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1. Introduction

A growing focus on sustainability has led to an increased interest across New Zealand in measuring one's carbon footprint. Measuring and reporting on emissions empowers individuals and organisations to manage and reduce the emitted amount more effectively over time. To support organisations that are acting on climate change, the Ministry for the Environment publishes a guide and emission factors for this reporting, on which this report is based.

Manawatu Golf Club reached out to Litefoot for support on not only measuring, but also managing the facility’s carbon footprint. The club had already made attempts to become more energy efficient, and Litefoot’s specific sports club programme – LiteClub – helped them on their sustainability journey through advisory services on resource efficiency.

The golf club has since actively sought out methods to reduce their environmental impact. Once the club gains detailed insight into the activities contributing to their emissions through this report, they will be able to form strategic plans to reduce and/or offset these emissions.
Four of the past six years have been among the warmest in New Zealand’s recorded history. We have witnessed devastating wildfires across the Tasman region in early 2019. Rising sea levels are starting to affect our towns and cities, with Whanganui, South Dunedin and others experiencing one-in-100 year floods several years running. This is the reality of climate change.

Whilst often known as the main culprit, carbon dioxide, or CO$_2$, is not alone in its warming effect; it is part of a group called greenhouse gases (GHGs), which consist of nitrous oxide (N$_2$O), methane (CH$_4$), water vapour, and fluorinated gases, such as hydrofluorocarbons (HFCs), commonly found in refrigerants. Some of these GHGs existed before we came along, however, human activities are increasing them. CO$_2$ is what we generate most of, thanks to the fossil fuels we burn and the beautiful forests we chop down.

Many of these GHGs behave in different ways. Methane emissions for instance, which are commonly associated with agricultural practices, trap about 100 times more heat than CO$_2$, but it also disintegrates more quickly meaning over a period of 100 years methane is 25-times as bad as CO$_2$. This translates roughly into one tonne of methane as equivalent to 25 tonnes of CO$_2$-e when it comes to calculating greenhouse gas emissions. GHG emissions are reported in carbon dioxide equivalent (CO$_2$-e) units, which is a measure for how much global warming a given type and amount of greenhouse gas causes, using the equivalent amount of carbon dioxide as the reference. CO$_2$-e is used for describing different greenhouse gases in a common unit, which allows them to be reported consistently.
So, when we talk about carbon footprints, we are referring to all emissions related to human activities. For instance, in 2017 New Zealand released 80.9 million tonnes of CO$_2$-e, of which nearly half were methane and nitrous oxide emissions from NZ’s agricultural sector. This places the country as the fifth highest CO$_2$-e emitter per person (among OECD countries), at 17.2 tonnes per capita.

**Nitrous Oxide**

“Nitrous oxide is a much more powerful GHG than methane – 298 times more powerful than carbon dioxide over a 100 year period. Fortunately, the absolute amount of nitrous oxide emitted from agriculture is lower than methane. In New Zealand, most nitrous oxide is produced by the action of soil bacteria in urine patches in paddocks. Smaller amounts come from dung deposited during grazing, stored manures spread back onto pasture, and from nitrogen fertilizer.”

Source: New Zealand Agricultural Greenhouse Gas Research Centre

<table>
<thead>
<tr>
<th>Country</th>
<th>GHG emissions per capita 2017 (excluding LULUCF, OECD countries)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>22.54</td>
</tr>
<tr>
<td>United States</td>
<td>19.74</td>
</tr>
<tr>
<td>Canada</td>
<td>19.49</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>17.29</td>
</tr>
<tr>
<td>New Zealand</td>
<td>17.20</td>
</tr>
<tr>
<td>Estonia</td>
<td>15.83</td>
</tr>
<tr>
<td>Russia</td>
<td>14.79</td>
</tr>
<tr>
<td>Iceland</td>
<td>14.22</td>
</tr>
<tr>
<td>Ireland</td>
<td>12.78</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>12.09</td>
</tr>
</tbody>
</table>

Figure 1: GHG emissions per capita 2017 (excluding LULUCF, OECD countries) (Source https://stats.oecd.org/Index.aspx?DataSetCode=AIR_GHG#)

The New Zealand government has recognised the country’s direct contribution to GHG emissions and signed the Zero Carbon Bill, which sees NZ reduce all greenhouse gases to net zero by 2050. The bill gives the country a clear strategy for delivering on the Paris Climate Agreement, which aims to limit global warming below 1.5 degrees Celsius above pre-industrial levels.
This report is the greenhouse gas emissions inventory report for Manawatu Golf Club for the 2019 calendar year, which is also the base year. The inventory is a complete and accurate quantification of the amount of GHG emissions that can be directly attributed to the organisation’s operations within the declared boundary and scope for the specified reporting period. This report is intended purely as an advisory document for Manawatu Golf Club. If your club intends to become carbon neutral certified in the future, you will need to re-verify the inventory with a carbon credit provider. MfE recommends getting the inventory verified by an independent body before publicly releasing information.

Our calculations show that Manawatu Golf Club emitted 123.66 tonnes of CO\textsubscript{2}-e in 2019.

**SCOPE 01**

**Direct GHG emissions and removals** – occurring from sources that are owned or controlled by the organisation. These include emissions from fuel (e.g. boiler, electricity generator, mowers and vehicles); refrigerants; agriculture, forestry and other land uses.

**SCOPE 02**

**Indirect GHG emissions** – occurring from the generation of purchased electricity consumed by the organisation.

**SCOPE 03**

**Other indirect GHG emissions** – occurring as a consequence of the activities of the organisation, but generated from sources not owned or controlled by the organisation. Include emissions transmission and distribution losses from purchased electricity and natural gas; Air Travel (e.g. subways, trains, buses, trams, taxis, ferries); waste to landfill; water supply.
As Manawatu Golf Club is one of the few clubs in the country to measure and prepare its emissions inventory, we cannot comment on how this compares to golf clubs around the country, but it appears to be relatively normal for an organisation of Manawatu Golf Club’s size. The following table breaks down emissions by scope for the club. The following chapters identify these emission types in more detail.


Table 1: Emissions Summary by Scope

<table>
<thead>
<tr>
<th>Scope</th>
<th>Direct/ indirect emissions</th>
<th>Source</th>
<th>Emissions (tCO₂e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCOPE 1</td>
<td>Direct GHG emissions and removals</td>
<td>Fuel consumption, refrigerant use, Forest &amp; land-use</td>
<td>76.98*</td>
</tr>
<tr>
<td>SCOPE 2</td>
<td>Indirect GHG emissions from imported energy</td>
<td>Purchased electricity</td>
<td>19.38</td>
</tr>
<tr>
<td>SCOPE 3</td>
<td>Indirect GHG emissions from transportation</td>
<td>Business travel, accommodation, transport</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indirect GHG emissions from products an organisation uses</td>
<td>Water supply and wastewater treatment, materials and waste, transmission and distribution losses from purchased energy</td>
<td>27.30</td>
</tr>
</tbody>
</table>

*excluding planted and natural forest offset

TOTAL 123.66
Manawatu Golf Club is a not-for-profit, volunteer-driven community golf club in Palmerston North. Proudly promoting the title of “oldest golf course in New Zealand”, its high quality 18-hole course regularly attracts professional and amateur tournaments. Manawatu Golf Club’s committee and almost 1,000 members are proud of their club’s heritage and strive to highest environmental standards in their club operations.

This inventory forms part of Manawatu Golf Club’s commitment to measure and manage their emissions, informed by the club’s environmental standard:

“Manawatu Golf Club commits to the on-going ecological enhancement of the golf course and its biodiversity. The Club recognises the contribution it makes towards the conservation and safe-guarding of local flora and fauna and acknowledges the need to incorporate ecological best practice in the pursuit of providing premium playing surfaces.”
5. Organisational boundaries

The club has two main facilities, which are included in this report. The clubhouse is used primarily by members of the club for recreational purposes, but it is also hired out for social events and weddings. The clubhouse tends to get regular use all year round, but the summer months are generally more popular. The greenkeepers facility is strictly used by employees of the club. This facility sees heavy usage throughout the year and operates machinery, equipment, vehicles and tools for the maintenance and management of the course. Activities such as mowing, irrigation and fertilisation contribute considerably to GHG emissions and energy use.

Any other facilities the club might operate are not included in this report.

6. GHG Emissions Source Inclusions and Data Collection

The GHG emissions sources included in this inventory were identified with reference to the methodology in the GHG Protocol and ISO14064-1:2006 standards, and emissions factors sourced from the Ministry for the Environment’s 2019 Measuring Emissions: A Guide for Organisations.

The following section gives an overview of how data was collected for each GHG emissions source, the source of the data, and an explanation of any uncertainties or assumptions.
<table>
<thead>
<tr>
<th>GHG Emission Source</th>
<th>Scope</th>
<th>Data Source</th>
<th>Unit</th>
<th>Uncertainty (description)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Consumption – Petrol</td>
<td></td>
<td>Monthly supply amounts from fuel supplier</td>
<td>Litres</td>
<td>The monthly supply data may differ from the actual monthly consumption to some extent. Emission factors for direct (Scope 1) emissions from fuel combustion are not fuel-cycle emissions factors and do not incorporate indirect (Scope 3) emissions associated with the extraction, production and transport of the fuel (MfE, 2019: 21-22)</td>
</tr>
<tr>
<td>Fuel Consumption – Diesel</td>
<td>Scope 1</td>
<td>Monthly consumption data obtained directly from supplier Nova Energy</td>
<td>kWh</td>
<td></td>
</tr>
<tr>
<td>Fuel Consumption – Natural Gas</td>
<td></td>
<td>Monthly supply amounts from fuel supplier</td>
<td>Litres</td>
<td>The monthly supply data may differ from the actual monthly consumption to some extent. Emission factors for direct (Scope 1) emissions from fuel combustion are not fuel-cycle emissions factors and do not incorporate indirect (Scope 3) emissions associated with the extraction, production and transport of the fuel (MfE, 2019: 21-22)</td>
</tr>
<tr>
<td>Forest &amp; Land-Use – Planted Forest and Natural Forest Growth</td>
<td>Scope 1</td>
<td>Data collected on forest area cover on the golf course directly from club</td>
<td>Hectares (ha)</td>
<td>This does not (fully) take into account individual species-related emissions factors. Where only the number of trees was available, this was converted into ha-units based on the average plant per hectare for that species.</td>
</tr>
<tr>
<td>Forest &amp; Land-Use – Fertiliser</td>
<td>Scope 1</td>
<td>Data collected directly from the club’s greenkeeper</td>
<td>kg</td>
<td>It is assumed we have complete and accurate fertiliser use data. There is no country-specific methodology on GHG emissions from area application for New Zealand.</td>
</tr>
<tr>
<td>Refrigerant Use</td>
<td>Scope 1</td>
<td>Primary data collection, default MfE leak rates and GWPs of refrigerants</td>
<td>kg</td>
<td>No data from refrigeration supplier on top-ups in kgs for 2019, but default leak rates per appliance size/scope deemed acceptable by supplier and MfE report (MfE, 2019: 31 and 114-117).</td>
</tr>
<tr>
<td>Purchased Electricity</td>
<td>Scope 2</td>
<td>Monthly consumption data sourced from Nova Energy</td>
<td>kWh</td>
<td>It is assumed the supplier has provided data for all meters. Transmission and distribution losses attached to this are included in Scope 3.</td>
</tr>
</tbody>
</table>

Source: New Zealand’s LUCAS national forest inventory data November 2018
<table>
<thead>
<tr>
<th>GHG Emission Source</th>
<th>Scope</th>
<th>Data Source</th>
<th>Unit</th>
<th>Uncertainty (description)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport – Employees’ Private Vehicles; Taxi Travel;</td>
<td>Scope 3</td>
<td>Employees’ monthly allowance, kms travelled, costs reimbursed</td>
<td>NZ$, km</td>
<td>Calculations based on monthly allowance given to course superintendent. Monthly kms driven might be below or indeed exceed this allowance.</td>
</tr>
<tr>
<td>Travel – Air Travel</td>
<td>Scope 3</td>
<td>Record obtained from club travel accounts</td>
<td>pkm</td>
<td>It is assumed the data source represents a complete and accurate account of all travel activity. National average emission factor are used, as aircraft type (Small/Medium/Large aircraft) is unknown (MfE, 2019: 58).</td>
</tr>
<tr>
<td>Travel – Hotel Accommodation</td>
<td>Scope 3</td>
<td>General emissions factor used for all Australian hotels, which doesn’t necessarily take into account individual hotel footprints (MfE, 2019: 60).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waste to Landfill</td>
<td>Scope 3</td>
<td>Monthly weight data per collection of skip by Envirowaste (12-month reports – weight of landfill waste)</td>
<td>kg</td>
<td>Complete skip weight data was available, but no data was available on the actual weight of collected bins. For our calculations, we used the recommended 30kg maximum weight of 240l bins, as stipulated by Envirowaste. As the waste composition is unknown, we categorised waste as ‘office’.</td>
</tr>
<tr>
<td>Water – Supply</td>
<td>Scope 3</td>
<td>Monthly water use data sourced from Palmerston North City Council</td>
<td>m³</td>
<td>The water meter is read and charged every 2 months. We extrapolated the monthly water consumption on the basis of average daily water use.</td>
</tr>
<tr>
<td>Water – Waste Water</td>
<td>Scope 3</td>
<td>As the majority of the water consumption is likely to be related to kitchen and ablutions, we have assumed a 1:1 ratio as suggested by council. The club has its own bore for irrigating the greens, tees and fairways.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmission &amp; Distribution Losses from Purchased Energy</td>
<td>Scope 3</td>
<td>Monthly consumption data sourced from Nova Energy</td>
<td>kWh</td>
<td>It is assumed the supplier has provided data for all meters. Transmission and distribution losses attached to this are included in Scope 3.</td>
</tr>
</tbody>
</table>
Various activities were excluded in this emissions inventory. The details and reasons are outlined in Table 3 below.

### Table 3: GHG emissions sources excluded from the inventory

<table>
<thead>
<tr>
<th>GHG Emission Source</th>
<th>Scope</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff Taxi Travel</td>
<td>Scope 3</td>
<td>Not all taxi travel is included in this inventory. Some employees may have paid for taxis using their personal accounts and claimed back this amount from the club. Given the small estimated impact on the total, we have chosen to exclude this.</td>
</tr>
<tr>
<td>Freight Transport</td>
<td>Scope 3</td>
<td>While freight emissions are usually calculated as indirect emissions (Scope 3), we assume that the cost of freight is already covered by the suppliers of the goods. The club mostly uses its own vehicles for movement of goods which is minimal.</td>
</tr>
<tr>
<td>Soil Carbon Sequestration</td>
<td>Scope 3</td>
<td>Although turf grasses undoubtedly sequester carbon from the atmosphere, it is not included in the total emissions. So far, there are no emission factors for grass in MfE guidelines.</td>
</tr>
</tbody>
</table>
8. GHG Emissions Calculations and Results

The following tables and graphs give an overview of where the emissions are occurring across the club. This will help your club identify carbon-intense activities and guide you towards finding alternative practices and/or reducing the impact of current activities. It is then further broken down into the individual components from which carbon emissions were calculated.

Table 4: Emissions inventory summary

<table>
<thead>
<tr>
<th>Type</th>
<th>CO₂-e (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrol</td>
<td>18.95</td>
</tr>
<tr>
<td>Diesel</td>
<td>37.78</td>
</tr>
<tr>
<td>Natural gas</td>
<td>13.15</td>
</tr>
<tr>
<td>LPG</td>
<td>-</td>
</tr>
<tr>
<td>Coal</td>
<td>-</td>
</tr>
<tr>
<td>Wood</td>
<td>-</td>
</tr>
<tr>
<td>Company Vehicles</td>
<td>-</td>
</tr>
<tr>
<td>Employees’ Own Vehicles</td>
<td>1.87</td>
</tr>
<tr>
<td>Rental Cars</td>
<td>-</td>
</tr>
<tr>
<td>Taxi - by distance</td>
<td>-</td>
</tr>
<tr>
<td>Or Taxi - NZ$ Spent</td>
<td>0.00</td>
</tr>
<tr>
<td>Refrigerants</td>
<td>3.02</td>
</tr>
<tr>
<td>Electricity - NOVA</td>
<td>19.38</td>
</tr>
<tr>
<td>Electricity - Others</td>
<td>-</td>
</tr>
<tr>
<td>Air Travel</td>
<td>12.07</td>
</tr>
<tr>
<td>Hotel Accommodation</td>
<td>4.33</td>
</tr>
<tr>
<td>Waste</td>
<td>5.24</td>
</tr>
<tr>
<td>Composting</td>
<td>-</td>
</tr>
<tr>
<td>Water Supply</td>
<td>0.05</td>
</tr>
<tr>
<td>Waste Water</td>
<td>0.73</td>
</tr>
<tr>
<td>Septic Tanks</td>
<td>-</td>
</tr>
<tr>
<td>Natural gas used</td>
<td>1.54</td>
</tr>
<tr>
<td>Electricity used</td>
<td>1.47</td>
</tr>
<tr>
<td>Planted Forest</td>
<td>(118.32)</td>
</tr>
<tr>
<td>Natural Forest</td>
<td>(1.17)</td>
</tr>
<tr>
<td>Fertiliser Use</td>
<td>4.08</td>
</tr>
<tr>
<td><strong>Total Emissions</strong></td>
<td><strong>123.66</strong></td>
</tr>
<tr>
<td><strong>Total Offset</strong></td>
<td><strong>(119.50)</strong></td>
</tr>
</tbody>
</table>

Figure 2: GHG Emissions by Scope

Figure 3: Emissions (without forest) Breakdown - 2019
8.1 FUEL CONSUMPTION

Emissions from fuel consumption for the club in 2019 were 69.98 tCO\(_2\)-e, which accounts for 57% of Manawatu Golf Club’s total emissions and is by far the biggest contributor to the club’s carbon footprint. Diesel and petrol-powered equipment used for course maintenance were among the key emitters.

Figure 3 breaks down fuel consumption by type. While the total consumption of natural gas at the club is actually higher than both Petrol and Diesel, it has the lowest emissions factor of the three, as it is a comparatively clean fossil fuel.

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8.2 REFRIGERANT USE

The club’s annual emissions from refrigerant use totalled 3.02 tCO\(_2\)-e, which is around 2% of the club’s combined emissions for 2019. Figure 4 breaks these emissions down into appliances, with heat pumps making up the bulk of the refrigerant emissions.

GHG emissions from hydrofluorocarbons (HFCs) are associated with unintentional leaks and spills from refrigeration units, air conditioners, and heat pumps. While the amount of HFCs in your GHG inventory is relatively small, HFCs have very high global warming potential (commonly 1,300 to 3,300 times more potent than carbon dioxide).

In 2016, 486 tonnes of the HFC refrigerants in appliances across New Zealand were lost to the atmosphere via leaks, equipment failures, servicing, and what is called ‘catastrophic failures’ such as car crashes. A recent study commissioned by NZ’s Ministry for the Environment highlighted annual leak rates of refrigerants in appliances. Among the big hitters were walk-in chillers and refrigeration cabinets with up to 17.5% and 7% annual leak rates respectively.
8.3 ELECTRICITY CONSUMPTION

The club's electricity consumption per annum is just under 200,000kWh, which translates to **19.38 tCO₂-e**. This is approximately 16% of the club's overall emissions – so a fairly big contributor. Figure 5 illustrates the electricity consumption and emissions per month:

![Electricity Consumption and Emissions Per Month](image)

**Figure 6: Electricity consumption and emissions per month**

8.4 TRAVEL

The club’s travel emissions total **16.4 tCO₂-e** (13% of the overall emissions) and derive primarily from air travel and accommodation. As is commonly known by now, air travel has comparatively high emissions and therefore make a relatively high proportion of the club's overall carbon emissions figures. Figures 6 & 7 provide more in-depth information on the club’s travel emissions.

![Travel Emissions and Air Travel Compared](image)

**Figure 7: Travel emissions (tCO₂-e) by air travel and hotel accommodation**

**Figure 8: Travel emissions (tCO₂-e) domestic and international air travel**
8.5 WASTE

The club sent 13,765kg of waste to landfill in 2019. The club’s total emissions for waste was 5.24t CO$_2$-e, which is almost twice above the average of 2.9t CO$_2$-e for sports clubs in the country. Landfill waste breaks down to produce methane, a greenhouse gas that is 28 times more potent than CO$_2$ at trapping heat in the atmosphere over a 100-year period.

Figure 8 illustrates the amount of waste sent to landfill per month (kgs) and its relative emissions (tCO$_2$-e).

Figure 9: Waste to landfill amount (kgs) by month and emissions (tCO$_2$-e)
8.6 WATER

Excluding irrigation, the club used 1.64 million litres of water in 2019. The club’s 0.78 t CO₂-e (tonnes) water emissions are mainly from waste water (93%).

Water emissions result from energy use in the water supply and waste-water treatment plants. Some treatment plants also generate emissions from the treatment of organic matter.

8.7 FOREST & LAND USE

Confusingly, forest and land-use is responsible for both emitting and removing GHGs from the atmosphere. In Manawatu Golf Club’s case, forest growth and planted forest at the club helps to remove 119.5 tonnes of CO₂ from the atmosphere, which almost offsets the club’s entire emissions (123.66 t CO₂-e) for 2019. Planted forest however, which has been calculated to remove 118.32 t CO₂-e from the atmosphere at your club, is not an annual figure, meaning that the club’s 2020 inventory would only include new planted forest, natural forest and fertiliser use.

There are 4.08 t CO₂-e caused by sources related to fertiliser use. Much of this is nitrous oxide emissions from the use of nitrogen fertilisers: non-urea nitrogen fertiliser (2.87 t CO₂-e), Urea nitrogen fertiliser not coated with urease inhibitor (1.18 t CO₂-e), and Urea nitrogen fertiliser coated with urease inhibitor (0.028 t CO₂-e).
9. Next Steps for Manawatu Golf Club

After learning the key activities contributing to the annual carbon emissions, the next natural step is to work towards reducing them. The following section outlines the proposed actions your club can take to tackle those high emissions activities. We identified six key areas to target in Manawatu Golf’s efforts to reduce emissions over the coming years:

**Carbon Reduction Key Advice: In Summary**

1. **Fuel Consumption:**
   Look for opportunities to upgrade fossil-fuel driven machinery, equipment, vehicles and tools with electric alternatives.

2. **Land Management:**
   The efficient use of resources such as water and fertilisers will lower the GHG emissions from your golf course.

3. **Electricity Generation:**
   Consider renewable sources for electricity such as Solar PV to replace the club’s reliance on imported energy.

4. **Travel:**
   Reduce air travel where possible and look to offset necessary flights by purchasing carbon credits.

5. **Waste:**
   Divert organic waste from landfill by initiating composting for food and other green waste at the club.

6. **Water:**
   Upgrade your water infrastructure to conserve water where you can.
Fuel Consumption: in detail

The club’s fuel consumption consists mainly of Stationary Combustion Fuel (burning of fossil fuels for electricity, heat generation etc.) and Transport Fuel (energy sources that power various means of transport).

Fuel consumption is responsible for 57% of your overall annual emissions. This can be broken down into Diesel, Petrol and Natural Gas.

i) Diesel

Diesel is responsible for 38 tonnes CO₂-e, which is 31% of your annual emissions. So, this is a really important area to focus on if your club wants to reduce carbon emissions. The majority of this diesel consumption is from transport such as tractors, utes and mowers. There are readily available electric alternatives for all of these vehicles, but obviously this will come at a sizeable upfront cost. For a club that relies on volunteers and membership fees, we realise that replacing a fleet of tractors, utes and mowers is an unrealistic expectation. It is also important to note that the average age of the club’s equipment and vehicles is relatively low at 7 years. However, transitioning to electric vehicles over the coming years makes financial sense in the long-term for your club, so look into replacing ageing diesel-powered equipment such as the club’s ‘ISEKI TK538 Tractor’ and the ‘TORO Groundamaster 3500D’, with electric alternatives where possible.

In addition, the club should consider using biofuels which can be blended into ordinary diesel or petrol. Biofuels are produced from renewable materials such as plant and animal matter and have the ability to reduce GHG emissions. They are usually blended with petrol and diesel to make biofuel blends. All vehicles can use a 5% biodiesel blend without having to modify any engine or fuel system. Blending 5% of biodiesel will reduce your club’s emissions by almost 2 tonnes.

Regular maintenance of vehicles and equipment is key for running them efficiently. Ensure routine maintenance by certified professionals remains a priority.

ii) Petrol

Petrol is only about half the emissions than diesel for the club, but still represents a fairly sizeable 19 tonnes CO₂-e (15% of annual emissions). Similar to diesel consumption, most of the petrol consumption at your club comes from petrol-fuelled machinery and equipment. The Kubota RTV500 utility vehicles used for getting around the course, for instance, could be replaced with EZGO converted buggies and/or other electric utility vehicles available on the market.

Similar to biodiesel, bioethanol-blended petrol can be used in almost any petrol engine - from lawn mowers to generators.
ii) Natural Gas

Natural gas is the cleanest burning, lowest emission fossil fuel, though it still emits more carbon dioxide than renewable sources of energy. In New Zealand, because of our large proportion of renewable energy sources, electricity is cleaner than gas. Your club has a strong reliance on natural gas for space heating, water heating and cooking. This contributes to just under 13 tonnes CO$_2$-e (11%) of your annual emissions.

Whilst we understand this will be at some cost to the club, we highly recommend replacing your cooking, space heating, and water heating with more sustainable substitutes.

For water heating, there are numerous alternative options available; we would recommend a hot water heat pump system as it is not only environmentally the most efficient system, but can also bring large financial savings in the long term.

Your club’s gas usage considerably increases in the winter months as the gas fireplace is used to heat the lounge area. We recommend prioritising the use of heat pumps over the gas heater as much as possible to reduce gas consumption and the direct emissions attached to it.

9.2 Land Management: in detail

Manawatu Golf Club is located in a beautiful part of Aotearoa and occupies stunning land in Palmerston North. A large part of golfing is the enjoyment of spending time in nature, so it ought to be every golf club’s responsibility and privilege to protect it for future generations.

Sustainable land management is multi-faceted, but central to its success is protecting nature, promoting biodiversity and preventing pollution.

i) Fertiliser use

A major source of GHG emissions is associated with fertiliser use both through manufacturing, in which carbon dioxide (CO$_2$) and nitrous oxide (N$_2$O) is released, and through emissions of nitrous oxide (N$_2$O) from the soil after application and irrigation. Nitrous oxide (N$_2$O) traps 265 times more heat over a 100-year period than carbon dioxide, meaning it is a significantly more potent GHG than carbon dioxide. The club uses non-urea as well as urea nitrogen fertiliser, which collectively emitted 4.08 tonnes CO$_2$-e in 2019. Finding ways to reduce your fertiliser application rate while maintaining turf quality should be a priority to reduce GHG emissions. The club should experiment with reductions in fertiliser application as it will impact the growth of turf grass, ultimately reducing the frequency of mowing. Some studies also recommend recycling of grass clippings as a means of reducing the nitrogen application rate (see references for link). Golf courses in particular should look into exploiting the fertiliser value of recycled clippings in different conditions and reducing the application rates of nitrogen fertilisers to effectively manage and reduce nitrous oxide (N$_2$O) from greens.

The club should also look into trailing organic fertilisers as another means to reduce emissions. There are affordable organic fertilisers for turfgrass available on the market that will help your club reduce nitrous oxide emissions.
ii) Harvest and Deforestation
Land-use and forestry has the potential to both emit GHGs into the atmosphere through harvesting and deforestation and remove GHGs from the atmosphere through vegetation growth and increasing organic carbon stored in soils. The club has an opportunity to offset their current emissions by increasing forest growth. Native forests and vegetation can help the club promote biodiversity, prevent pollution and most importantly sequester carbon.

The club should explore options to increase plantations around the course and converting them into carbon credits through programmes such as The Native Carbon programmes by EKOS.

Initiatives such as the government’s One Billion Trees Programme can help your club with necessary funds to increase native forest on the course. Tree plantation can further help with erosion control and waterways protection on the golf course.

9.3 Electricity Generation: in detail

In New Zealand we are fortunate to have access to plenty of renewable energy sources to generate our electricity. Renewable energy comes from sources that are naturally replenished in a relatively short timeframe. Sunlight, wind, water and geothermal heat are all renewable energy sources.

New Zealand currently generates 84% of its total electricity through renewable sources. However, only 67% of this is from clean renewable sources¹ – Hydro, Solar and Wind.

i) Power Supplier
You can make many changes to reduce the amount of electricity you are using (which are listed in our recommendations in the next paragraph), but you can also switch to a CarboNZero certified energy supplier such as Ecotricity, who have basically done the hard work for you. Simply by switching your provider, the club’s annual emissions from purchased electricity would fall from over 19.4 tonnes $\text{CO}_2\text{-e}$ to just under 2 tonnes $\text{CO}_2\text{-e}$ (see graph below).

![Electricity Emissions - $\text{CO}_2\text{-e}$ (tonnes)](image)

Figure 12: Electricity emissions comparison Nova Energy to Ecotricity

¹ Whilst Geothermal energy is considered renewable, it is still responsible for 17.5% of overall annual emissions from the energy sector in 2018, which was higher than coal in the sector.
ii) Reducing electricity consumption
There are several simple steps through which your club could reduce its electricity consumption:

- Look into making low-cost upgrades first, e.g. upgrade fluorescent tubes in the club house with efficient LED panel lights.
- Ask your electricity supplier for off-peak energy rates, and manage and adjust the times when electric golf carts are being charged accordingly.
- Check and monitor the energy consumption of your irrigation pump. If necessary, put it on a separate meter with off-peak electricity rates.
- Experiment with reducing the flow rate and water use for irrigation.
- Use tools such as soil water sensors and weather data to monitor turf grass and landscape irrigation needs.
- Switch off equipment when not in use.
- Consolidate the contents of the older refrigeration units into as few units as possible and dispose of appliances that are older than 15 years. The average fridge or freezer in NZ is 16 years old and costs $200 per year more to run than a newer, more efficient model.
- Install fit-to-purpose timers on fridges that stock non-perishable items ONLY, e.g. drinks fridges. Timers can schedule the appliances to turn off overnight and during other low periods without affecting the drinks’ quality.
- Ensure periodic maintenance of walk-in chillers in the bar & kitchen. Install strip curtains to prevent air being blown out of the door when it is opened.

ii) Renewable Energy
There is also a great opportunity for the club to install a photovoltaic solar system, as the predominant use of electricity is throughout daylight hours when solar energy is most effective. There are numerous options available, so we recommend getting in touch with a few local solar providers to obtain quotations for a cost-effective system. Look for funding or financing opportunities in your region that may be able to assist the club with this installation.

9.4 Travel: in detail

i) Air travel
Emissions from air travel were just over 12 tonnes CO$_2$-e for 2019. This consisted of a couple of medium-distance flights to Australia, and a number of short-distance flights between Palmerston North and Auckland. Whilst we understand it is often necessary to fly for work, try and reduce this need and organise skype meetings instead of face-to-face where possible. If flying is the only option, look to offset the emissions related to air travel through certified carbon offsetting organisations such as Ekos and Toitū Envirocare.

ii) Accommodation
Emissions related to hotel accommodation amassed over 4 tonnes CO$_2$-e for 2019. Most of these emissions are Scope 3, meaning the club ultimately doesn’t have direct control over them. However, when booking accommodation, you can look for CarboNZero certified hotels or accommodation that are environmentally conscious. Sudima Hotels is an example of a CarboNZero certified accommodation provider.
9.5 Waste: in detail

The club’s emissions relating to waste for 2019 was over **5.24 tonnes CO2-e**. Waste generated by households is considered the third largest source of methane emissions and New Zealand’s waste emissions per capita are the second highest in the developed world at more than double the average. We see a lot of potential for the club to reduce emissions through a reduction of waste sent to landfill.

**i) Composting**

Organic waste such as food and green waste breaks down in landfills to produce greenhouse gases, and takes up valuable space in your landfill bin. The club should consider diverting food and green waste from landfill and introduce composting on site to produce nutrients for soil. There are several affordable options to dispose of organic waste responsibly using compost bins, worm farms or bokashi systems.

**ii) Recycling**

The club can increase its capture of recyclable materials around the course by installing recycling stations so that fewer recyclables end up in the landfill skip or bins. The Public Place Recycling Scheme may be able to fund new infrastructure through their capital projects funding scheme.

Recycling is great, but unfortunately it is not the solution to our climate emergency. Repurposing and reusing materials must be prioritised and with glass, there is a huge opportunity to reduce emissions related to waste management services through schemes that break down used glass bottles into sand. Instead of paying to refill your bunkers, why not use your empty beer bottles. Whilst this technology is relatively new, there are other golf clubs who have been experimenting with this. A recent trial was done by DB Breweries to recycle empty beer bottles into glass sand. Each bottle produces 200g of powder substitute in about 5 seconds.

Check with the Glass Packaging Forum for funding and grant support towards your investment.

9.6 Water: in detail

It’s easy to forget that our water supply is finite. With a growing population and the uncertainty of climate change placing pressure on our water resources, it is important that we all use water as efficiently as possible.

**i) Waste water**

Waste water has a relatively high emission factor per m³, meaning that preserving water where possible not only improves resource efficiency, but also reduces carbon emissions. The club’s waste water emissions were just under 1 tCO₂-e, which is relatively low but there is always room for improvement. Invest in efficient tapware such as WELS rated dual flush toilets, push-button taps and low-flow commercial grade shower units. Also, think about fitting a smart meter to help you monitor and manage your water consumption and identify any undetected leaks.
Other Opportunities

Carbon Credits
There is an approximate total of “unmanaged” land area of 11,250 ha within all the 18 hole golf courses in New Zealand. “Unmanaged” areas are defined as any area that receives fewer than three mows per year. What this means is there is a huge opportunity for golf clubs like Manawatu to gain carbon credits through afforestation or ‘rewilding’ at the club. If the club owns the forest land, then the club can sell these carbon credits through the New Zealand Emissions Trading Scheme (ETS). Owners can apply to register their post-1989 forest land into the ETS to earn New Zealand Units (NZUs): the primary unit of trade in the ETS (often referred to as a carbon credit).

So, not only does planted forest and regenerating natural forest growth offer an environmental incentive for the club, but it might also offer a financial one. If this isn’t a feasible option for the club, then there is also an opportunity to offset current emissions through purchasing carbon credits. This is becoming increasingly popular for air travel in particular, with organisations such as EKOS and Toitū Envirocare offering carbon offsetting options.

GEO Certification
The club is already targeting this, but GEO certification is ‘Golf’s most comprehensive and widely regarded sustainability distinction’ and should be a manageable goal for Manawatu Golf Club given current sustainability efforts. Most of the data needed to become certified can be inputted using GEO and NZ Golf’s new OnCourse® platform (mobile app or online). This will then need to be verified by a GEO professional in order to become certified. There are currently only 5 GEO certified clubs in New Zealand: Jack’s Point Golf, Remuera Golf Club, Royal Wellington Golf Club, Tara Iti Golf Club and Wairakei Golf & Sanctuary.
CarboNZero certified
The club can get Litefoot’s advisory GHG emissions inventory verified by a third party and start to work towards gaining Carbon Neutral certification. If you intend to publicly release the inventory, we recommend to get it independently verified to confirm our calculations are accurate, the inventory is complete, and has followed the correct methodology. If you do choose to become verified, we recommend using verifiers who are independent, members of a suitable professional organisation, have experience with emissions inventories, understand ISO 14064 and the GHG Protocol and have effective internal peer review and quality control processes. In New Zealand, the Joint Accreditation System of Australia and New Zealand (JAS-ANZ) issues accreditations and publishes a list of accredited bodies on its website (MfE, 2019: 17).

Carbon Membership Fee
The costs involved in reducing the club’s carbon footprint can be considerable for a club reliant on membership fees and volunteer work. Therefore, consider applying an optional carbon fee for membership every year. This will benefit the club in the long run, as becoming GEO certified and carbon neutral will open up opportunities for national and international tournaments to take place at the club.
For further information and to learn more:

**Fuels:**
https://www.energywise.govt.nz/on-the-road/biofuels/

**Electricity Generation:**
https://ecotricity.co.nz/

**Land Management:**
https://ekos.org.nz/

**Waste:**
http://www.dbexportbeer.co.nz/beer-bottle-sand

**Travel:**
https://www.ecotricity.co.nz/

**Water:**
https://www.mfe.govt.nz/fresh-water/we-all-have-role-play/choosing-water-efficient-products

**Carbon Credits:**
https://ekos.org.nz/
https://www.toitu.co.nz/what-we-offer/carbon-management

**GEO Certification:**
https://sustainable.golf/
https://www.golf.co.nz/About/Sustainability.aspx

**CarboNZero:**
https://www.iso.org/standard/66453.html
https://www.landcareresearch.co.nz/resources/business/the-carbonzero-programme
https://www.jas-anz.org/

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10. References


