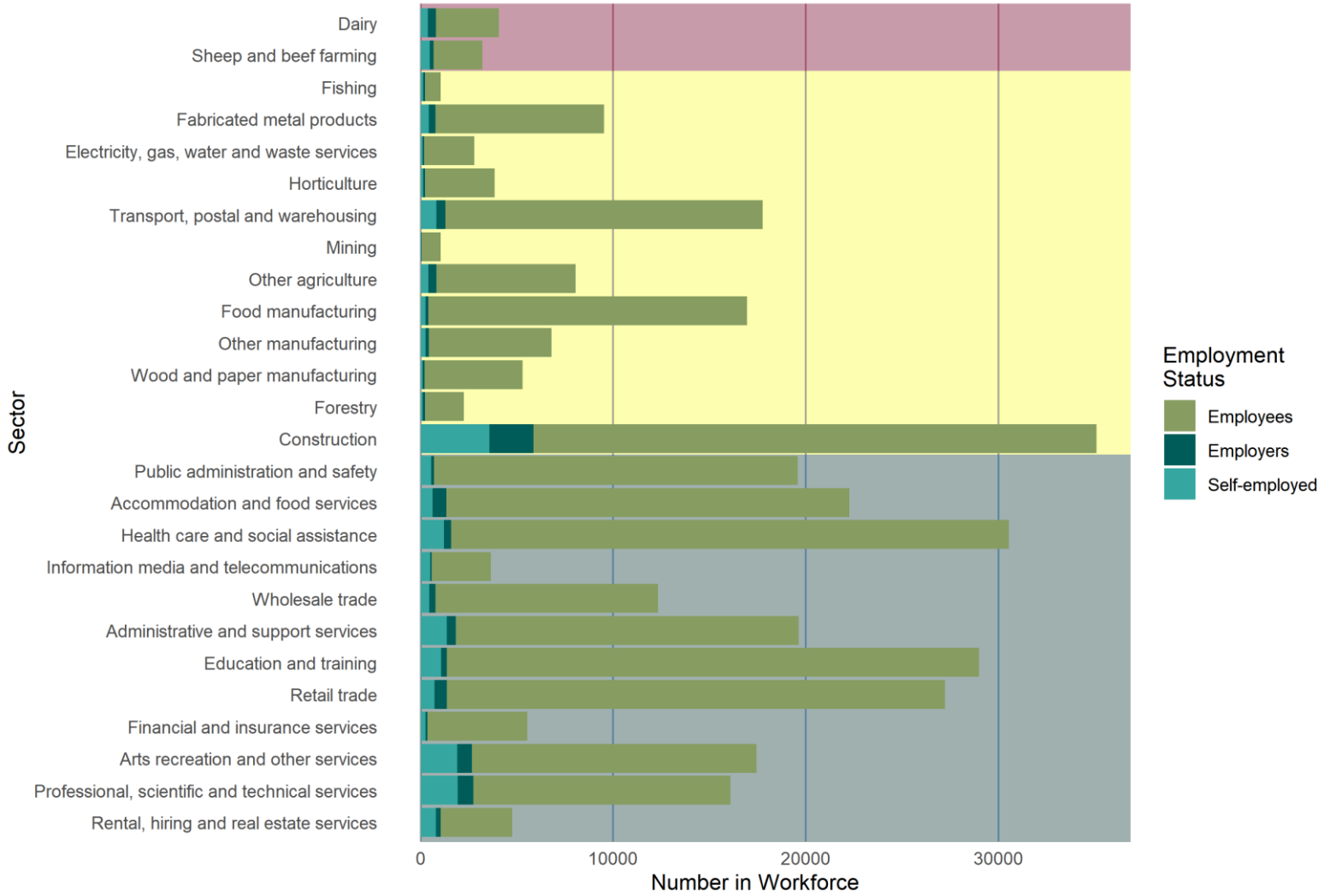


Source: Statistics New Zealand, BERL, and LUC Assessments analysis

A third approach to understanding the Māori economy's vulnerability to climate change mitigation policy is the workforce composition. Figure 18 provides the workforce count broken down by employment status (employers, employees, and self-employed). It shows:

- Unsurprisingly, employees make up most of the workforce (approximately 90 percent). *Te Ōhanga Māori 2018* report demonstrates that this is a higher proportion than the total New Zealand workforce (Reserve Bank of New Zealand (RBNZ), 2021). As such, the Māori economy has a lower proportion of employers and self-employed
- Self-employed and employers are more pronounced in construction than other industries
- A significant number of Māori work within construction (35,103 people, 11 percent of the Māori workforce)
- Aggregating the manufacturing industries together highlights that many Māori work in the manufacturing workforce (38,580 people, 12 percent of the Māori workforce). Of these manufacturing industries, food manufacturing is the largest employer. The food manufacturing industries are considered moderate emissions industries, and as such will be significantly impacted by the transition to a low emissions economy. Disaggregating the food industry into meat processing, dairy processing and other food manufacturing would highlight that 55 percent of this workforce is in the meat processing industry. Understanding the distribution of employment within the food manufacturing industry is important because some types of food manufacturing are likely to be more vulnerable than others, such as meat processing
- The transport, postal, and warehousing industry, which is a moderate emissions intensity industry, is also a large employer for Māori
- Education and training, health care and social assistance, and retail trade industries also employ a significant number of Māori. These industries are considered low emissions industries for the purposes of this report. As such, expanding these industries may provide opportunities in the transition to a low emissions economy. However, it is important to note that many roles in these industries are underpaid.

Figure 18 Māori workforce, broken down by sector and employment status



Source: Statistics New Zealand, BERL, and LUC Assessments analysis

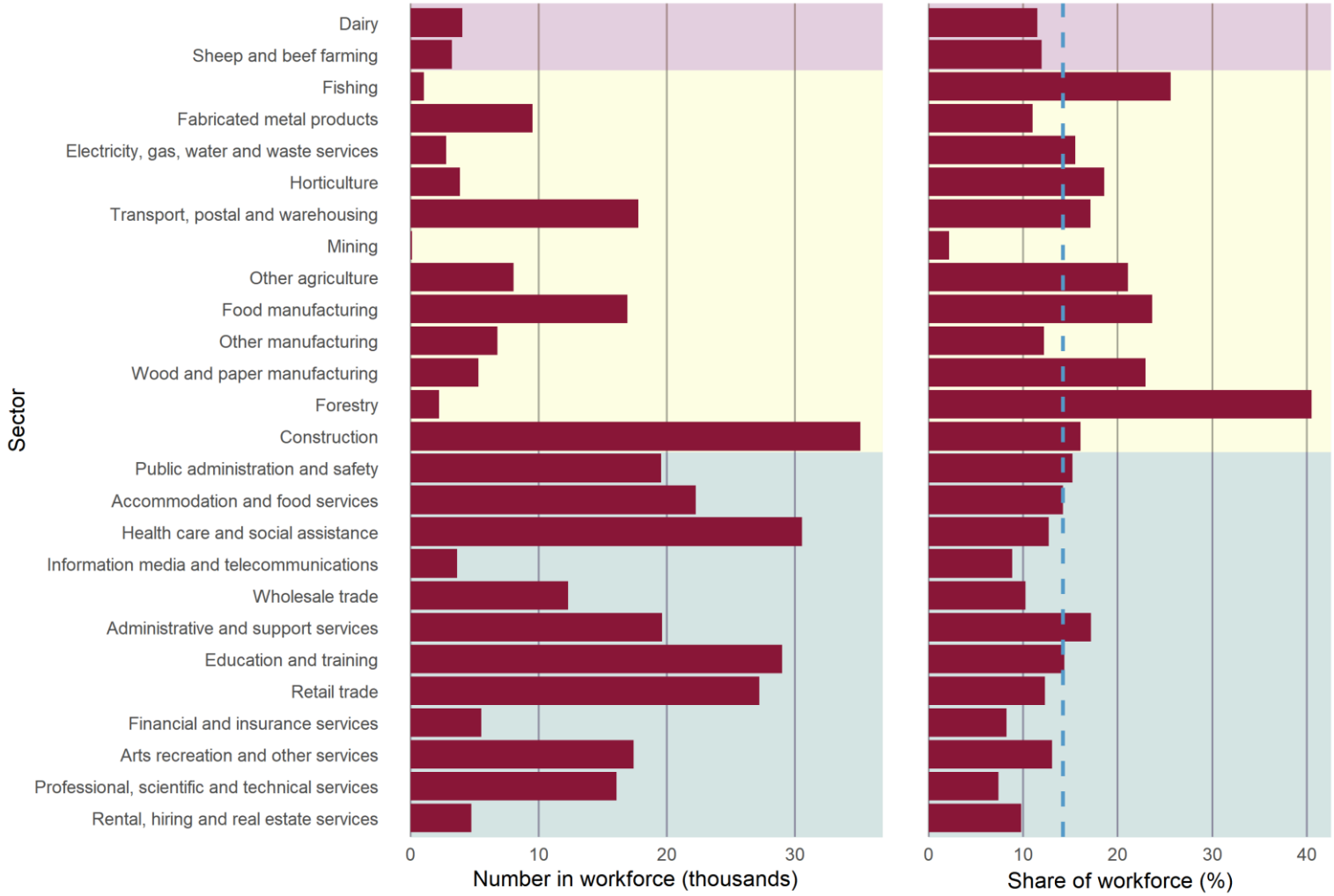
3.2.1 Workforce characteristics

This section provides analysis of the characteristics of the Māori workforce, and is disaggregated by occupation skill level and age. Figure 19 highlights that:

- Māori are overrepresented in forestry (40 percent of the industry workforce), fishing (26 percent), and food processing (24 percent)
- The industries in which Māori are most underrepresented are: mining, information media and telecommunications, financial and insurance services, rental, and hiring and real estate services. Māori are significantly underrepresented in the professional, scientific, and technical services industry. This industry makes up five percent of the Māori workforce, compared to 10 percent for total New Zealand. With the exception of mining, these industries are low emissions industries. As such, Māori are underrepresented in many industries that are very low emissions. These industries are also likely to be high-income.

The Māori workforce is likely to be vulnerable to climate change mitigation for reasons other than industry composition. Māori have previously been adversely affected by economic shocks due to high proportion of Māori in low-skilled, low-income jobs, and industry concentration, positioning Māori as highly vulnerable to economic fluctuations (BERL, 2020). Māori households are likely to be disproportionately impacted by a labour market disruption or economic shocks due to historic and ongoing inequities (BERL & Climate Change Commission, 2021). These inequities may also hinder Māori from creating businesses and entering low emissions industries.

Figure 19 Māori workforce and share of workforce, broken down by sector[8]

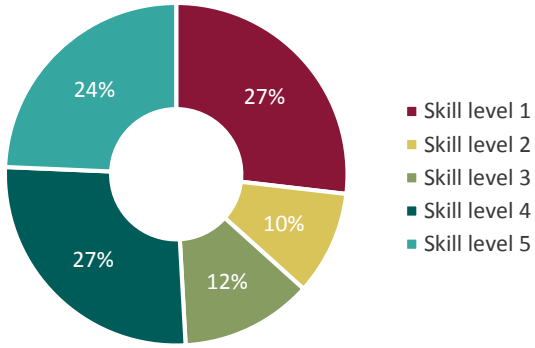


Source: Statistics New Zealand, BERL, and LUC Assessments analysis

[8] Blue line indicates Māori share of the population aged between 15 to 64 years (14.2%)

As mentioned, historic and ongoing inequities have resulted in Māori being more likely to be low-skilled and low-income. Furthermore, Māori are over-represented in lower-skilled jobs compared to non-Māori in 2018; 50 percent of Māori were employed in lower-skilled jobs (see Figure 20), compared to 40 percent of non-Māori (BERL & RBNZ, 2021). However, the report also showed that this is changing with Māori being increasingly employed in high-skill jobs. Furthermore, Māori in high-skill jobs increased from 47,500 to nearly 87,200 between 2006 and 2018, which was an 83 percent increase. In general, self-employed and employers are more likely to be higher-skilled than employees; disaggregating Figure 20 by employment status would show that this holds true for the Māori economy (as shown in *Te Ōhanga Māori 2018* report).

Figure 20 Māori share of labour force by skill level, 2018



Source: Climate Change Commission and BERL - Emissions Reduction Plan Impact on the Māori economy

The Australian and New Zealand Standard Classification of Occupations (ANZSCO) assigns an occupation to one of five skill levels (Statistics New Zealand, n.d.). One is considered highly-skilled and five is considered low-skill. This approach uses qualification levels as a proxy for the skills required for an occupation. A weakness of this approach is that New Zealand has no system for measuring skills (BERL, 2020).

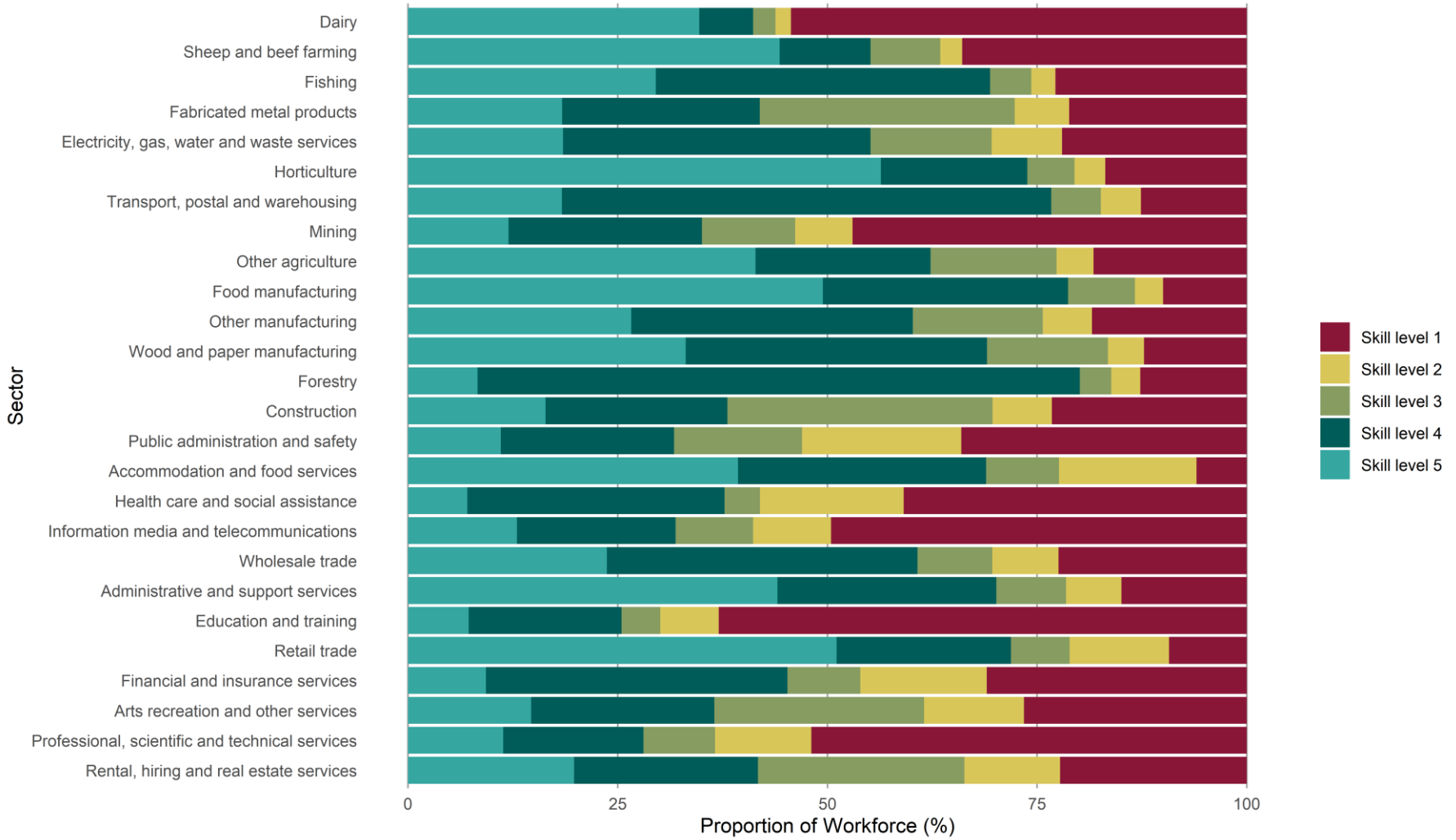
Understanding the skill composition of the Māori workforce is important for understanding vulnerability to the transition. This is because low-skill jobs are more likely to provide lower employment stability, lower incomes, and are often less resilient to automation (BERL & RBNZ, 2021). Low-skill jobs also typically provide less professional development (Organisation for Economic Co-operation and Development (OECD), 2019). These factors may hinder a person's ability to transition to the low emissions economy.

Figure 21 shows the following:

- There is a significant number of Māori in low-skill transport jobs
- The majority of the Māori workforce in manufacturing industries are in low-skill positions
- The biggest portion of the Māori workforce in construction are considered skilled (level three), however this is closely followed by level four (low-skill).

Māori being overrepresented in lower-skilled jobs is a risk to the Māori economy in the transition to the low emissions economy.

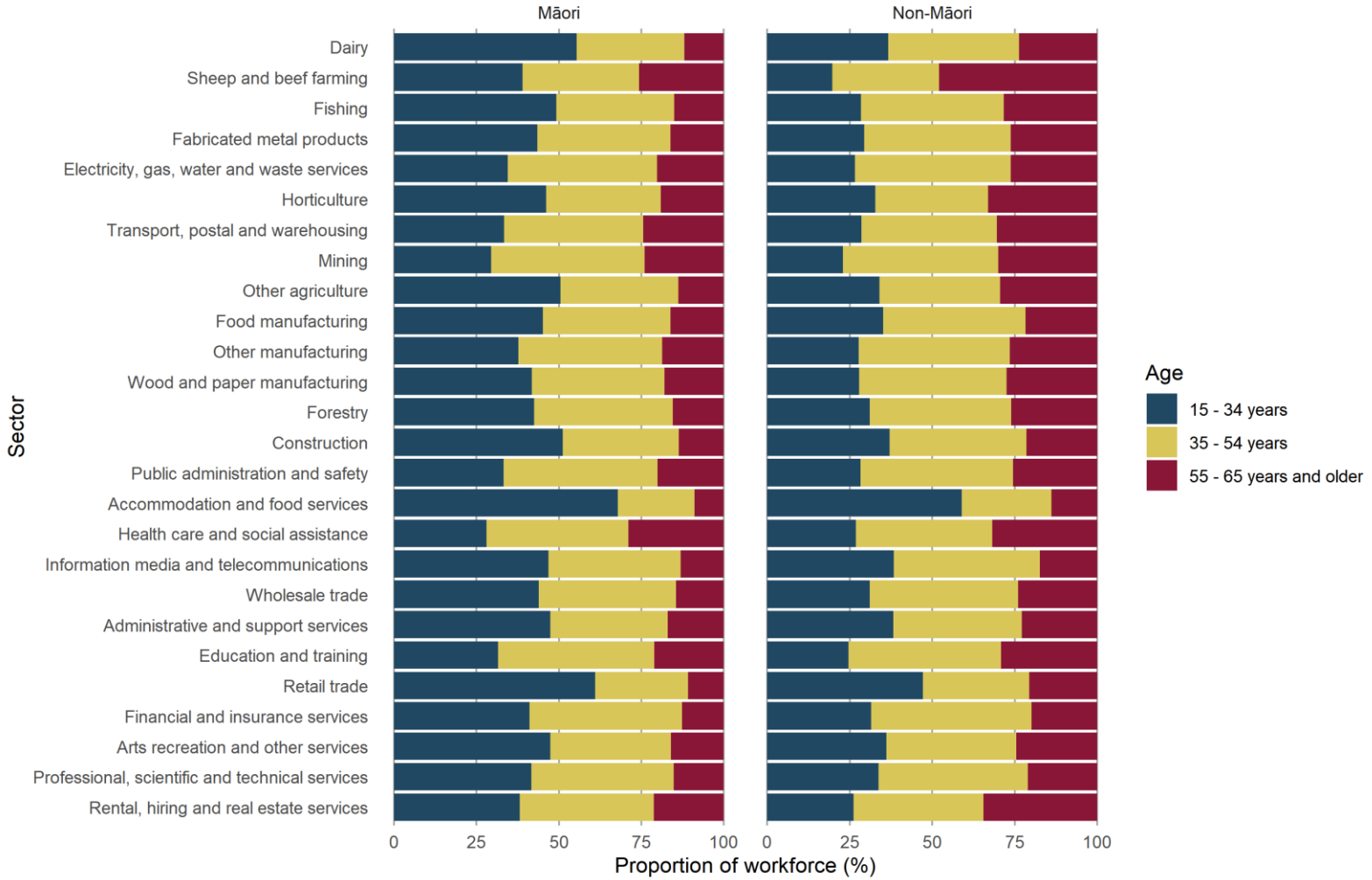
Figure 21 Skill level of Māori workforce, broken down by sector



Source: Statistics New Zealand, BERL, and LUC Assessments analysis

Te Ōhanga Māori 2018 report found that there was a significant increase in the Māori population and workforce between 2013 and 2018 (BERL & RBNZ, 2021). The Māori workforce increased by 40 percent, compared to eight percent for the rest of the population. Māori populations are much younger than non-Māori. The median age of Māori people in 2013 was 24 years old, while the median age of non-Māori in New Zealand was 38. This is reflected in Figure 22, which shows that workers aged 15 to 34 years is a larger proportion of the Māori workforce for each industry, than for non-Māori. Moderate and high emitting industries which are significantly overrepresented by workers aged 15 to 34 years are dairy, other agriculture, and construction. The transition to a low emissions economy will significantly influence the labour market; jobs will be created, eliminated, substituted or transformed. Comprehensive education and labour market policies that support rangatahi to develop appropriate skills are required for the transition to a low emissions economy (International Labor Organization, 2018).

Figure 22 New Zealand and Māori workforce, broken down by sector and age

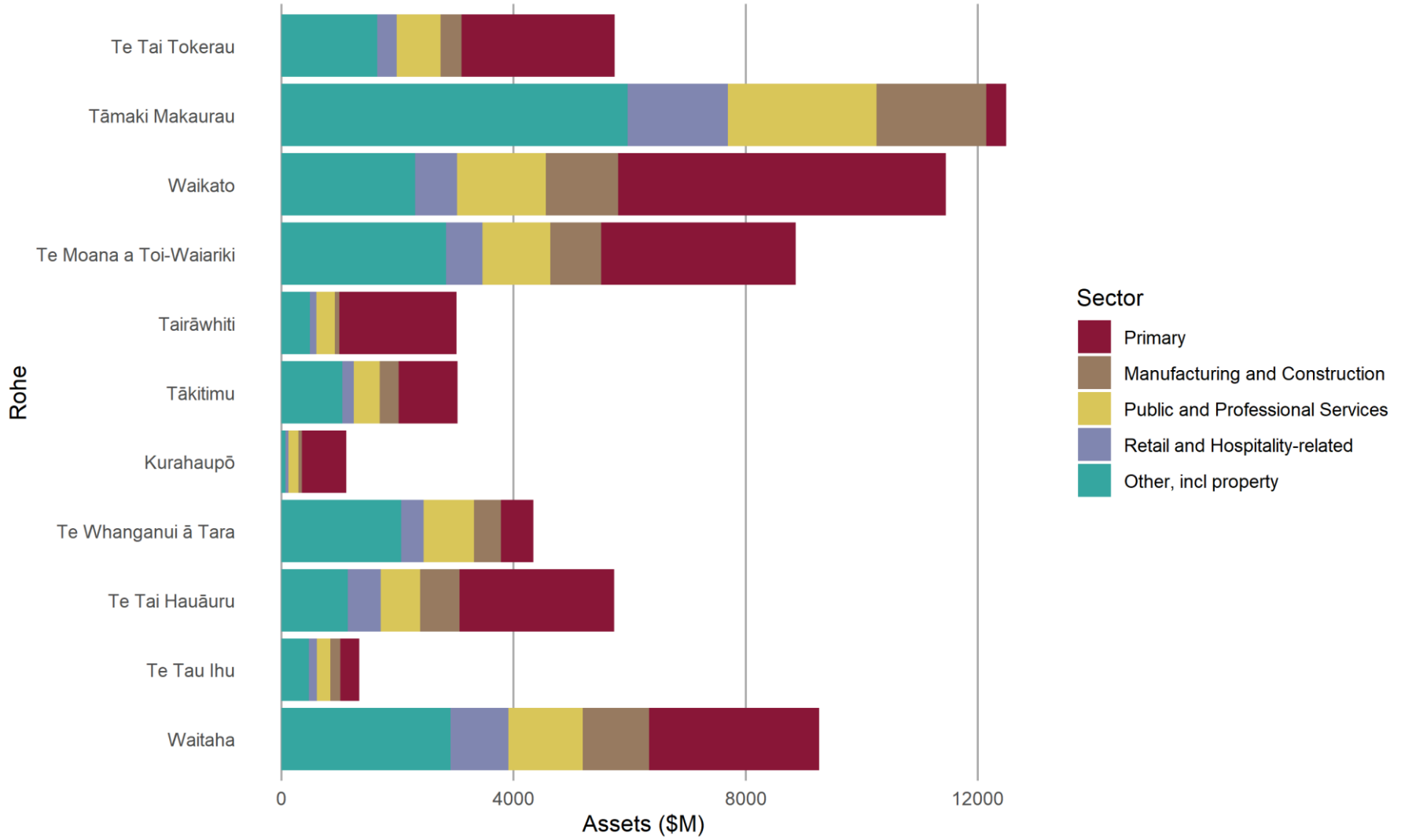


Source: Statistics New Zealand, BERL, and LUC Assessments analysis

3.3 Rohe level analysis

This section provides rohe level analysis to understand the Māori economy's vulnerability to the transition to the low emissions economy in different rohe. Figure 23 provides a breakdown of the Māori economy asset base by sector and rohe. It is reflective of the GHG emissions analysis provided in Figure 6 and Figure 7, which showed that Waikato, Waitaha and Te Tai Hauāuru are heavily invested in the primary sector. The figure also shows that about half of the Tāmaki Makaurau asset base is situated in the 'other' sector, which includes property. Ngāti Whātua, the Iwi in Tāmaki Makaurau, conduct various economic activity but are predominantly involved in commercial property development and investment. According to the Ngāti Whātua Ōrākei Trust's 2019 financial statements, the entity has $1.25 billion of assets of which $1.12 billion is land/investment property.

Figure 23 Māori economy asset base, broken down by sector and rohe

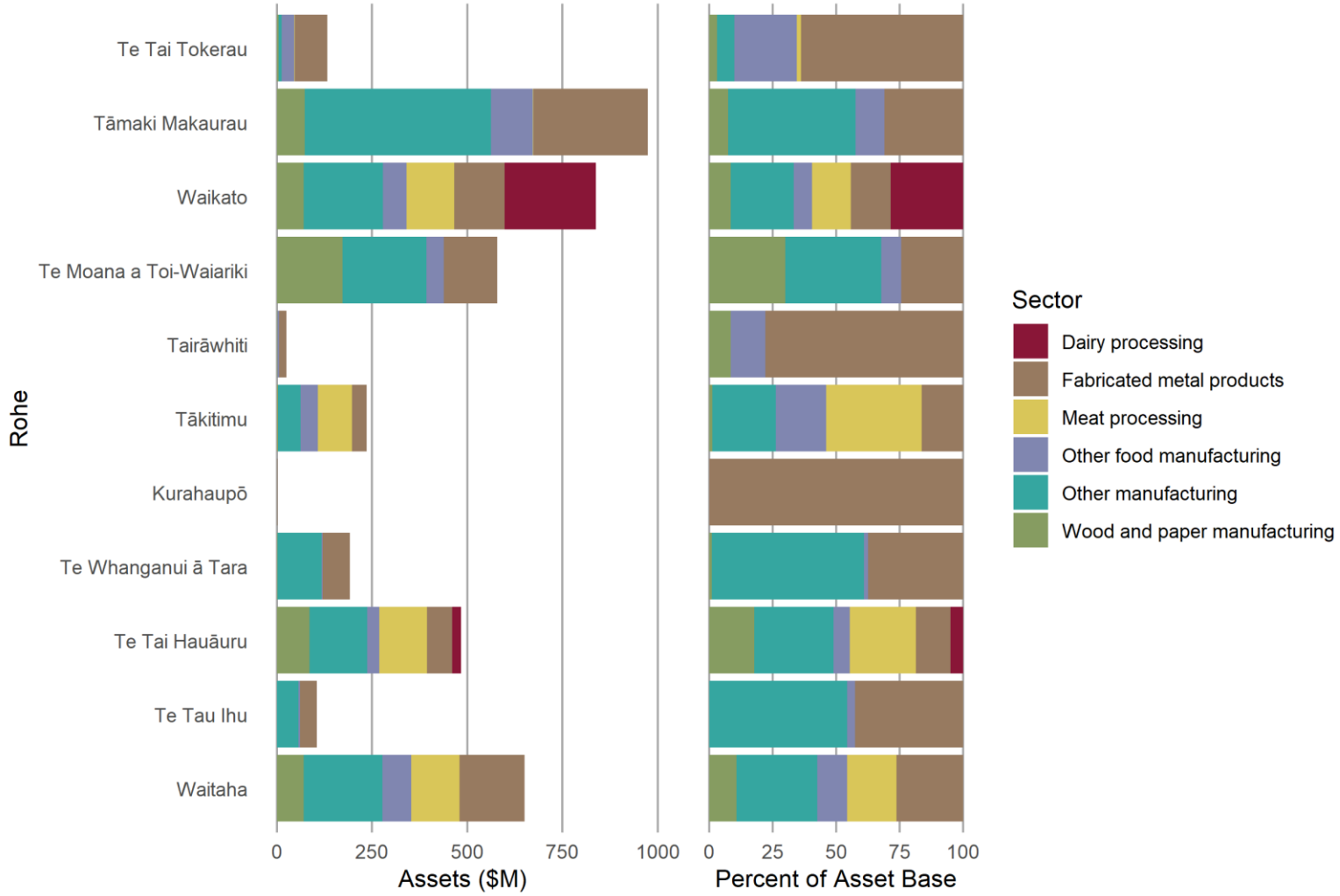


Source: Statistics New Zealand, BERL, and LUC Assessments analysis

Figure 24 provides a breakdown of the Māori asset base by rohe for the manufacturing subsectors. It highlights that:

- Dairy processing makes up 29 percent of total manufacturing in Waikato. This is likely due to Miraka, a Māori-owned dairy-processing entity, which is based in the Waikato rohe
- A significant proportion of the Tāmaki Makaurau manufacturing asset base is dominated by other manufacturing. Other manufacturing includes textiles, leather, clothing etc.
- Fabricated metal products manufacturing is also important to the Māori economy. In absolute numbers, it is mostly carried out in Tāmaki Makaurau, Waikato, Waitaha, and Te Moana a Toi-Waiariki. However, the right panel of the graph shows that fabricated metal production takes place in all rohe. In Te Tai Tokerau and Tairāwhiti, it is over half of the asset base.
- As shown in Figure 15, most of the manufacturing asset base is owned by employers (collectives own a small proportion of the food manufacturing asset base).

Figure 24 Māori manufacturing asset base, broken down by subsector and rohe[9]



Source: Statistics New Zealand, BERL, and LUC Assessments analysis

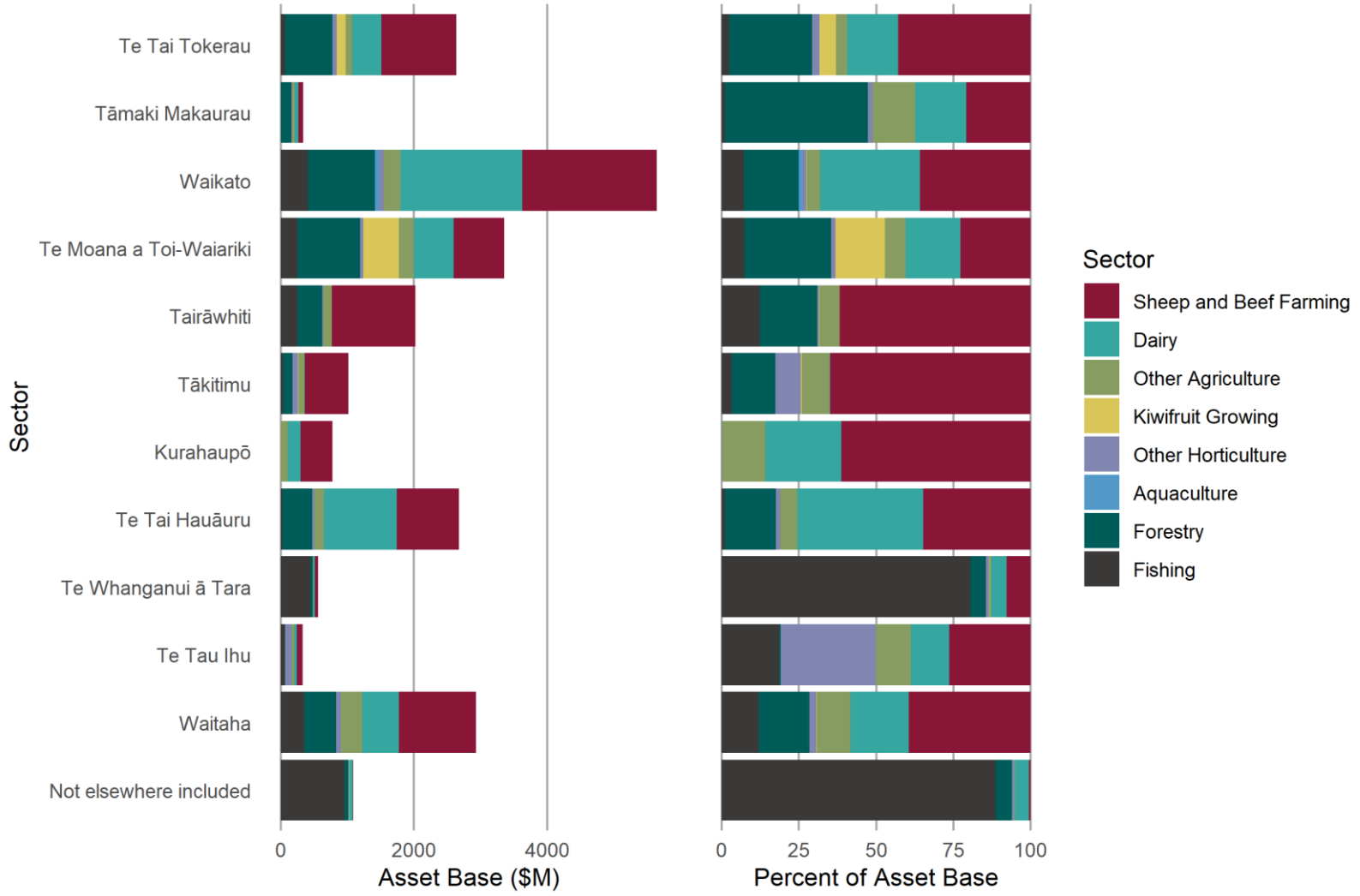
[9] There is $676 million of the dairy processing manufacturing asset base that is not included because it is not attributed to a rohe

Figure 25 provides a breakdown of the primary sector by rohe. It shows the following:

- The forestry industry is significant in Te Tai Tokerau, Waikato, and Te Moana a Toi-Waiariki. The forestry asset base is not only forests, it includes other assets such as machinery and infrastructure. The forestry sector will be significantly impacted by climate change mitigation. However, as discussed in section 2.4.5, there may be opportunities for forestry on Māori freehold land in terms of net emissions
- Moana New Zealand (Aotearoa Fisheries Limited) is the largest Māori–owned fisheries company in New Zealand. It is a custodian of commercial fisheries assets returned to Māori through the Treaty of Waitangi Fisheries Settlement Act 1992. This Treaty Settlement also resulted in the Māori Fisheries Act 2004, which recognises 57 iwi or groups of iwi. It is likely that these fishing assets are the significant amount of fishing assets included in the not elsewhere included category
- The Māori fishing asset base is also significant in Waikato, Te Moana a Toi-Waiariki, Tairāwhiti, Te Whanganu ā Tara, and Waitahi. In Waikato, Ngāti Tūwharetoa Fisheries Charitable Trust is a shareholder in Moana New Zealand and Sealord and leases out a large portion of its Annual Catch Entitlement (ACE). Ngāi Tahu through Ngāi Tahu Seafood manages its own fisheries assets as well as the fisheries settlement assets owned by Ngāi Tahu Fisheries Settlement Ltd
- Kiwifruit is significant in Te Moana a Toi-Waiariki.

The primary sector industries are considered either high or moderate emitting industries. As such, this significant primary sector asset base may provide a risk for the Māori economy in the transition to the low emissions economy.

Figure 25 Māori primary sector asset base, broken down by subsector and rohe



Source: Statistics New Zealand, BERL, and LUC Assessments analysis

4 Discussion and mitigation opportunities

4.1 Summary

In 2018, the Māori economy gross greenhouse gas emissions were 8.1 million tonnes of carbon dioxide equivalent (Mt CO_2-e), and were 11.2 percent of New Zealand's total emissions profile. Taking a split-gas approach (Section 2.3), the Māori economy makes up 8.9 percent of New Zealand's long-lived greenhouse gases emissions, and 13.8 percent of total methane emissions. However, the Māori economy's share of New Zealand's GDP is 6.4 percent. As such, the Māori economy is overrepresented in New Zealand's emissions profile. This is largely due to the Māori economy's high involvement in agriculture.

This report analysed the Māori economy GDP, asset base, and workforce to understand the vulnerability of the Māori economy to the transition to a low emissions economy. It found the following key areas of risk for the Māori economy:

- Māori collectives (see section 1.3.2) are heavily invested in agriculture, especially sheep and beef, and dairy. Since collectives are responsible for managing assets for the benefit of its members, the challenge that collectives face in the transition to a low emissions economy may negatively impact Māori whānau
- Land use characteristics of Māori freehold land mean that these landowners may have more limited options and face challenges in terms of land use change, independent of climate policy
- Māori freehold land has high forest coverage, but a large portion was planted before 1990, rendering this land ineligible for earning emissions trading units. The land owner is also likely to be liable to pay carbon credits if deforestation occurs and the area is not replanted into forest. The implication is that it may be expensive to change the land use of pre-1990 forest land
- Māori are overrepresented in lower-skilled jobs, which are likely to be lower-income. This may provide a barrier for transition to the low emissions economy
- Māori SMEs make up almost all of the Māori asset base for transport, construction, and manufacturing. The transition towards a low emissions economy is likely to require significant capital expenditure for these Māori SMEs, which also face access to capital barriers.

4.2 Historical analysis

Te Ōhanga Māori 2018 report highlighted that the growth of the Māori asset base between 2010 and 2018 has largely been dispersed across industries and across collectives, self-employed, and employers (BERL & RBNZ, 2021). It is important to note that data quality has significantly improved since BERL first measured the Māori economy in 2010, and as such, comparing the two datasets may not be precise.

Key changes between 2010 and 2018 are:

- A significant growth area for the collectives was the primary sector, which grew from $5.8 billion to $14 billion
- Employers and self-employed people also moved into the primary sector
- The primary sector is becoming more diverse. Māori have increasingly invested in horticulture between 2006 and 2018, with the Māori horticulture industry growing 300 percent in 12 years

(BERL & TPK, 2020). Māori now own more than 4,200 hectares of horticultural land. Growth is expected to continue, with many collectives planning expansions in kiwifruit, avocados, and berries. This diversification is positive for climate mitigation, since horticulture creates significantly less emissions than sheep and beef, and dairy

- The manufacturing asset base of employers has more than doubled since 2010, as has that of the construction industry
- There has also been a significant increase in the rental, hiring, and real estate services asset base. This growth has occurred across collectives, employers, and self-employed.

4.3 Mitigation opportunities

As discussed, climate change poses risks and challenges for the Māori economy, as it does for the New Zealand economy and the global economy. However, climate change also brings opportunities. This section considers opportunities for reducing emissions from high emissions industries and opportunities for expanding low emissions industries and transition-aligned industries.

4.3.1 Reducing emissions from high emissions industries

Primary sector

The *Biological Emissions Working Group (BERG)* report provided comprehensive advice on pathways towards the reduction of emissions from the primary sector (BERG, 2018). Three broad categories of mitigation in agriculture were identified: changes in farming practices (without the adoption of new technologies); new technologies; and those involving a land use change. The report points out that the mitigation options with the greatest potential — the new technologies, such as methane vaccines and methane inhibitors — are not yet commercially available. For the first category of mitigation (changes in farming practices), the *BERG* report recommends an approach that packages the following for the different sub-sectors:

Sheep and beef farming

- Reducing stocking rates while improving productivity per animal can reduce emissions by 2–5 percent
- Replacing breeding beef cows on hill country farms with surplus bulls and steers from the dairy herd can result in 1–4 percent emissions reductions
- Integrating forestry into farm operations

Dairy

- Improving productivity per animal, while reducing stocking rates, has the potential to consistently reduce greenhouse gas emissions by up to 10 percent
- Once-a-day milking
- Low protein supplementary feeds, removing nitrogen fertiliser, and removing summer crops
- On-farm forestry

Other agriculture

- Reductions in stocking rates
- Eliminating nitrogen fertiliser use
- On-farm forestry

Horticulture

- Organic fertilisers

- Biomass/manure management.

In general, the challenges and opportunities associated with the adoption of these mitigations strategies with each of these sub-sectors will be common to Māori and non-Māori enterprises. However, the proportionately greater level of economic activity by Māori in the sheep and beef sub-sector means that mitigation in this industry is of greater relevance to the Māori agriculture sector.

The three mitigation strategies outlined for sheep and beef farms have potential synergies within individual properties. For instance, integrating greater areas of forest into farming operations is consistent with reducing stocking rates at a property level. However, there is the potential for a greater level of grazing intensity on the remaining effective area. Further, shifting away from breeding cattle on sheep and beef properties reduces metabolic energy demands and the high concomitant methane emissions.

Adopting these mitigation practices and realising the potential synergies is likely to require a tighter management of farming systems. Access to expertise and institutional support will be critical to the uptake of these practices. In particular, establishing plantation forest on sheep and beef properties requires significant capital input.

Manufacturing

This research has found that the manufacturing sector is an important part of the Māori economy. Mitigation opportunities for manufacturing include using renewable energy sources, improving energy efficiency, using low emissions materials, and applying eco-design principles and circular economy innovations.

Food manufacturing plays a key role in the Māori manufacturing sector. This provides mitigation opportunities because food processing mostly involves low temperatures. As such, there are readily available options to reduce emissions that are likely to be accessible at relatively low costs. For example, replacing coal boilers with biomass or electricity.

Transport

The transport, postal, and warehousing sector has been shown to be important to the Māori economy. The Climate Change Commission's advice outlines that the transition to a low emissions economy requires the acceleration of the uptake of electric and zero-emissions cars, buses, and trucks. The advice also highlights the need for improving the efficiency of vehicles and freight movement. Some of these technologies are already available. If these technologies are made accessible, this will provide mitigation opportunities for the Māori transport sector.

4.3.2 Expansion of low emissions industries

There are mitigation opportunities in terms of growing low emissions industries within the Māori economy.

Education and training

The education and training industry is already a well-established aspect of the Māori economy, and has low emissions. Education is vital for whānau and New Zealand as a whole. As such, growing this industry is an opportunity for the Māori economy.

Health care and social assistance

Health and disability system reforms, such as the establishment of the new Māori Health Authority may provide opportunities to strengthen the Māori economy's health sector. Resourcing Māori entities and Māori in these industries may provide opportunities in the transition to a low emissions economy since it is a low emitting industry.

4.3.3 Expansion of transition-aligned industries

There are mitigation opportunities in terms of creating and growing transition-aligned industries within the Māori economy.

Emissions Trading Scheme

As discussed in section 2.4.5, there are opportunities for Māori freehold land in the ETS. First, the amount of low productivity grassland on Māori land provides a measure of afforestation opportunities. Furthermore, in rohe with large areas of low producing grassland, there are opportunities for earning carbon units by a full retirement from grazing. Second, only around half of eligible forests have been registered with the ETS, so there are potential opportunities for maximising the benefit of ETS for post-1989 forests that have not yet been realised.

Bioeconomy

The bioeconomy encompasses the production of renewable biological resources from land, forestry, fisheries, and aquaculture, and the conversion into food, feed, bio-based products and bioenergy via innovative and efficient technologies. The Māori economy's high investment in land, forestry and fisheries may provide opportunities within the bioeconomy.

Renewable and distributed energy

Renewable and distributed energy could involve renewable energy generation to sell to the grid, but it could also involve implementing community smart grids for peer-to-peer electricity trading. Smart grid technologies enable an entity to be involved not only in the generation but also the distribution, trading and management of energy locally.

Low emissions food

The Māori economy's position in the primary sector and the food manufacturing sector creates business opportunities for low emissions food. Low emissions food could take many forms, from how the food is produced, what food is produced or how the food is processed. Other agriculture and horticulture opportunities may be options; the recent diversification of the Māori economy asset base provides a platform to leverage these opportunities. Decentralised supply chains (i.e. growing and distributing food locally) could also be explored.

Manufacturing using circular economy principles

Given the importance of manufacturing and construction to the Māori economy, exploring options for manufacturing using circular economy principles provides an opportunity. The Ellen MacArthur Foundation states that "a circular economy is based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems". Furthermore, a circular economy keeps resources in use for as long as possible, while products in a linear economy are not designed for reuse, and usually end up in the landfill. Changes are required throughout the entire supply chain: design, manufacturing, and packaging, etc. Businesses may also shift focus to manufacturing goods that are made for reuse and repair.

Blue economy

There is preliminary evidence indicating that the 'blue economy' (e.g. kelp farms) can be stores of CO_2, although this is not currently a viable mitigation strategy. There are many areas where future research is needed to understand the carbon opportunity in the blue economy. Significant technical and methodological constraints would need to be overcome to allow blue economy carbon mitigation strategies at scale.

Sharing economy

The sharing economy, a concept within the circular economy, is about providing access to goods and services, rather than ownership. Examples include peer-to-peer accommodation, shared transport, or 'public libraries' for goods. These new business models may provide opportunities for the Māori economy. In particular, new sharing initiatives could be structured to improve accessibility to goods and services for whānau.

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Appendix B Ranking emissions intensity

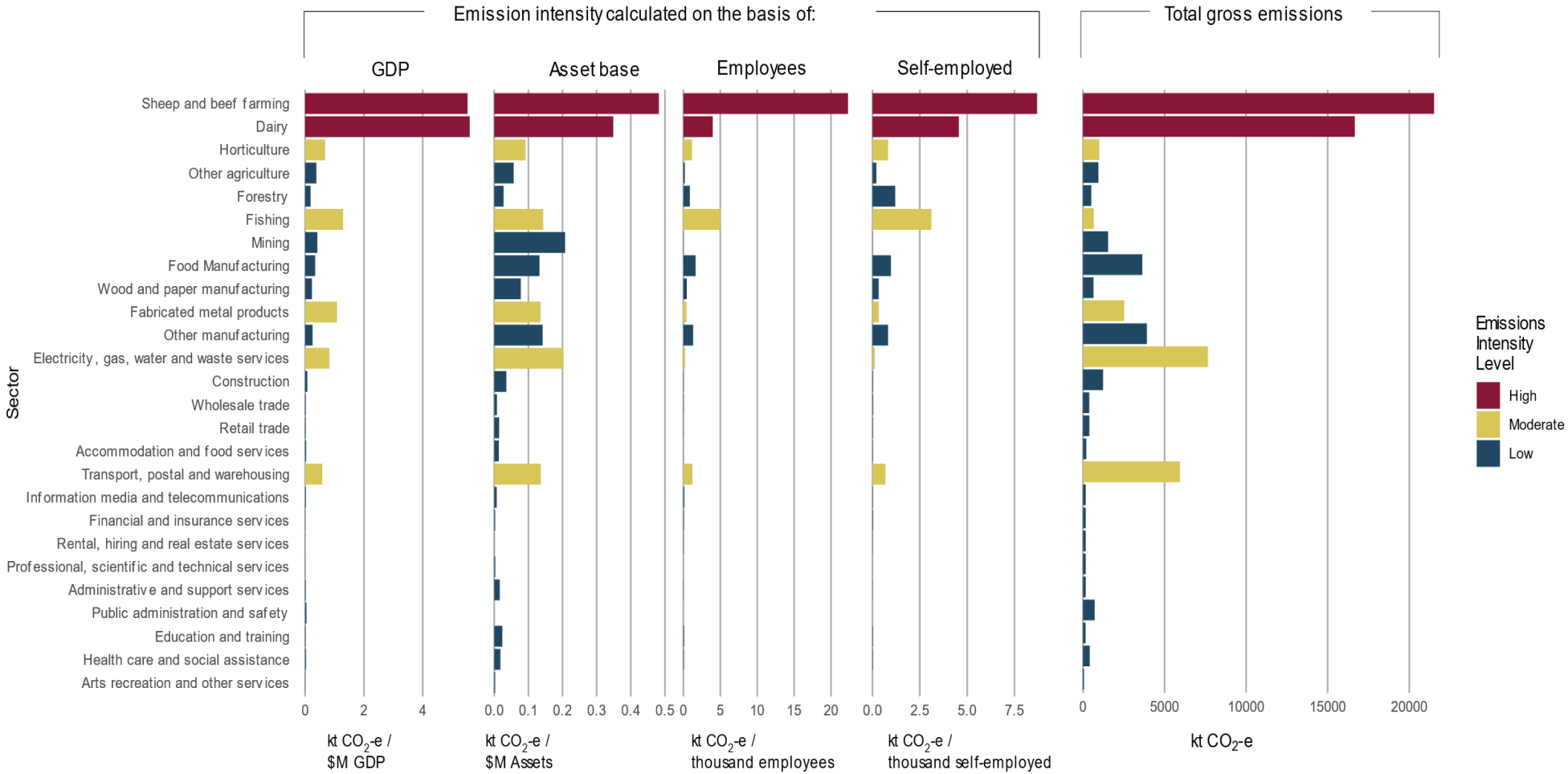
Figure 26 illustrates how we chose to categorise the 26 sectors into "High", "Moderate" and "Low" emitting industries. The left four panels are emissions intensity calculated by emissions (from the Māori sector) divided by GDP, asset base, number of employees and number of employers, respectively. The right-most panel shows the gross emissions from the Māori economy. The sectors categorised as "High" emitting are those with a GDP-based emissions-intensity exceeding 1.5 kT CO_2-e/$M GDP. The sectors categorised as "Moderate" emitting are those with a GDP-based emissions-intensity between 0.05 to 1.5 kT CO_2-e/$M GDP. The sectors categorised as "Low" emitting are those with a GDP-based emissions-intensity below 0.05 kT CO_2-e/$M GDP.

The plot shows that the two sectors ranked "High" on an emissions per GDP basis also rank the highest across the other four metrics. The sectors ranked "Moderate" on an emissions per GDP basis also would have ranked "Moderate" on emissions intensity based on other economic metrics. The sectors ranked as "Low" on an emissions per GDP basis, are always lower than "High" for the other metrics and generally lower than "Moderate" for the other metrics. We assume here that GDP is the best integrated measure of the economic importance of the sectors to the Māori economy, and therefore use ranking according to GDP-based emissions intensity as the primary way of identifying high, moderate and low emitting sectors.

An alternative approach to quantifying emissions intensity is to focus on consumption-based emissions. For example, Allan et al (2015) used an environmental input-output model to relate production emissions to consumption emissions to determine household emissions in New Zealand. In the current study, the key objective was to determine the relationship between economic metrics of sectors within the Māori economy and their associated emissions. The production-based approach to estimating emissions intensity was better suited for this analysis with its specific focus on Māori industries.

It is important to recognise that, while GDP-based emissions intensity provides a method of normalising emissions to a measure of economic activity, it does not capture the interdependencies of GDP among sectors. For instance, a full consideration of the contrast between the high emissions intensity of the agriculture sector and the low emissions intensity of the retail trade sector requires the additional context of the extent to which GDP in the agriculture sector affects GDP in the retail sector.

Figure 26 Emissions intensity on a GDP, assets, employee count and employer count basis, and gross emissions



Source: Statistics New Zealand, BERL, and LUC Assessments analysis