

Productive and low-emissions business

Off-road liquid fuel insights

Quantifying off-road diesel and petrol use in New Zealand

July 2021

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Foreword

Twenty-eight percent of all liquid fossil fuel sold in New Zealand is used in off-road applications in both industrial and recreational activities. In 2019, this contributed 9% of New Zealand's Greenhouse Gas Emissions¹, a number that needs to come down if we are to meet our climate change action commitments.

This research provides a more detailed breakdown of where off-road fuel is used than has previously been available, enabling better understanding of how fossil fuels are used in the off-road context, along with which industries and technologies are using it and how it is transported and stored, to enable planning for decarbonisation.

EECA is pleased to have collaborated with MartinJenkins to deliver this research, which sits within our wider work understanding the potential to decarbonise industry and transport in New Zealand through efficiencies, electrification and fuel-switching.

Every year, EECA publishes the Energy End Use Database, and one of the key areas where there has been a need for more data is in understanding where off-road liquid fossil fuel is used.

Understanding which sectors and activities are currently using off-road liquid fuels at a more granular level will enable planning for decarbonisation. This research, which includes interviews and surveys across sectors, has enabled a deeper understanding of the places where liquid fuels are being used in both industrial and recreational activities. Understanding where it is being used across sectors will enable better planning for decarbonisation with alternative renewable fuels and technologies.

Kate Kolich

Manager Evidence Insights and Innovation



¹ This represents 3.89 million tonnes of CO2-e per year (EECA). MBIE, 2020. Oil statistics to June quarter 2020 (Retrieved on 15 Sept 2020). <https://www.mbie.govt.nz/assets/Data-Files/Energy/nz-energy-quarterly-and-energy-in-nz/Oil.xlsx>

Summary of key insights



Bulk deliveries are the primary source for a large proportion of off-road fuel, with some exceptions

The core assumption within the current statistics – that fuel delivered direct to customers is used off-road and fuel purchased through the retail network is used on-road – mostly holds true. However, there are some exceptions:

- larger operators filling off-road and on-road equipment/vehicles from the same bulk tank
- the use of ute/trailer tanks to transport fuel; these tanks can be filled from bulk tanks or from the retail network
- recreational marine use where boats are filled via the retail network.



The use of ute/trailer tanks in the agriculture sector is not accurately reflected in the current data

Within the agricultural sector it was found that approximately 9 million litres per year is sourced by this sector from the retail network for filling ute/trailer tanks. This will have been recorded as on-road transport in the current statistics; this has been corrected for this in our estimates.



Recreational marine use should be recorded as 'off-road' in future data

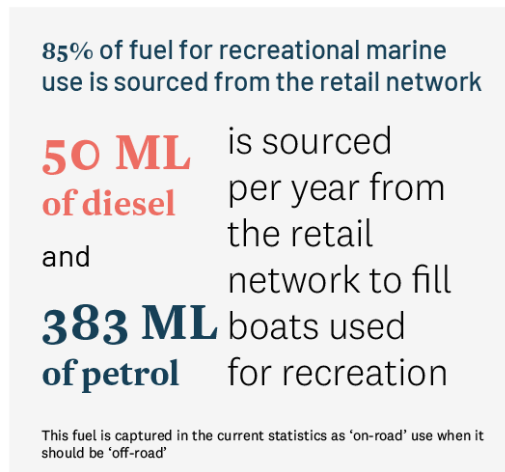
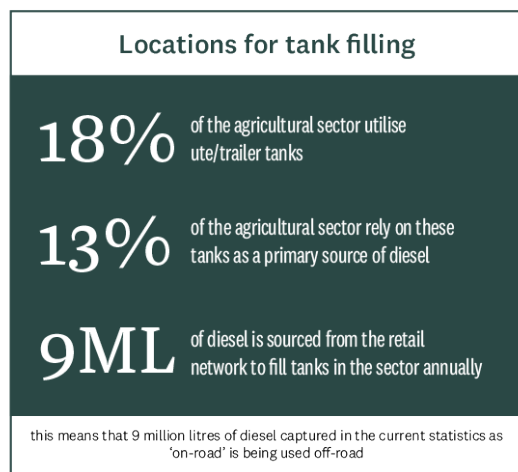
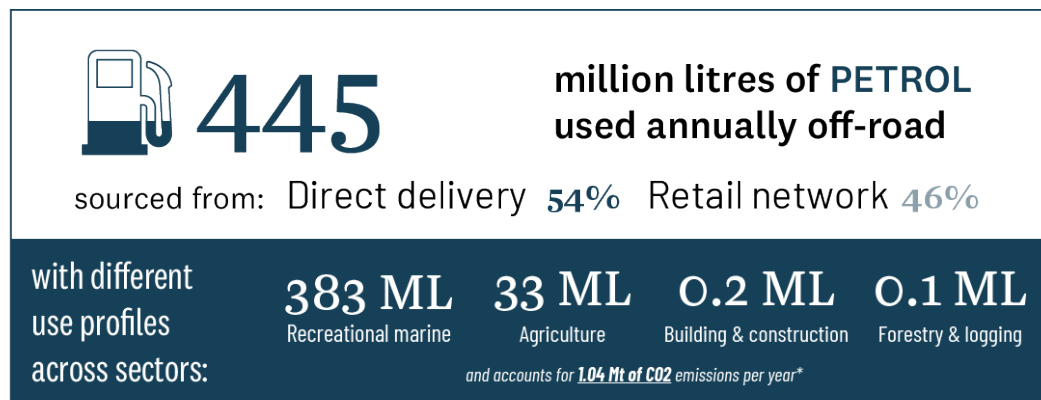
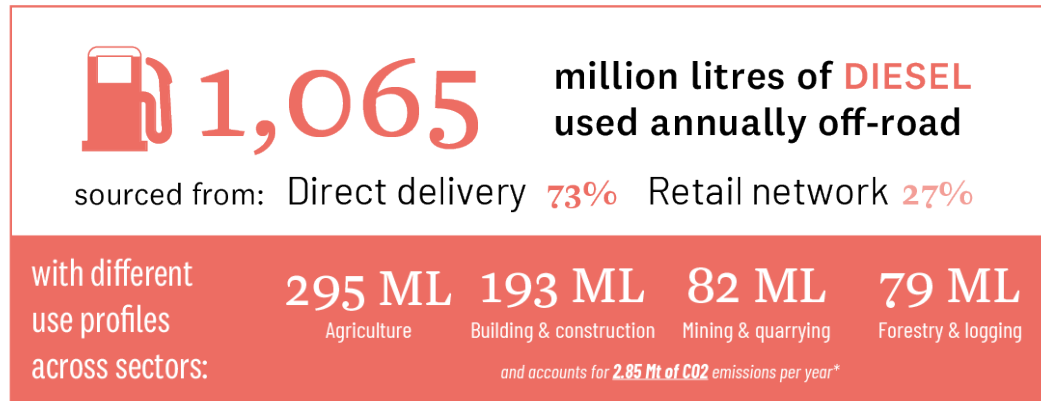
This research has found that there is the potential for 383 million litres of petrol and 50 million litres of diesel is sourced through the retail network for recreational marine use annually. This is recorded as 'on-road' use in the current data, while its actual use is off-road. This should be seen as an upper bound and should be further investigated to gain a clearer picture of the scale of this use.



This research provides insight into end-use technology at a sector level

Because this research included surveys of end-users, representatives from different sectors provided details about the types of technology they are using off-road that uses petrol or diesel. This information adds to the richness of the data for modelling and reporting on consumption.

Off-road liquid fuel use in New Zealand



* Emissions estimates are for carbon dioxide only - emissions of carbon dioxide account for over 99% of all emissions resulting from the combustion of petrol and diesel. Mt = million tonnes

Off-road liquid fuel use in New Zealand

In 2019, New Zealand used just over 6.9 billion litres of petrol and diesel (3.2 billion litres and 3.7 billion litres respectively)². Although most of this fossil fuel is used on New Zealand roads, it is estimated that about 26% of diesel and 2% of petrol are used for off-road applications across various sectors. These off-road uses of liquid fossil fuels accounted for 6.6% of New Zealand's Total Consumer Energy in 2019,³ and 9% of New Zealand's energy sector greenhouse gas emissions in 2018.⁴ This represents 3.89 million tonnes of CO₂-e per year.

In order to reduce this liquid fossil fuel use and its associated emissions, EECA determined that the opportunity must be sized first. The purpose of commissioning this report was to test the assumptions used in current data gathering, as well as to gain a higher level of granularity in the sectoral breakdown reported. This will allow EECA to more effectively plan future programs and interventions involving this area.

Overview of current understanding

A 2008 report commissioned by the Ministry of Economic Development (MED, now part of the Ministry of Business, Innovation and Employment, MBIE) found that the final delivery for 6% of New Zealand's petrol and 19% of New Zealand's diesel in 2007 was made by 18 independent distributors who purchase this fuel from the large oil companies.⁵ Consequently, these deliveries were included in the national statistics as on-road transport. The report recommended regularly collecting data from independent distributors on an annual basis going forward.

A 2010 report by MED extended this research by collecting deliveries data from these independent distributors back to 1990 to estimate these deliveries from 2009 back to 1990.⁶ MBIE has collected data from independent distributors annually since 2009 and has used this data to correct the national statistics on fuel consumption to ensure that direct deliveries to industries are recorded as off-road use within those industries and not as on-road transport.

Current statistical approach

Statistics on fuel use in New Zealand are currently compiled by MBIE through two surveys: the quarterly Delivery of Petroleum Fuels by Industry (DPFI) survey completed by the oil companies, and the Annual Liquid Fuel Survey (ALFS) completed by independent distributors.

² MBIE, 2020. Oil statistics to June quarter 2020 (Retrieved on 15 Sept 2020). <https://www.mbie.govt.nz/assets/Data-Files/Energy/nz-energy-quarterly-and-energy-in-nz/Oil.xlsx>

³ MBIE, 2020. Energy in New Zealand 2020. <https://www.mbie.govt.nz/dmsdocument/11679-energy-in-new-zealand-2020>

⁴ MBIE, 2020. Annual greenhouse gas emissions tables. <https://www.mbie.govt.nz/assets/Data-Files/Energy/annual-emissions-data-table.xlsx>. Latest data available is from 2018

⁵ Ministry of Economic Development, 2008. <https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-publications-and-technical-papers/liquid-fuels-use-in-new-zealand/>

⁶ Ministry of Economic Development, 2010. <https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-publications-and-technical-papers/delivering-the-diesel-liquid-fuel-deliveries-in-new-zealand-1990-2008/>

Until recently, EECA supplemented the national statistics with data collected by Statistics NZ through the NZ Energy Use Surveys. These surveys provided important data on energy use collected directly from end users (including on- and off-road use of petrol and diesel). The latest data available for the NZ Energy Use Surveys was from 2017.⁷

Limitations of current approach to data collection about off-road liquid fuels

Currently, the national level statistics on fuel use by sector do not provide the necessary level of detail. Current data outlines fuel volumes delivered to industry sectors, but there is limited visibility on how customers are then using the fuel (in what equipment, and where). The NZ Energy Use Surveys, previously run by Statistics NZ, have been discontinued which has created a gap in the current approach.

There is a need to quantify the volume of fuel used by end users and sub-sectors, as well as identifying the sub-sectors with the largest fuel use. This data would improve the datasets utilised by EECA and other government agencies for modelling and analysis – such as the Energy End Use Database.⁸ Without more detailed data on off-road liquid fuel use, there is a limit to government agencies' abilities to accurately report on and model consumption.

Purpose of this research

This research was commissioned to support the improvement of the datasets used by EECA and other government agencies for modelling and analysis. It is intended to improve government's ability to report on and model off-road consumption of petrol and diesel.

This research aims to provide detailed understanding, evidence, and data on:

- the annual volume by type of fuel used for off-road use
- the volume breakdown by sub-sector and end users that use this fuel
- a stocktake of the key applications and technologies used in these sectors.

Data from 2019 used for findings

This study uses data from 2019 from the current statistics for findings. This is due to the impact of the COVID-19 pandemic on some sector's fuel use during 2020. For example, fuel use in 2020 was affected by the various lockdowns during the year and some sectors were impacted by there being far fewer international visitors to New Zealand (for example, tourism, hospitality, and accommodation). It was therefore decided to use the most recent year from the data that was not affected by COVID-19.

The anonymised survey results and analysis are available on the EECA website⁹.

⁷ Statistics NZ, 2017. NZ Energy Use 2017.
http://archive.stats.govt.nz/browse_for_stats/industry_sectors/Energy/EnergyUseSurvey_HOTP17.aspx#gsc.tab=0

⁸ <https://tools.eeca.govt.nz/energy-end-use-database/>

⁹ www.eeca.govt.nz/Off-road-liquid-fuels-research-data.xlsx

This research provides updated data for diesel

MBIE's two surveys



DPFI - quarterly
Completed by
oil companies

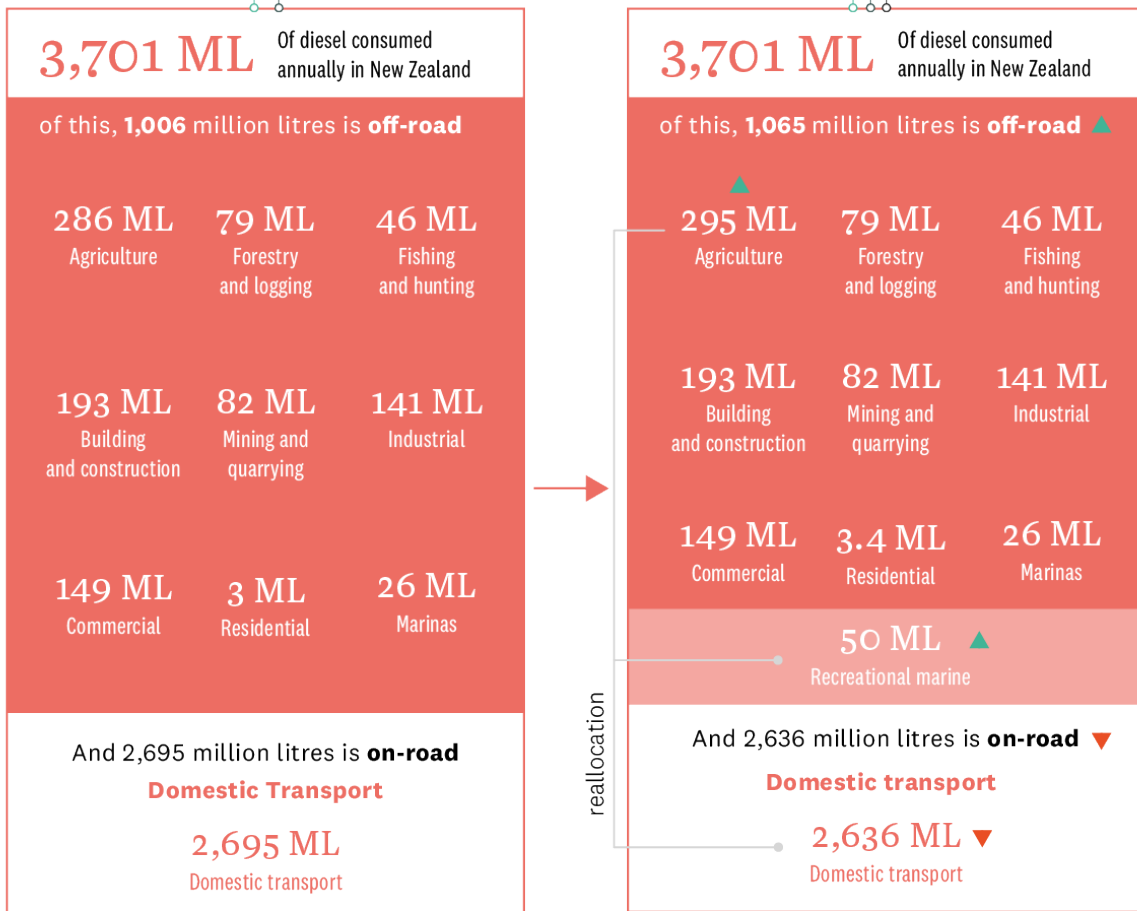


ALFS - annually
Completed by
independent distributors

EECA research



Off-road liquid
fuel research



This research

End use data collection



Review of current approach
to identify areas to focus on



Survey of businesses
using petrol and diesel off-road

This research provides updated data for petrol

MBIE's two surveys



DPFI - quarterly
Completed by
oil companies

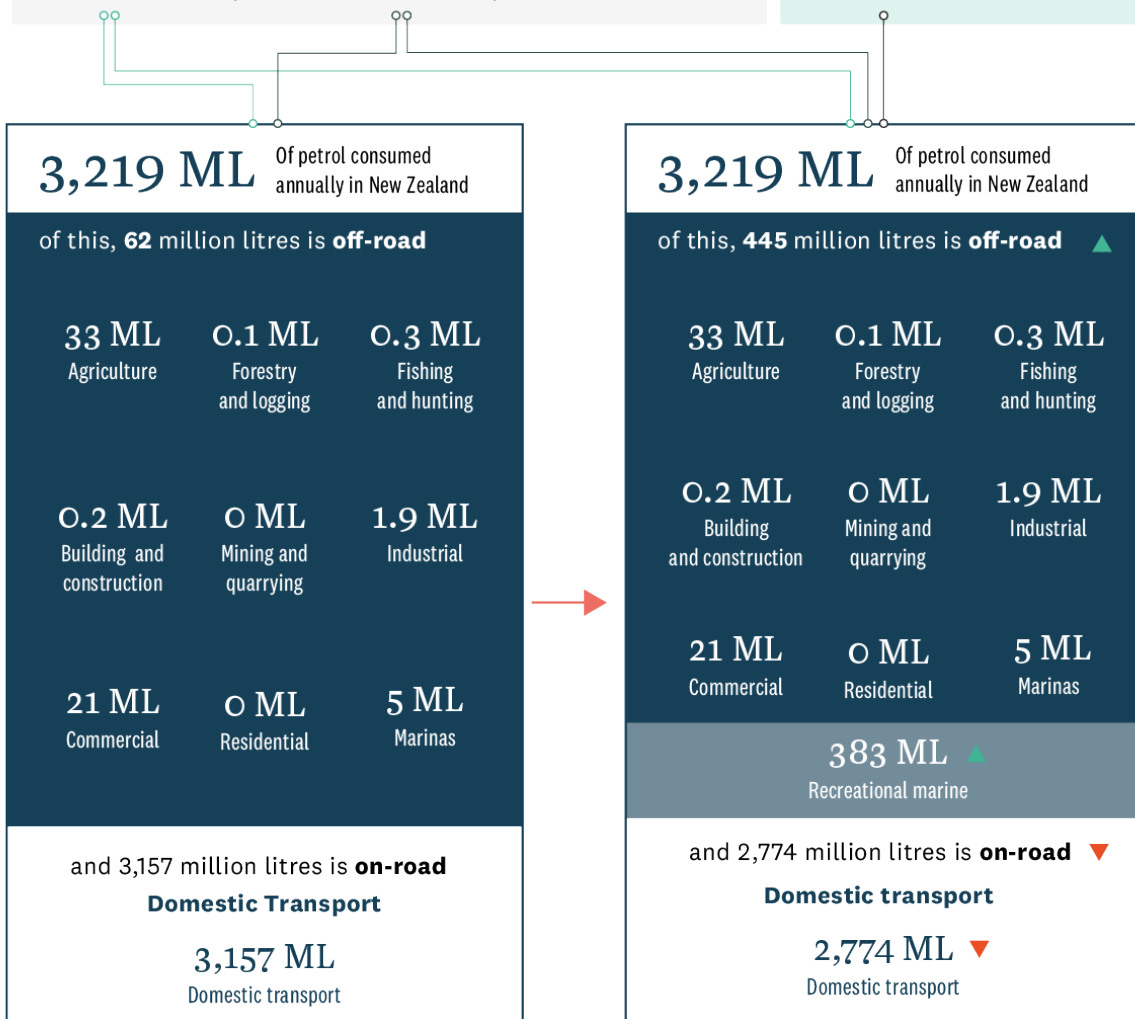


ALFS - annually
Completed by
independent distributors

EECA research



Off-road liquid
fuel research



This research

End use data collection



Review of current approach
to identify areas to focus on



Survey of businesses
using petrol and diesel off-road

Overview of off-road use

General insights

Bulk deliveries are the primary source for a large proportion of off-road fuel...

There is a core assumption within the current statistics – that liquid fuels delivered direct to customers (for example, to bulk tanks) are used off-road, and fuel purchased through the retail network (from a service station or truck stop) is used on-road. This impacts where fuel is captured within the current statistics – for example, if a business fills a trailer tank with diesel at a local service station and then uses that fuel off-road this would be captured as on-road use in the current statistical approach.

This research tested this assumption and has found that it mostly holds true – particularly for diesel and for businesses. This means that the current top-down estimates of total off-road liquid fuel use are relatively accurate.

...but there are some exceptions...

The exceptions found to this core assumption are:

- larger operators that have both off-road machinery and on-road vehicles, will sometimes fill these from the same bulk tanks (for example, tourism companies that have boats and buses)
- some end users use ute/trailer tanks to transport fuel. These can be filled up from bulk tanks onsite, from the retail network, or a mixture of both
- for recreational marine use, many boats are filled via the retail network and this is counted as on-road use.

... meaning some off-road use is not captured in the current statistics.

This research has enabled quantification of the impacts of these exceptions on the current statistics. Based on this research, it was found that:

- the retail network is used for filling some ute/trailer tanks with diesel. The agricultural sector data was analysed, and it was found that approximately 9 million litres of diesel per year is sourced in this way. This diesel is captured as on-road in the current statistics; this has been corrected for in the estimates.
- approximately 383 million litres of petrol, and 50 million litres of diesel, per year is used for recreational marine and is accessed via the retail network. This fuel is captured as on-road use in the current statistics; this has been corrected for in these estimates.

Diesel electricity generators are used in New Zealand, but do not use large volumes of fuel

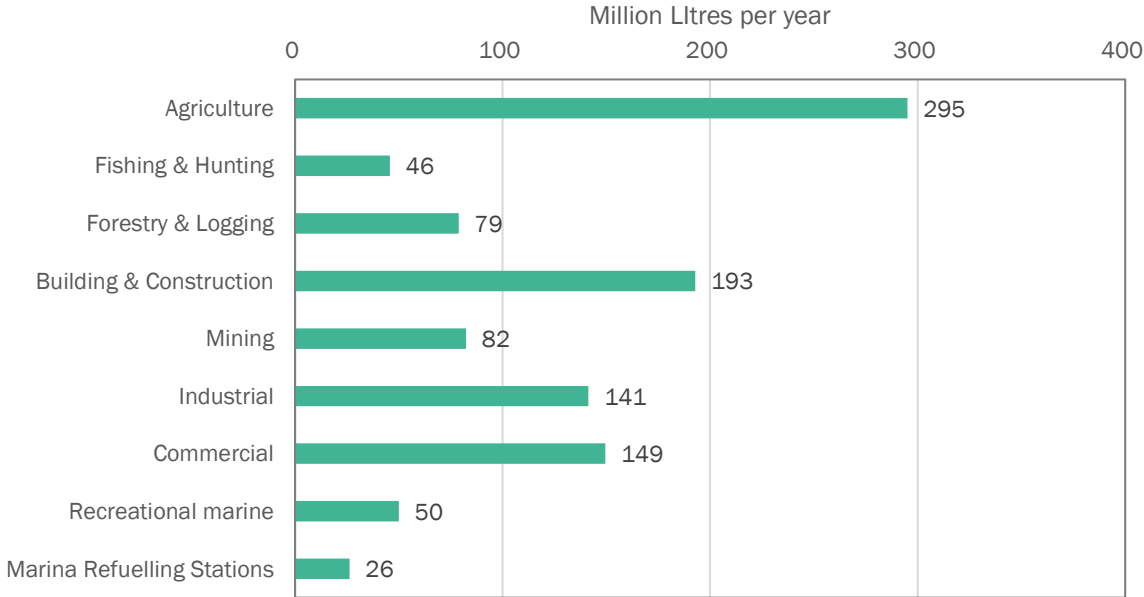
The issue of diesel generators was explored with industry peak bodies and companies that were interviewed. They said that use of diesel generators did occur within many sectors, including agriculture, building and construction, and mining, but that these were primarily used as a back-up to mains

electricity supply (for example, on remote farms where there may be an unreliable power supply). Because they are used as back-up generation they are used infrequently and normally for short durations; therefore, they do not use significant quantities of diesel.

Diesel insights

About 29% of New Zealand’s diesel consumption is off-road – approximately 1,065 million litres per year. Most of this diesel is used in the agriculture sector (295 million litres) and the building and construction sector (193 million litres). Diesel is predominantly used in heavy machinery (such as tractors, diggers, and heavy trucks), and in light vehicles (such as utes). It should be noted that while the commercial sector is a relatively large user off off-road liquid fuels, it was decided not to specifically target this area in the surveying, due to the sector being a broad ‘catch-all’ with many varying businesses covered, as well this figure being made up of many small uses, so would be more difficult for EECA to make an impact than other sectors.

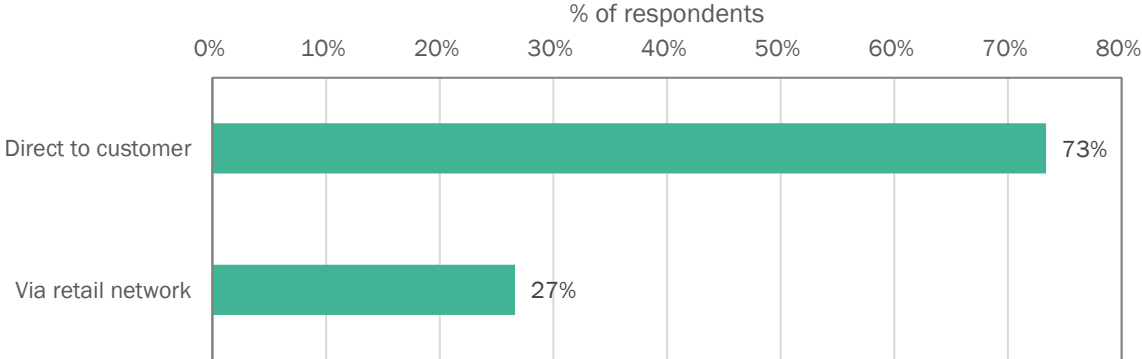
Figure 1: Off-road diesel consumption by sector



Source: MBIE and MartinJenkins calculations

This research found that the primary source for most users of off-road diesel is direct delivery (delivered into bulk onsite tanks or into equipment – 73%), with the balance sourced from the retail network (27%).

Figure 2: How off-road diesel is sourced



Source: MartinJenkins survey of businesses using liquid fuel off-road

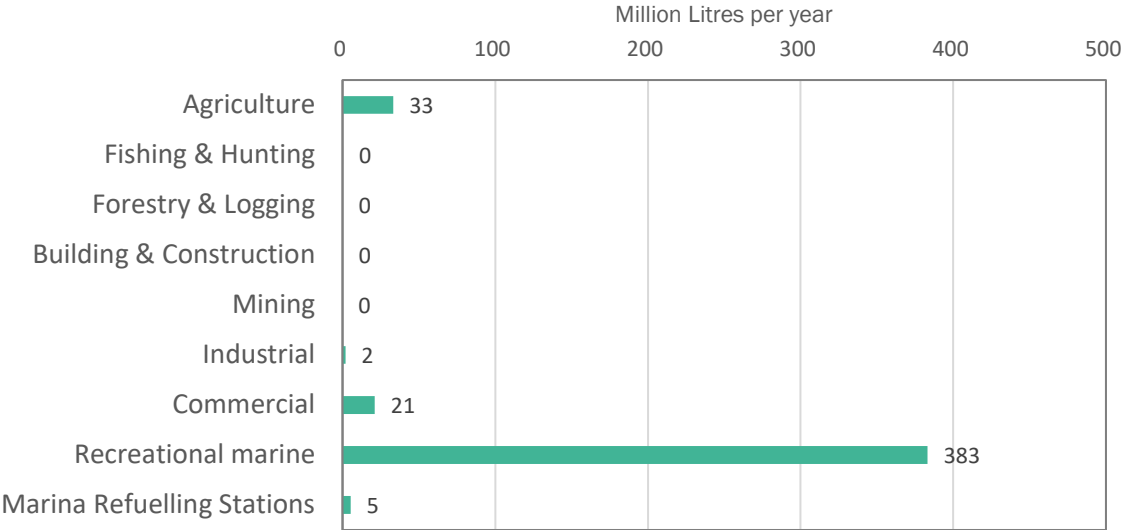
Using ute/trailer tanks for diesel

Survey respondents from the agricultural sector reported that many of them use ute/trailer tanks to transport fuel from either onsite bulk tanks or service stations onto sites. For this sector, it is estimated that approximately 9 million litres per year being sourced through the retail network. There was not enough data received to estimate ute/trailer tank usage in other sectors (although our survey did indicate that they are used in non-agriculture sectors). The 9 million litres of diesel per year sourced from the retail network will have been recorded as on-road transport in MBIE’s current statistics – this has been corrected for in these estimates.

Petrol insights

About 14% of New Zealand’s petrol consumption is off-road – approximately 445 million litres of per year. Most of this petrol is used by recreational marine users, 383 million litres (87%), with the next highest use in the agriculture sector at 33 million litres (7%). Petrol is predominantly used in recreational boats, small equipment (such as chainsaws and pumps), and light vehicles (such as utes and quad bikes).

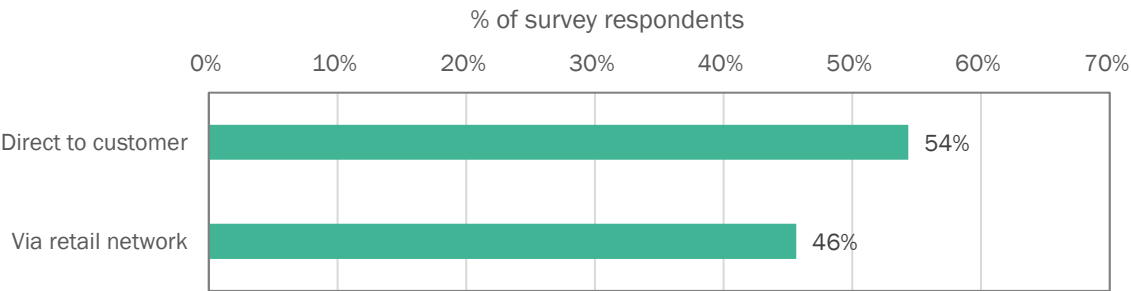
Figure 3: Off-road petrol consumption by sector



Source: MBIE and MartinJenkins calculations

This research found that the primary source for most users of off-road petrol is direct delivery (delivered into bulk onsite tanks or into equipment – 54%), with the balance (46%) sourced from the retail network. There is a heavier reliance on the retail network for petrol supply than there is for diesel supply (46% for petrol compared with 27% for diesel). This finding makes sense due to the high level of health and safety requirements and compliance costs of onsite petrol tanks for businesses.¹⁰ For small users of petrol, this is likely to be cheaper and less risky than maintaining an onsite supply.

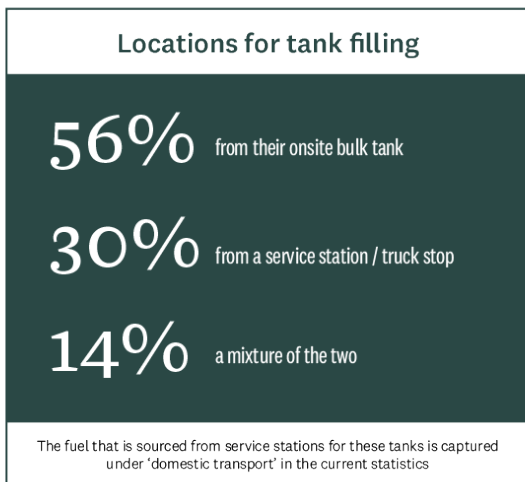
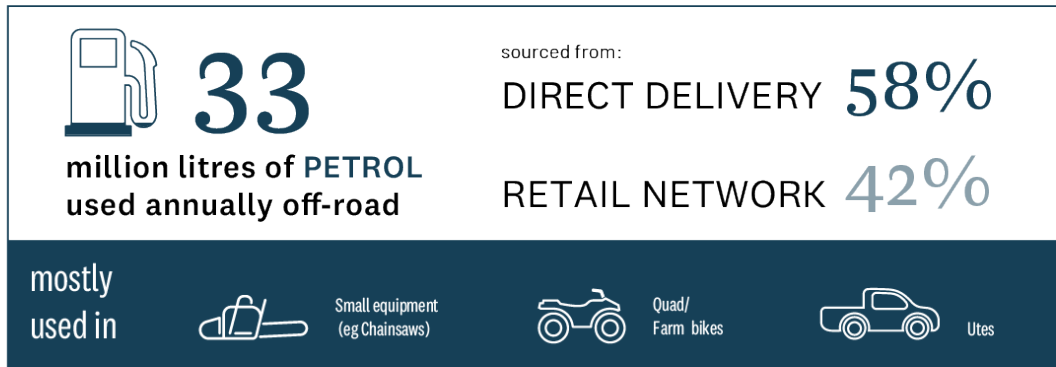
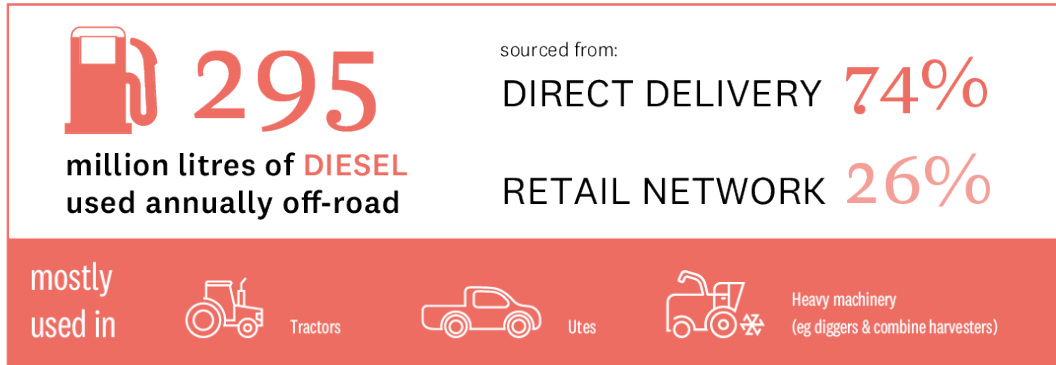
Figure 4: How off-road petrol is sourced



Source: MartinJenkins survey of businesses using liquid fuel off-road

¹⁰ See 'Above ground fuel storage on farms' from WorkSafe <https://www.worksafe.govt.nz/topic-and-industry/agriculture/chemicals-and-fuels-on-farms/above-ground-fuel-storage-on-farms/>

Sector Insights: Agriculture



Annual consumption by sub-sector:

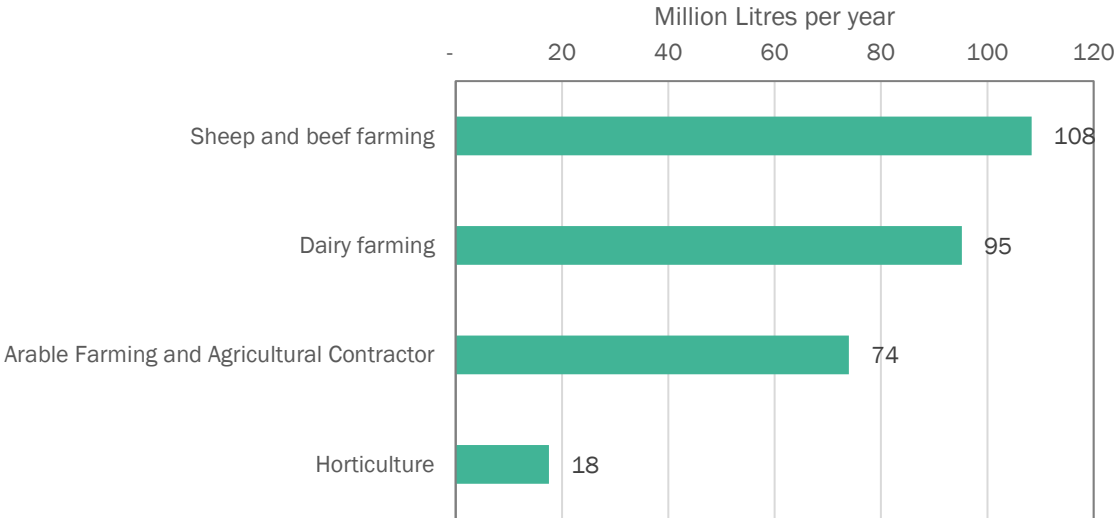
Sheep & Beef	108 ML of diesel	19 ML of petrol
Dairy	95 ML of diesel	11 ML of petrol
Arable & Contractors	74 ML of diesel	1.4 ML of petrol
Horticulture	17.5 ML of diesel	2.2 ML of petrol

Sector insights: Agriculture

Diesel insights

The agriculture sector uses 295 million litres of diesel per year, with sheep and beef farming using the most (108 million litres), followed by dairy farming (95 million litres), and arable farming and agricultural contractors (74 million litres). Diesel is predominantly used in tractors, utes, and heavy machinery such as diggers and combine harvesters.

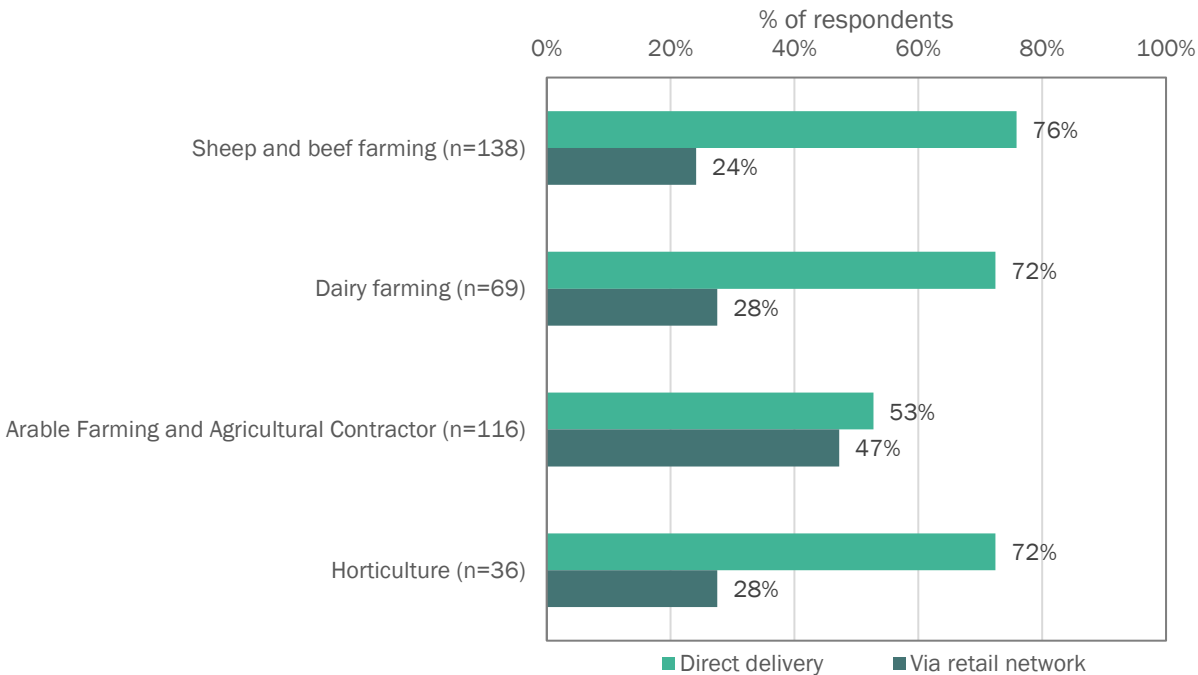
Figure 5: Agriculture off-road diesel consumption by sub-sector



Source: MartinJenkins calculations

This research found that the primary source for most agricultural users of off-road diesel is direct delivery (delivered into bulk onsite tanks or into equipment - 74%). The sub-sector with the largest reliance on the retail network is arable farming and agricultural contractors – this is likely due to the nature of contracting businesses where not all enterprises will have a relevant fixed site for a bulk fuel tank.

Figure 6: How off-road diesel is sourced by agriculture sub-sector



Source: MartinJenkins survey of businesses using liquid fuels off-road

Use of ute/trailer tanks for diesel

Around 18% of the sector uses ute/trailer tanks for accessing fuel off-road...

Ute/trailer tanks are used within the sector for transporting fuel from a bulk tank or the retail network to the relevant site or equipment. This research found that 18% of the agricultural sector use these tanks, filling them from their onsite bulk tank (56%), the retail network (30%) or a mixture of both (14%).

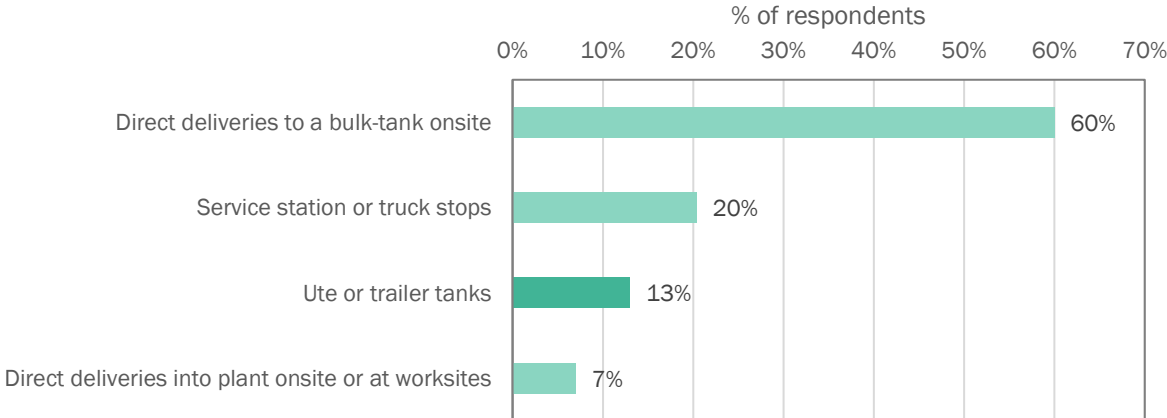
About 13% of respondents use ute/trailer tanks as their primary source of off-road fuel

13% of the survey respondents identified ute/trailer tanks as their primary source of off-road fuel – indicating a reliance on these tanks for some of the sector.

This means that approximately 6,660 agricultural businesses¹¹ rely on these tanks for their primary source of diesel.

¹¹ Statistics NZ, Business Demography Statistics: Enterprises by industry 2000-20, data from 2020 (retrieved 01 March 2021).

Figure 7: Primary source of off-road diesel for the agriculture sector

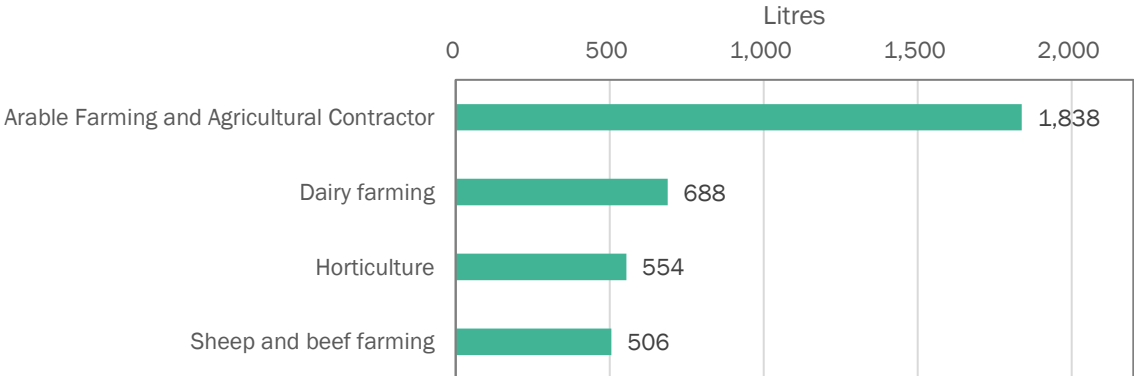


Source: MartinJenkins survey of businesses using liquid fuels off-road

Consequently, 9 million litres of diesel is not captured as off-road use in the current statistics

Different tank sizes are used across the sub-sectors, with the average reported capacity higher for the arable farming and agricultural contractors sub-sector (see chart below). Arable farming and agricultural contractors also fill their ute/trailer tanks more frequently than other sub-sectors.

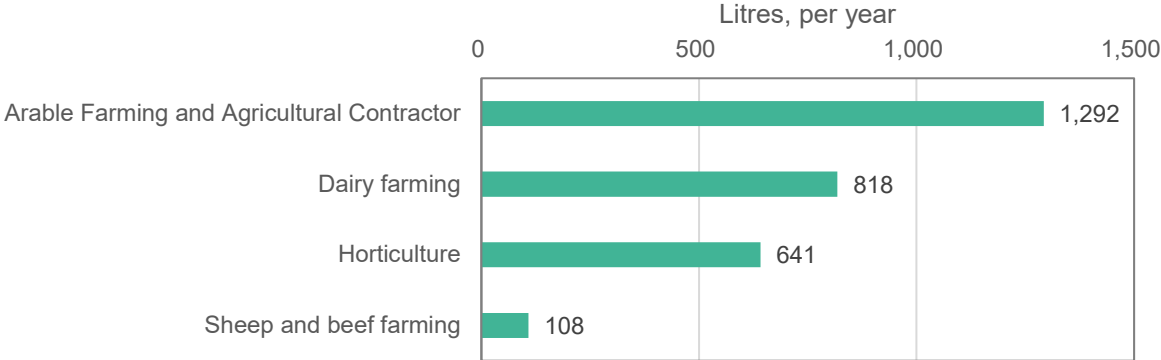
Figure 8: Average capacity of diesel ute/trailer tanks



Source: MartinJenkins survey of businesses using liquid fuels off-road

Considering the capacity, frequency of fill, and source of fuel for the ute/trailer tanks, the annual average volume of diesel accessed from the retail network via ute/trailer tanks per enterprise was modelled (see Estimates of diesel sourced from the retail network via ute/trailer tanks). These amounts are shown in the following chart.

Figure 9: Average amount of diesel per respondent sourced via ute/trailer tanks from the retail network

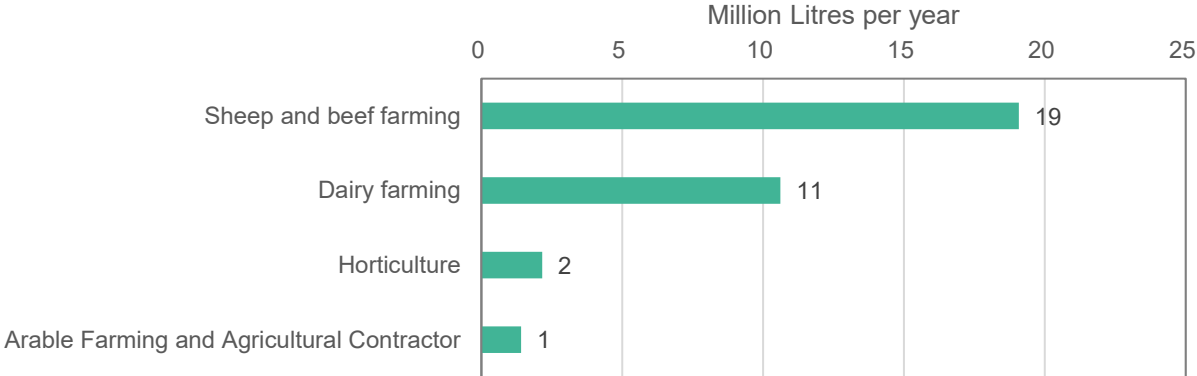


Source: MartinJenkins calculations

Extrapolating to the total number of agricultural enterprises in each of the sub-sectors, this translates to approximately 9 million litres of diesel per year for the sector that is currently allocated as 'on-road' use.

Petrol insights

Figure 10: Agriculture off-road petrol consumption by sub-sector



Source: MartinJenkins calculations

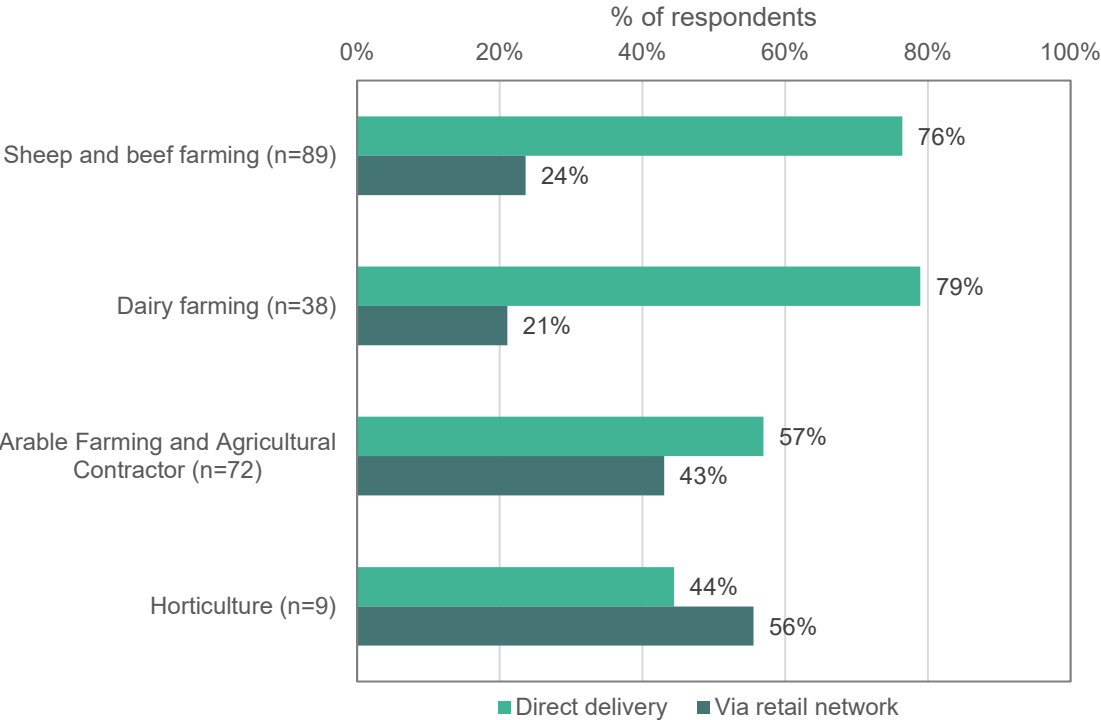
As a sector, agriculture uses 33 million litres of petrol off-road per year, with sheep and beef farming using the most (19 million litres), followed by dairy farming (11 million litres). Petrol is predominantly used by the sector in small equipment (such as chainsaws), quad/farm bikes, and utes.

The primary source for most agricultural users of off-road petrol is direct delivery (delivered into bulk onsite tanks or into equipment – 58%), with the remaining petrol (42%) from the retail network.

There is a higher reliance for agricultural users on the retail network for petrol supply than there is for diesel supply (42% for petrol to 26% for diesel). This finding makes sense due to the high level of health

and safety requirements and compliance costs of onsite petrol tanks for businesses.¹² For small users of petrol, using the retail network is likely to be cheaper than maintaining an onsite supply. The sub-sectors with the largest reliance on the retail network are arable farming and agricultural contracting, and the horticulture sub-sectors. However, only the horticulture sub-sector respondents identified higher use of the retail network than for direct deliveries for off-road petrol.

Figure 11: How off-road petrol is sourced by agriculture sub-sector



Source: MartinJenkins survey of businesses using liquid fuels off-road

¹² Worksafe NZ. Same source as cited in footnote 10.



The average sheep and beef farm we heard from has:

3 employees

608 hectares

3,277 livestock

Sub-sector: Sheep & Beef

76%
or 9,463 L

of their **DIESEL** consumption is off-road and is used in:



Tractors



Irrigation pumps



Trucks/Utes



Heavy machinery (such as diggers)

85%
or 2,383 L

of their **PETROL** consumption is off-road and is used in:



Small equipment (e.g. chainsaws)



Quad/ Farm bikes



Trucks/Utes



Family car

and they utilise a diesel ute/trailer tank that has an average capacity of 506 litres, and is filled up at least monthly

The sub-sector uses:

108 million litres of **DIESEL** used annually off-road
sourced from: Direct delivery **72%** Retail network **28%**

19 million litres of **PETROL** annually off-road
sourced from: Direct delivery **76%** Retail network **24%**



The average dairy farm we heard from has:

21 employees

318 hectares

748 livestock

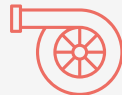
Sub-sector: Dairy

85%
or 14,608 L

of their **DIESEL** consumption is off-road and is used in:



Tractors



Irrigation pumps



Trucks/Utes



Heavy machinery (such as diggers)

86%
or 2,538 L

of their **PETROL** consumption is off-road and is used in:



Small equipment (e.g. chainsaws)



Quad/ Farm bikes



Trucks/Utes



Family car

and utilises a diesel ute/trailer tank that has an average capacity of 688 litres and is filled up at least monthly

The sub-sector uses:

95 million litres of **DIESEL** used annually off-road
sourced from: Direct delivery **72%** Retail network **28%**

11 million litres of **PETROL** annually off-road
sourced from: Direct delivery **79%** Retail network **21%**



The average arable farm or agricultural contractor we heard from has:

9 employees

Sub-sector: Arable & Agricultural Contractors

78%
or 100,318 L

of their **DIESEL** consumption is off-road and is used in:



Tractors



Heavy machinery
(such as combine harvesters)



Trucks/Utes



Generators

77%
or 2,745 L

of their **PETROL** consumption is off-road and is used in:



Small equipment
(e.g. chainsaws)



Quad/ Farm bikes



Trucks/Utes



Family car

and utilises a diesel ute/trailer tank that has an average capacity of 1,838 litres and is filled up at least weekly, but often daily

The sub-sector uses:

74 million litres of **DIESEL** used annually off-road
sourced from: Direct delivery **53%** Retail network **47%**

1.4 million litres of **PETROL** annually off-road
sourced from: Direct delivery **57%** Retail network **43%**



Sub-sector: Horticulture

The average horticulture enterprise we heard from has:

21 employees

43 hectares

86%
or 4,429 L

of their **DIESEL** consumption is off-road and is used in:



Tractors



Heavy machinery
(such as combine harvesters)



Trucks/Utes



Other specialist
equipment

67%
or 998 L

of their **PETROL** consumption is off-road and is used in:



Small equipment
(e.g. chainsaws)



Quad/ Farm bikes



Family car

and utilises a diesel ute/trailer tank that has an average capacity of 1,838 litres and is filled up at least weekly, but often daily

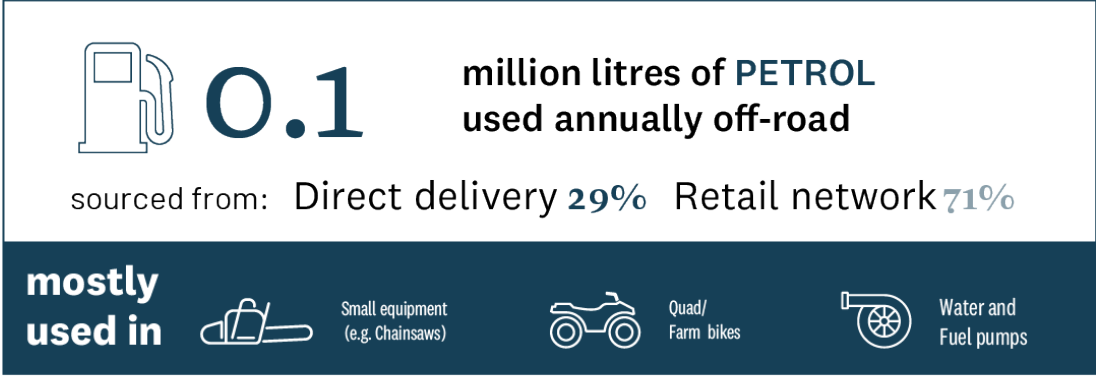
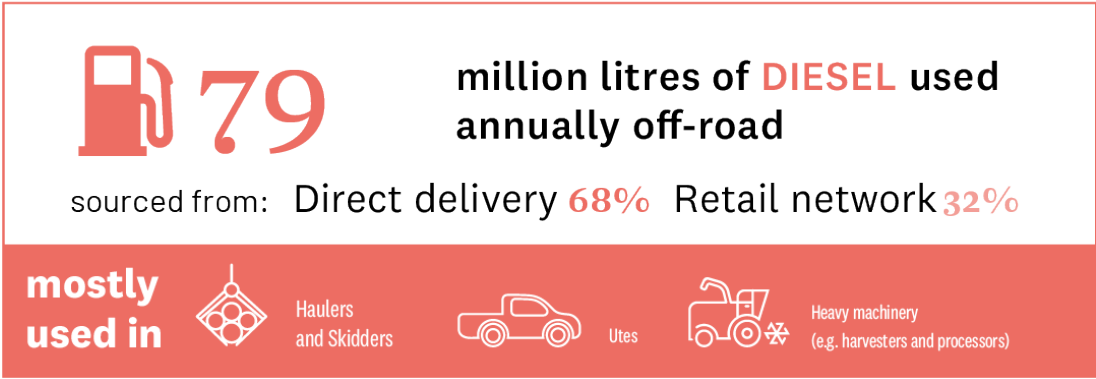
The sub-sector uses:

17.5 million litres of **DIESEL** used annually off-road
sourced from: Direct delivery **72%** Retail network **28%**

2.2 million litres of **PETROL** annually off-road
sourced from: Direct delivery **44%** Retail network **56%**

Sector Insights: Forestry and Logging

The forestry and logging sector includes growing, harvesting and onsite processing of trees.



Sector insights: Forestry

Diesel insights

The forestry sector uses 79 million litres of diesel per year. This diesel is predominantly used in heavy machinery and specialist equipment, such as harvesters, processors, haulers, and skidders, and in utes and light vehicles.

The sector predominantly sources diesel through direct delivery (either into onsite bulk tanks or equipment – 68%). There is still some reliance on the retail network for diesel – 32% – which likely reflects the nature and size of some forestry operations, where bulk delivery is expensive, or the ability to have an onsite tank is restricted.

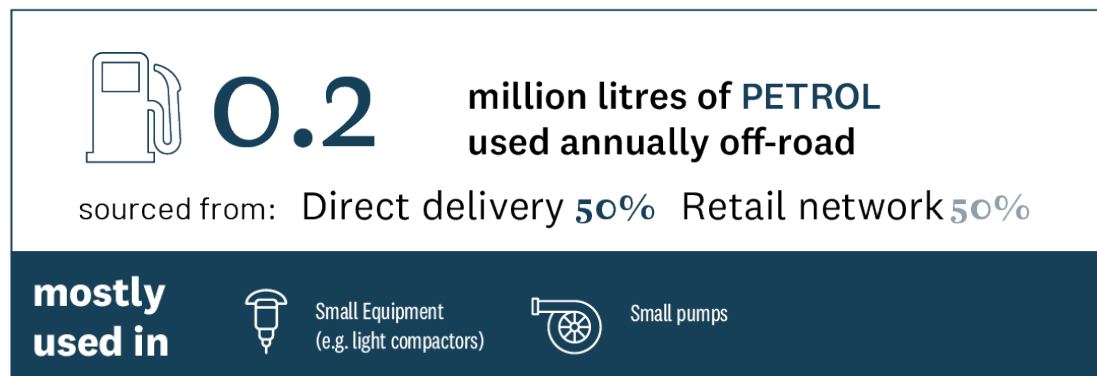
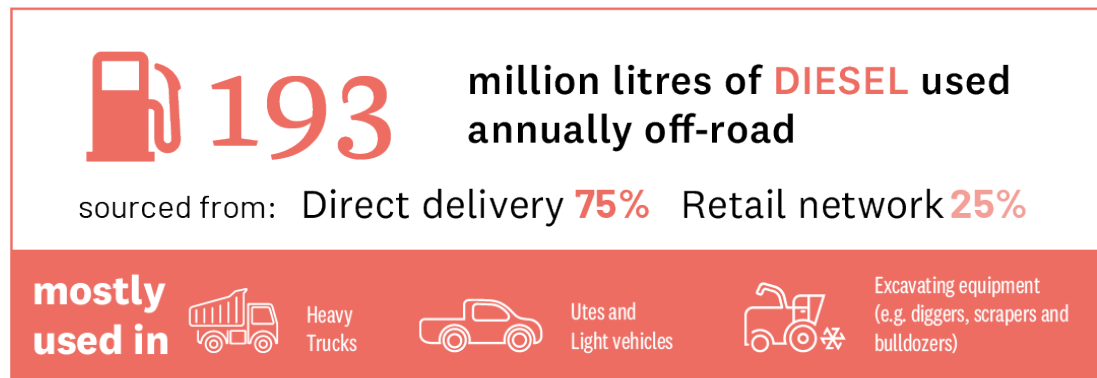
Petrol insights

As a sector, forestry is a relatively low petrol user, with just 100 thousand litres of petrol used annually. Petrol is predominantly used in the sector in small equipment (such as chainsaws and small generators), quad bikes and utility terrain vehicles (including side-by-sides), and to power water and fuel pumps.

Most off-road petrol is sourced by forestry users via the retail network (71%). This is a significantly heavier reliance on the retail network for petrol supply in comparison to the sector's diesel supply (71% for petrol, 32% for diesel). This finding makes sense; the high level of compliance costs for onsite petrol tanks within a forestry environment would outweigh the benefit of maintaining onsite supply, particularly with low use.

Sector Insights: Building and Construction

The forestry and logging sector includes growing, harvesting and onsite processing of trees.



Sector insights: Building and construction

Diesel insights

193 million litres of diesel are used by the sector annually. This diesel is predominantly used in excavating equipment (such as diggers, scrapers, and bulldozers), heavy trucks (over 3.5 tonnes), and utes and light vehicles.

The sector predominantly sources diesel through direct delivery (either into onsite bulk tanks or equipment – 75%). There is still some reliance on the retail network for diesel (25%) which likely reflects the nature of some civil construction operations where the ability to have an onsite tank would be restricted.

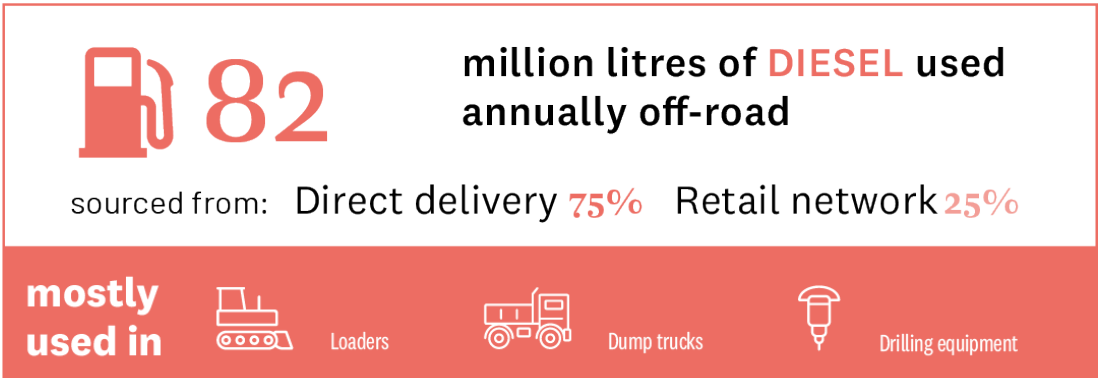
Petrol insights

The building and construction sector uses relatively low amounts of petrol, about 0.2 million litres annually. Petrol is predominantly used in the sector in small equipment (such as light compactors and small generators and to power small pumps).

Off-road petrol is sourced by building and construction users through both the retail network (50%) and direct deliveries (50%). This is from a small dataset, and so may not be representative of the sector as a whole.

Sector Insights: Mining and Quarrying

The mining and quarrying sector includes mining, oil and gas extraction, and quarrying of non-metallic minerals.



Sector insights: Mining and quarrying

Diesel insights

The mining and quarrying sector uses 82 million litres of diesel per year. This diesel is predominantly used in the heavy machinery (e.g. dump trucks and loaders) as well as specialist drilling equipment. It is also used in processing and crushing equipment, particularly when mobile.

The sector predominantly sources diesel through direct delivery (either into onsite bulk tanks or equipment – 75%). There is still some reliance on the retail network for diesel (25%); however, the strong preference for direct delivery is not surprising due to the remoteness of sites, and the relatively large quantities per enterprise.

Petrol insights

The Mining and Quarrying sector use less than 100,000 litres of petrol off-road per year. This is unsurprising as most equipment used in these operations is large and is likely to be diesel-powered.

Sector Insights: Recreational Marine

New Zealand has an estimated:

92,146
jet skis

175,077
dinghies with engines

215,621
power boats <6m

81,088
power boats >6m

36,858
sail boats >6m



76

million litres of DIESEL used
in these boats annually



388

million litres of PETROL used
in these boats annually

of these boats

14% 86%

use diesel

use petrol

they are refuelled from

15% 85%

marina

service stations

this means that fuel is
incorrectly allocated in
the current statistics as
on-road usage

50 ML
of DIESEL

383 ML
of PETROL

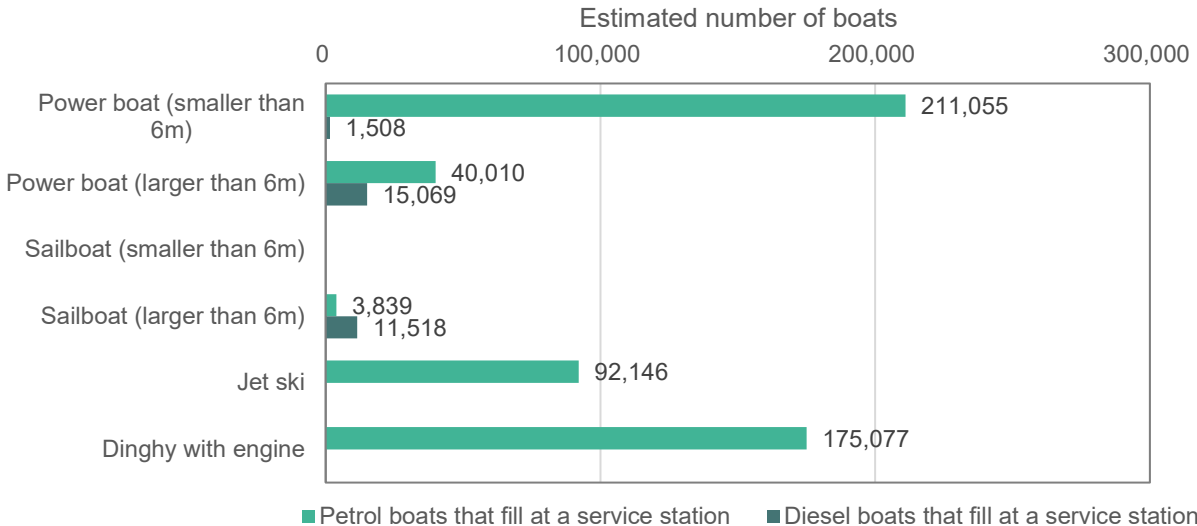
Sector insights: Recreational marine

General insights

Most powered boats in New Zealand use petrol and refuel through the retail network

86% of the respondents for the survey of boat owners identified that their boat uses petrol (14% diesel). 85% of respondents also identified that they refuel via service stations, with only 15% refuelling at marinas. Extrapolating to the number of each type of boat in New Zealand, this means approximately 522,127 petrol boats and 28,094 diesel boats refuel through the retail network (see Estimating fuel sourced from the retail network and used for recreational boating for more detail).

Figure 12: Number of boats that refuel through the retail network



Source: MartinJenkins calculations on Maritime NZ data

...this means that there is diesel and petrol not captured as off-road use in the current statistics

The average amount of fuel used by each boat type per year was identified from the survey data and filtered by fuel and boat type. When multiplying this by the estimated numbers of boats that are refuelling through the retail network, it can be seen that 383 million litres of petrol and 50 million litres of diesel are not captured as 'off-road' use within the current statistics.

While the figures found do provide an important insight, this survey is just a one-off snapshot, compared to the regular surveying of the ALFS and DPFI. As such, the result found should be seen as an upper bound, but with such a potential size EECA believes it warrants further investigation.

Conclusions

Amounts of liquid fuels used off-road in New Zealand

This research found that a total of 1,065 million litres of diesel and 445 million litres of petrol were used off-road in New Zealand in 2019. These amounts of off-road fuel are used by various industries within the New Zealand economy.

The sectors that use the most off-road diesel per year include:

- Agriculture (295 million litres)
- Building and construction (193 million litres)
- Commercial (149 million litres).

The sectors that use the most off-road petrol per year include:

- Recreational marine (388 million litres)
- Agriculture (33 million litres).

Furthermore, the diesel and petrol used off-road by the Agriculture sector was disaggregated into the following sub-sectors:

- Sheep and beef farming
- Dairy farming
- Agricultural contractors and arable farming
- Horticulture.

Access to liquid fuel supplies and implications for measuring off-road fuel use

This research confirmed that the majority of diesel and petrol that is used off-road in New Zealand is directly delivered to customers by oil companies or independent fuel distributors (either to bulk tanks or directly into customers' machinery). By contrast, on-road use of fuel is generally sourced from the retail network (service stations and truck stops). Consequently, the current method of measuring on-and off-road fuel use in New Zealand (by surveying oil companies' and independent fuel distributors' direct deliveries to sectors) is still fit for purpose.

Few sectors or fuel uses were found in MBIE's statistics to incorrectly record on-road fuel as an off-road use (or the opposite). Exceptions to these findings are small uses of fuel and are generally balanced (for example, farmers occasionally filling the family car from the farm's bulk tank or filling the farm ute at the service station when they are in town). Three notable exceptions were found where fuel that is recorded by MBIE's statistics as on-road use is used off-road:

1. Large companies with both on-road and off-road equipment: For example, large tourism operators that have large diesel boats and buses will fill both from the same bulk tank
2. Recreational marine users filling their boats with fuel at the service station
3. Use of ute/trailer tanks that are filled at a service station and then to fill off-road machinery.

Recreational marine is a substantial off-road use of petrol and diesel that is recorded as on-road use

Data from Maritime New Zealand was used on the numbers of recreational boats and surveyed boat owners on how much fuel they use in their boats each year. As a result, it is estimated that 383 million litres of petrol per year is sourced by recreational boat users from the retail network. This is a substantial use of fuel and is an issue that warrants further research.

Use of ute/trailer tanks by agricultural businesses also leads to off-road use being recorded as on-road use

Businesses were surveyed about their use of ute/trailer tanks. It is estimated that agricultural businesses source around 9 million litres of diesel per year from the retail network via ute/trailer tanks. While all survey respondents were asked about their use of ute/trailer tanks, too few responses were received from non-agriculture sectors to estimate amounts of fuel sourced from the retail network for these sectors.

Glossary of terms

Term	Definition
ALFS – Annual Liquid Fuel Survey	An annual survey by MBIE of fuel deliveries by the independent distributors operating in New Zealand
Bottom-up data	The data collected in the survey phase of this research that end-use businesses responded to
Current statistics / top-down statistics	The data collected and collated by MBIE from the DPFI and ALFS surveys This is termed ‘top-down’ as it is reported by the suppliers of the fuel, not the end-users
DPFI – Delivery of Petroleum Fuel by Industry survey	A quarterly survey by MBIE of fuel deliveries to sectors by the oil companies operating in New Zealand
Independent distributors	Companies that purchase fuel from the oil companies, and then on-sell this fuel to other users - typically smaller and rural users.
Liquid fuels	For this research, the term ‘liquid fuels’ refers to petrol and diesel only.
Off-road fuel	For the purposes of this study, off-road fuel is defined as any fuel used for non-transport and non-road use, including recreational boating. This fuel is not subject to road user taxes (excise for petrol and Road User Charges, or RUC, for diesel).
Oil companies	The companies in New Zealand who act as wholesalers of fuel: BP, Mobil (ExxonMobil), Z, Tasman, and Gull.
Onsite bulk tank	A fuel tank located on a business’s site that is filled by an oil company or independent distributor. Bulk tanks can be used for petrol or diesel.
Retail network	Services stations, truck stops where fuel can be purchased by the ‘public’.
Ute/trailer tanks	Ute and trailer tanks are portable tanks for transporting diesel. A ute tank sits in the tray of the ute and typically hold <1,000 litres. Trailer tanks are pulled behind a vehicle and typically have a capacity of <2,000 litres.

APPENDIX 1: LIQUID FUEL CONSUMPTION TIMESERIES

Table 1: Diesel consumption by sector 2010-2020 (million litres)

Sector	Parent Sector (MBIE web tables)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Agriculture, of which:	Agriculture, Forestry and Fishing	213	243	261	292	325	310	302	263	265	295	293
Arable Farming and Agricultural Contractor	Agriculture, Forestry and Fishing	44	54	60	81	88	82	87	78	78	74	73
Dairy farming	Agriculture, Forestry and Fishing	68	77	84	89	101	99	94	82	80	95	96
Horticulture	Agriculture, Forestry and Fishing	14	16	16	18	20	17	17	15	15	18	16
Sheep and beef farming	Agriculture, Forestry and Fishing	87	95	101	104	115	112	105	89	93	108	108
Fishing & Hunting	Agriculture, Forestry and Fishing	44	43	48	43	39	36	36	25	43	46	46
Forestry & Logging	Agriculture, Forestry and Fishing	60	71	75	71	69	77	86	101	73	79	78
Building & Construction	Industrial	97	103	104	93	93	95	118	149	187	193	175
Mining	Industrial	92	87	90	129	81	74	71	70	80	82	81
Industrial	Industrial	92	105	115	158	196	185	208	168	138	141	151
Commercial	Commercial and Public Services	104	124	98	97	108	116	125	145	123	149	179
Residential	Residential	7	4	6	12	2	3	3	3	3	3	3

Recreational marine (fuelled via retail network)	Domestic Navigation	50	50	50	50	50	50	50	50	50	50	50
Marina Refuelling Stations	Domestic Navigation	12	14	28	21	21	22	24	26	25	26	30
Commercial Transport	Domestic Transport	232	222	216	233	182	199	186	281	259	265	311
Retail network (service stations and truck stops)	Domestic Transport	1,756	1,810	1,821	1,826	1,968	2,019	2,084	2,241	2,387	2,371	2,193
On-road transport	Domestic Transport	1,989	2,032	2,036	2,059	2,150	2,218	2,271	2,522	2,645	2,636	2,505
TOTAL	TOTAL	2,760	2,877	2,911	3,026	3,134	3,186	3,295	3,524	3,631	3,701	3,591

Source: MBIE and MartinJenkins calculations

Table 2: Petrol consumption by sector 2010-2020 (million litres)

Sector	Parent Sector (MBIE web tables)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Agriculture, of which:	Agriculture, Forestry and Fishing	38	47	43	62	40	34	41	31	31	33	31
Arable Farming and Agricultural Contractor	Agriculture, Forestry and Fishing	1	2	2	3	2	2	2	2	2	1	1
Dairy farming	Agriculture, Forestry and Fishing	11	14	13	19	13	11	13	10	10	11	10
Horticulture	Agriculture, Forestry and Fishing	3	3	3	4	3	2	3	2	2	2	2
Sheep and beef farming	Agriculture, Forestry and Fishing	23	28	25	35	23	19	23	18	18	19	18
Fishing Hunting &	Agriculture, Forestry and Fishing	0	0	0	6	3	3	3	2	0	0	0
Forestry Logging &	Agriculture, Forestry and Fishing	0	0	0	0	0	0	0	0	0	0	0
Building Construction &	Industrial	0	0	0	0	0	0	1	1	0	0	0
Mining	Industrial	0	0	0	0	0	0	0	0	0	0	0
Industrial	Industrial	2	29	2	4	4	11	11	4	2	2	2
Commercial	Commercial and Public Services	1	3	5	9	7	8	13	18	15	21	67
Residential	Residential	1	0	0	0	0	0	1	1	0	0	0
Recreational marine (fuelled via retail network)	Domestic Navigation	383	383	383	383	383	383	383	383	383	383	383

Marina Refuelling Stations	Domestic Navigation	1	1	2	4	2	3	5	4	4	5	6
Commercial Transport	Domestic Transport	15	21	6	18	5	5	6	5	14	5	16
Retail network (service stations and truck stops)	Domestic Transport	2,706	2,643	2,587	2,547	2,587	2,676	2,728	2,805	2,767	2,769	2,388
On-road transport	Domestic Transport	2,720	2,664	2,593	2,565	2,592	2,681	2,734	2,810	2,781	2,774	2,403
TOTAL	TOTAL	3,148	3,127	3,028	3,033	3,032	3,124	3,194	3,255	3,217	3,219	2,893

Source: MBIE and MartinJenkins calculations

APPENDIX 2: RESEARCH METHODS

General project approach

This research was conducted by MartinJenkins, on behalf of EECA. It was conducted in three phases:

- a **review** of the strengths and weaknesses of existing 'top-down' petrol and diesel statistics with key stakeholders (including EECA, MBIE, oil companies, independent distributors, industry peak bodies, and some large fuel using companies) and the assumptions that are inherent in this approach
- a **survey** of businesses that use petrol and diesel off-road in New Zealand to capture how much fuel they use per year, how they access their fuel supplies, and what equipment uses fuel off-road
- an **analysis** to match the top-down statistics with the bottom-up statistics to provide more detail on off-road petrol and diesel use in New Zealand (including by sector and sub-sector).

As part of this research, recreational boat owners were also surveyed on how they access fuel supplies and their annual fuel consumption. This part of the research arose as a key issue to explore from the review phase since many boat owners fill their boats with fuel at service stations and therefore, the top-down statistics capture this as on-road transport.

Review

The review phase consisted of:

- a workshop with MBIE and EECA to explore the strengths and weaknesses of MBIE's top-down fuel consumption statistics with respect to off-road use of petrol and diesel
- interviews with oil companies (who respond to the quarterly DPFI survey) – the largest two out of the four were interviewed, covering well over half of the market in New Zealand
- interviews with the three largest independent distributors
- interviews with seven industry peak bodies and some companies who use large amounts of fuel off-road (identified in partnership with EECA).

Surveys

Survey of businesses using petrol and diesel off-road

An online survey of business that use petrol and diesel off-road was conducted to capture data on:

- how they access fuel supplies
- use of ute/trailer tanks (and how these are filled and how often)
- how much fuel they use each year and the percentage of it that is used off-road
- the equipment that uses this fuel.

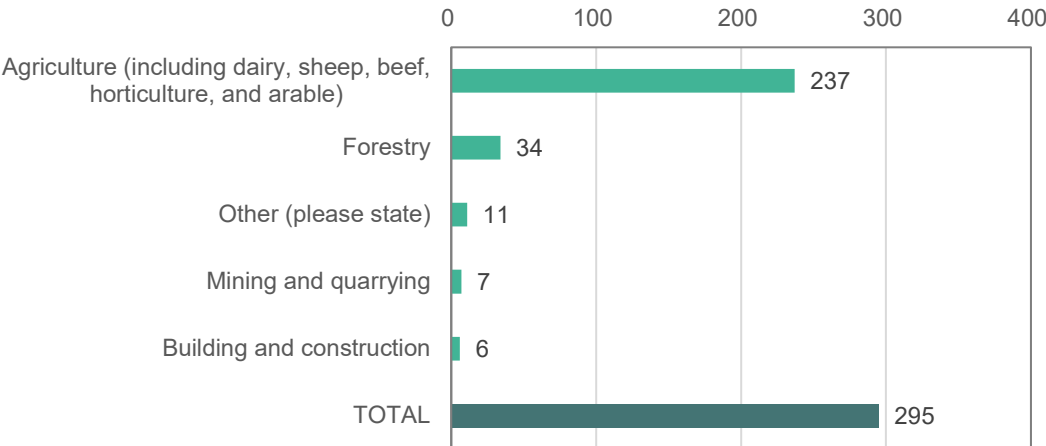
The survey was designed in consultation with EECA and several industry peak bodies. While the survey structure was similar for all sectors, there were specific questions and customised equipment lists for some sectors, including:

- Agriculture
- Forestry and logging
- Mining and quarrying
- Building and construction.

The approach for disseminating and promoting the survey was to ask industry peak bodies and business groups (including Business New Zealand) to email the survey link out to their members and to promote the survey through social media. EECA and MartinJenkins also posted a link to the survey on their LinkedIn pages. Participants were offered the chance to win one of 10 \$50 Prezzy cards as an incentive to respond to the survey.

In total, 295 responses to the survey were received. The following chart shows the breakdown of these responses by sector.

Figure 13: Number of responses to the survey of businesses using petrol and diesel off-road



Source: MartinJenkins survey of businesses using liquid fuels off-road

A geographically diverse response to the survey was received; the following map shows where in New Zealand these responses originated.

Responses to the off-road liquid fuels survey (n=295)



Survey of recreational boat owners

An online survey of recreational boat owners was also conducted to capture data on their annual fuel consumption and how they access fuel supplies. This survey sought to extend research undertaken by Ipsos for Maritime New Zealand on recreational boating.¹³ The Ipsos research contains estimates of the number of boats of various types in New Zealand (page 11 refers).

¹³ Ipsos, 2020. Recreational boating survey 2020, top-line results. Report prepared for Maritime NZ. https://www.maritimenz.govt.nz/recreational/safety-campaigns/recreational-research.asp#research_2020

This survey used the same categories of boats:

- Powerboat >6 m
- Powerboat <6 m
- Sailboat >6 m
- Sailboat <6 m
- Dinghy with engine
- Jetski.

Participants were asked which fuel their boat/vessel used (petrol or diesel) and how they refuelled their boat (at a service station, at a marina, or other). They were also asked how many trips they took in their boat per year, and the average number of litres of fuel used per trip.

This survey was disseminated through social media and approached boating clubs and other online boating forums to help us promote the survey. Furthermore, the survey was promoted through Facebook and LinkedIn. The chance to win one of four \$50 Prezzy cards was offered as an incentive to respond to this survey.

In total, 282 responses to the survey were received. The responses were geographically diverse; the following map shows where in New Zealand these responses originated.



Analysis of top-down and bottom-up data

Detail available from MBIE's top-down fuel consumption statistics

In this phase, top-down fuel consumption statistics were compiled by MBIE and the bottom-up data from the survey to estimate how much petrol and diesel is used off-road by sector and sub-sector.

MBIE's fuel consumption statistics are published on their website.¹⁴ These data are not published at the lowest possible level of disaggregation the most detailed data available was requested from MBIE. The data received included volumes of petrol and diesel consumption for the sectors and categories listed in Table 3.

Table 3: Fuel consumption sector categories available from MBIE

Sector category from MBIE fuel consumption surveys	Sector category that MBIE publishes
Agriculture	Agriculture, Forestry and Fishing
Fishing and Hunting	Agriculture, Forestry and Fishing
Forestry and Logging	Agriculture, Forestry and Fishing
Building and Construction	Industrial
Mining	Industrial
Industrial	Industrial
Commercial	Commercial and Public Services
Residential	Residential
Domestic Transport	Domestic Transport
Fuel Stops	Domestic Transport
Marina Refuelling Stations	Domestic Transport
Service Stations	Domestic Transport
Petrol Stations/Truck Stops	Domestic Transport
International Transport	International Transport

Source: MBIE

Table 3 shows that the Agriculture, Forestry, and Fishing category and the Industrial category from MBIE's webtables can be further disaggregated.

Disaggregating agricultural fuel consumption using bottom-up data

The data captured from this survey of businesses using fuel off-road to was used produce sub-sector estimates of petrol and diesel consumption for agriculture. It was not possible to do this for other sectors because not enough responses were received.

The agricultural sector data captured from the survey was able to be split into four categories:

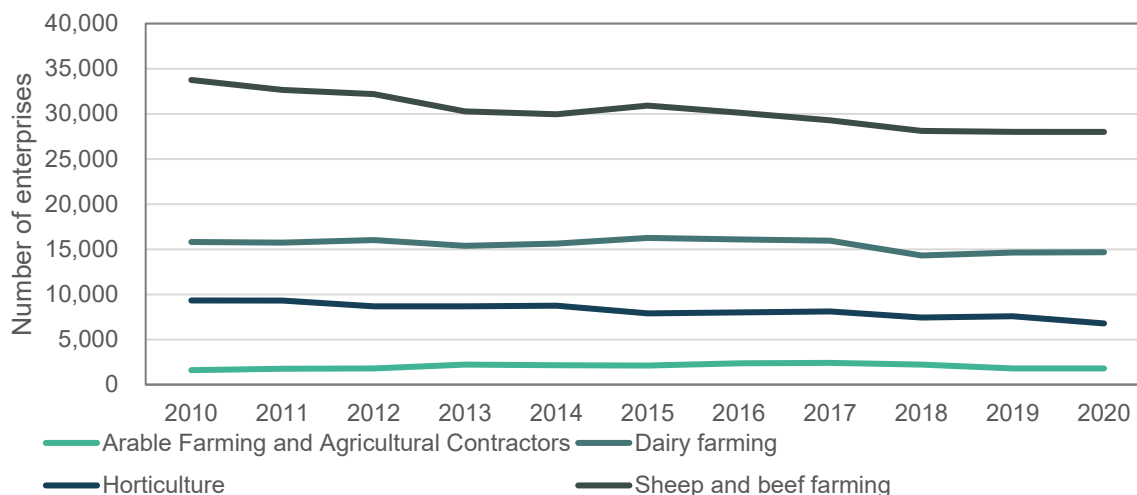
¹⁴ MBIE oil statistics. <https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/oil-statistics/>

- Dairy farms (n=45)
- Sheep and beef farms (n=95)
- Horticulture (n=27)
- Arable farming and agricultural contractors (n=62).

Only a small number of responses were received from arable farms – these were aggregated with agricultural contractors because these businesses had similar annual fuel consumption.

To estimate the average annual off-road petrol and diesel consumption per enterprise within each of these sectors, the annual average consumption of each fuel was multiplied by the percentages of each fuel used off-road. This was then multiplied per enterprise average fuel consumption by the number of enterprises of each type in New Zealand.¹⁵ The number of enterprises in each of these sub-sectors are shown in the following chart.

Figure 14: Number of agricultural enterprises by sub-sector (2010-2020)



Source: Statistics NZ

This chart shows that sheep and beef farming and dairy farming have the highest numbers of enterprises.

The percentage shares of the total for each sub-sector were then calculated and applied to the fuel consumption from MBIE’s agriculture fuel consumption figures (captured in their top-down statistics). This was done because the fuel consumption figures suggested by the bottom-up estimates were much higher than the top-down statistics suggested.

The initial review of the top-down fuel consumption indicated that the assumption that fuel that is direct delivered to agricultural businesses is used off-road was a reasonable one. This was supported by the survey (most fuel used by agricultural businesses was directly delivered).

¹⁵ Statistics NZ Business Demography Statistics, 2000-2020. Same source as cited in footnote 15.

The implication of this is that there is a high-side bias to the annual average consumption per business – this could be a consequence of several factors including:

- the survey not being completed by smaller businesses
- errors in self-reported fuel consumption.

However, the trends in the percentage shares for these sub-sectors should be robust.

For diesel consumption, we also corrected the top-down statistics for the volumes of diesel sourced from the retail network via ute/trailer tanks. The method for this estimate is described in the following section.

Estimates of diesel sourced from the retail network via ute/trailer tanks

In the review stage of this research, agricultural peak bodies were interviewed as well as independent distributors who deliver fuel directly to farmers. These stakeholders said that while it was uncommon for farmers to use a ute/trailer tank to access fuel from the retail network, it does happen. Because this is one of the cases where off-road fuel consumption would be mistakenly recorded as on-road consumption, it was decided to investigate this further. Stakeholders from other sectors (for example, building and construction and forestry) also noted that there was some use of ute/trailer tanks in their sectors.

In the survey of businesses using petrol and diesel off-road we asked about the use of ute/trailer tanks. Specifically, participants were asked the capacity of the ute/trailer tank, how frequently it is refilled, and where it is refilled. This allowed the modelling of an average annual volume of fuel that each respondent accessed from the retail network via a ute/trailer tank. The assumptions for modelling the annual average consumption from the retail network via ute/trailer tanks are shown in Table 4.

Table 4: Assumptions for modelling annual average fuel consumption accessed by ute/trailer tanks from the retail network

Frequency of refilling Number of fills per year		Portion of fuel from the retail network Percentage from retail network	
Daily	300	I fill it at a service station or a truck stop	100%
Weekly	50	I sometimes fill it at a service station/truck stop, and I sometimes fill it from a bulk tank	50%
Fortnightly	25	I fill it from a bulk tank and then use it to deliver fuel to my off-road machinery/equipment	0%
Monthly	12	Other (please specify)	0%
A few times per year	6		

While some respondents from non-agriculture sectors reported using ute/trailer tanks in the survey, there were too few respondents in these sectors to allow us to make estimates of the volumes of fuel accessed from the retail network via ute/trailer tanks.

The annual average fuel accessed from the retail network via ute/trailer tanks for each sub-sector within agriculture was calculated as follows:

$$T_n = C_n R_a P_b$$

Where:

- C_n is the capacity of the ute/trailer tank
- R_a is the number of times filled per year (see Table 4)
- P_b is the percentage of fuel accessed via the retail network (see Table 4)

T_n was then averaged by sub-sector and multiplied by the percentage of respondents within each sub-sector who filled their ute/trailer tank via the retail network – the result of this calculation is the average consumption of fuel per enterprise per year accessed from the retail network via a ute/trailer tank. The results of this calculation for agriculture are shown in the following table.

Table 5: Calculation of the volumes of diesel accessed from the retail network via ute/trailer tanks

Sub-sector	Percentage filling via the retail network (%)	Modelled annual average consumption (L/year)	Annual average consumption per enterprise (L/year/ent.)
Arable Farming and Agricultural Contractors (n=62)	15%	8,902	1,292
Dairy farming (n=48)	10%	7,856	818
Horticulture (n=29)	14%	4,650	641
Sheep and beef farming (n=99)	9%	1,189	108

Source: MartinJenkins survey of businesses using liquid fuels off-road

To estimate the average amount of diesel consumed by each of these sub-sectors each year in total, the annual average consumption per enterprise was multiplied by the number of enterprises.¹⁶ For diesel, these amounts are added to the sub-sector totals (see the previous section) before the sub-sector percentages of fuel consumed off-road are calculated. These sub-sector percentages are used to split the top-down agriculture estimate. The sub-sector percentages are multiplied by the ratio of the total bottom-up off-road consumption (including the ute/trailer tank estimate) to the bottom-up consumption without the ute/trailer tank estimate.

This results in an agriculture sector total that is higher than the one specified by MBIE's top-down statistics – the difference between the two is the amount of fuel accessed from the retail network via ute/trailer tanks. This amount (9 million litres) was removed from the retail network figures for diesel.

Estimating fuel sourced from the retail network and used for recreational boating

To estimate the amount of petrol and diesel sourced from the retail network that is used for recreational boating each year, recreational boat owners were surveyed to determine the annual fuel consumption, and the amount of this fuel sourced from the retail network.

¹⁶ Statistics NZ, Business Demography Statistics. Same source as cited in footnote 15.

This survey asked boat owners:

- what kind of boat they own
- what fuel their boat uses
- how they normally refuel their boat
- the average amount of fuel their boat uses per trip
- the average number of trips they take in their boat per year.

Maritime NZ undertakes research each year into recreational boating in New Zealand. This research allows Maritime NZ to estimate the number of recreational boats in New Zealand. The number of recreational boats by boat type are shown Table 6.

Table 6: Estimated number of recreational boats in New Zealand

Boat type	Estimated number in New Zealand
Power boat (larger than 6 m)	81,088
Power boat (smaller than 6 m)	215,621
Sailboat (larger than 6 m)	36,858
Sailboat (smaller than 6 m)	62,659
Dinghy with engine	175,077
Jet ski	92,146

Source: Maritime NZ, 2020. Recreational marine survey

To estimate the fuel used by each of these boat types each year, survey results were used to calculate the percentage of each boat type that access fuel from the retail network, and the percentage of these that are petrol (and the percentage that are diesel).

Survey data was also used to estimate the average amounts of fuel used by each boat type each year. These averages by fuel type and by boat type were multiplied by the estimated numbers of boats of each type that refuel via the retail network. This amount of petrol and diesel (383 million litres of petrol, and 50 million litres of diesel, per year) was removed from the retail network figures.