EECA ENERGY EFFICIENCY & CONSERVATION AUTHORITY
TE TARI TIAKI PŪNGAO

9(2)(a) [redacted]

21/01/2026

Dear 9(2)(a) [redacted],

Re: Official Information Act request

Thank you for your email on 19 December 2025 in which you requested information under the *Official Information Act 1982*. Further to your original request of 29 September, which we responded to on October 23. After clarification around the commercially sensitive nature of the emails in question and a discussion of redactions, you requested:

1. All letters / emails to and from WPC oil recovery for the last 2.5 years
2. All copies of notes from meetings regarding the use of waste / used oil

Please see the material that fell within the scope of your request attached as **Appendix 1.** As we advised previously, EECA has had limited engagement with WPC over the past 2.5 years.

The meeting notes and emails between EECA and WPC mostly consist of commercially sensitive information pertaining to WPC's private business and funding. Therefore, much of the email content and meeting notes have been redacted under section **9(2)(b)(ii)** of the *Official Information Act 1982*. (**9(2)(b)(ii)** applies where withholding is necessary to protect information where the making available of the information would be likely unreasonably to prejudice the commercial position of the person who supplied or who is the subject of the information).

You have the right to seek an investigation and review by the Ombudsman of this decision. Information about how to make a complaint is available at www.ombudsman.parliament.nz or freephone 0800 802 602. Please feel free to reach out to discuss this further with us if you have any questions.

Dr Marcos Pelenur

EECA Chief Executive

From: Kanchana Marasinghe <Kanchana.Marasinghe@eeca.govt.nz>
Sent on: Wednesday, May 21, 2025 4:23:01 AM
To: [redacted] Karen Orr <Karen.Orr@eeca.govt.nz>
CC: Stacey Fellows <Stacey.Fellows@eeca.govt.nz>; MS Teams (PoC)-Mobile Neat Board <RES_Teams_Tv_Trolley@eeca.govt.nz>
BCC: RES_Rangimarie - L8, Cap 8 <RES_Rangimarie@eeca.govt.nz>
Subject: [redacted] Re-refining waste oil in New Zealand

Microsoft Teams Need help?

Join the meeting now

Meeting ID: 430 411 013 636 1

Passcode: sH7Gd7wn

Dial in by phone

+64 4 886 4873,,448518554# New Zealand, Wellington

Find a local number

Phone conference ID: 448 518 554#

For organizers: Meeting options | Reset dial-in PIN

[redacted]

Outlook

[redacted]

From: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
Sent: Tuesday, 29 August 2023 10:17 am
To: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
[redacted]

Morning Dinesh,

[redacted]

Thanks,
Hamish

From: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
Sent: Monday, August 28, 2023 7:18 PM
To: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
[redacted]

D

Sent from my iPhone

> On 28/08/2023, at 4:39 PM, Hamish Thomson <Hamish.Thomson@eeca.govt.nz> wrote:
>
> Hey Dinesh,
>
> [redacted]
>
> Thanks,
> Hamish
>
> From: Glenn Wellington <Glenn.Wellington@eeca.govt.nz>
> Sent: Monday, August 28, 2023 4:21 PM
> To: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
> [redacted]

 [redacted]

Hi Hamish,

[redacted]

Cheers,

Glenn

Glenn Wellington
Manager Products & Partnerships
EECA

Mobile: +64 21 754 256
www.eeca.govt.nz

From: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
Sent: Monday, August 28, 2023 3:16 PM
To: Glenn Wellington <Glenn.Wellington@eeca.govt.nz>
[redacted]

Hey Glenn,

[redacted]

Cheers,
Hamish

From: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
Sent: Monday, August 21, 2023 3:40 PM
To: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
[redacted]

Hi Hamish

[redacted]

Cheers
Dinesh

[redacted]

Sent: Thursday, August 17, 2023 3:10 PM
To: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
[redacted]

Subject: WPC

WPC

Wednesday, 11 June 2025
4:10 pm

21.05.2025 [redacted]

Created with OneNote.

[redacted]

Date Tue 7/16/2024 1:10 PM
To Insa Errey <Insa.Errey@eeca.govt.nz>; Alan Young <alan.young@enerlytica.co.nz>

Hi Insa, are we able to see a copy of the report prepared by Alan Young, Enerlytica??

Kind Regards,

[redacted]

From: Insa Errey <Insa.Errey@eeca.govt.nz>
Sent: Thursday, July 11, 2024 1:08 PM
To: Alan Young <alan.young@enerlytica.co.nz>;[redacted]

[redacted]

[redacted]

How are you Next Friday 1pm for an online meeting?
Alan thanks for the e-introduction

Kind regards
Insa

From: Alan Young <alan.young@enerlytica.co.nz>
Sent: Thursday, July 11, 2024 12:54 PM
[redacted] Insa Errey <Insa.Errey@eeca.govt.nz>
[redacted]

CAUTION: This email came from outside of EECA. Please take care when clicking links or opening attachments.

[redacted] + Insa,

[redacted]

Best Regards

Alan

--
Alan Young
Associate Director

Cell +64 (0)27 332 2288
www.enerlytica.co.nz

From: Dinesh Chand

[redacted]

From: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
Sent: Tuesday, 29 August 2023 10:17 am
To: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
[redacted]

Morning Dinesh,

Yeah happy to get in contact so will give him a call today [redacted]

Thanks,
Hamish

From: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
Sent: Monday, August 28, 2023 7:18 PM
To: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
[redacted]

Thanks for progressing Hamish.
[redacted]
D

Sent from my iPhone

> On 28/08/2023, at 4:39 PM, Hamish Thomson <Hamish.Thomson@eeca.govt.nz> wrote:
>
> Hey Dinesh,
>
> [redacted]
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> Thanks,
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> ---
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> **From:** Glenn Wellington <Glenn.Wellington@eeca.govt.nz>
> **Sent:** Monday, August 28, 2023 4:21 PM
> **To:** Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
> [redacted]
>
> Hi Hamish,
>
> [redacted]

[redacted]

[redacted]

Cheers,

Glenn

Glenn Wellington
Manager Products & Partnerships
EECA

Mobile: +64 21 754 256
www.eeca.govt.nz

From: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
Sent: Monday, August 28, 2023 3:16 PM
To: Glenn Wellington <Glenn.Wellington@eeca.govt.nz>
[redacted]

Hey Glenn,

[redacted]

Would you agree? If so happy to relay this!

Cheers,
Hamish

From: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
Sent: Monday, August 21, 2023 3:40 PM
To: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
[redacted]

Hi Hamish
[redacted]

No worries if you can't – I will pick it up on Friday.

Cheers
Dinesh

[redacted]
Sent: Thursday, August 17, 2023 3:10 PM
To: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]
and erase all copies of the message and attachments. Thank you.

Please consider the environment before printing this eMail.

[redacted]

[redacted]

[redacted]

[redacted]

Sent: Monday, 11 September 2023 4:17 pm
To: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
Cc: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
[redacted]

[redacted]

From: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
Sent: Monday, September 4, 2023 9:27 AM
[redacted]
Cc: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Sent: Tuesday, August 29, 2023 2:29 PM
To: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>

Cc: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
[redacted]

[redacted]

[redacted]

[redacted]
Thanks
Dan

From: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
Sent: Tuesday, 29 August 2023 2:02 PM
[redacted]
Cc: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Thanks,
Hamish

[redacted]
Sent: Thursday, August 17, 2023 3:10 PM
To: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

From: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
Sent: Monday, 28 August 2023 4:39 pm
To: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
[redacted]

Hey Dinesh,

[redacted]

Thanks,
Hamish

From: Glenn Wellington <Glenn.Wellington@eeca.govt.nz>
Sent: Monday, August 28, 2023 4:21 PM
To: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
[redacted]

Hi Hamish,

[redacted]

[redacted]

[redacted]

Glenn

Glenn Wellington
Manager Products & Partnerships
EECA

Mobile: [redacted]
www.eeca.govt.nz

From: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
Sent: Monday, August 28, 2023 3:16 PM
To: Glenn Wellington <Glenn.Wellington@eeca.govt.nz>
[redacted]

Hey Glenn,

[redacted]

[redacted]

[redacted]
Hamish

From: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
Sent: Monday, August 21, 2023 3:40 PM
To: Hamish Thomson <Hamish.Thomson@eeca.govt.nz>
[redacted]

Hi Hamish
[redacted]

[redacted]

Cheers
Dinesh

[redacted]
Sent: Thursday, August 17, 2023 3:10 PM
To: Dinesh Chand <Dinesh.Chand@eeca.govt.nz>
[redacted]

[redacted]

Waste / used oil supply and demand in New Zealand

enerlytica

ABOUT THIS REPORT

EECA has commissioned Enerlytica to assist in its work to cost-effectively decarbonise process heat technologies and fuels. EECA wished to improve its understanding of the use of used oils in New Zealand, including used lubricants, hydraulic oils, and cooking oils, as a fuel for process heat applications. EECA has asked Enerlytica to investigate the available supply, demand, and pricing of used oils and to gather and review environmental and regulatory considerations associated with the recovery and use of used oil as a fuel.

We were asked by EECA to:

1. Quantify used oil supply and demand in New Zealand, identifying major sources and sinks and how these will change over time as the New Zealand vehicle fleet electrifies;
2. Identify the cost of used oils to consumers, how prices compare to other fuels, and how they would change if a carbon price were attached to used oils;
3. Identify the environmental impacts of used oil combustion versus other disposal methods; and
4. Identify any regulatory concerns by used oil market participants, particularly with regards to carbon emissions.

To build our analysis we undertook a series of interviews with participants in the used oil market including 11 used oil collectors, processors, and sellers, 5 used oil consumers, 3 boiler engineering companies and several individuals involved in the regulation of the used oil sector.

To estimate for market size we used Stats NZ import data on petroleum oils as well as bottom-up estimates for automotive demand for lubricating and hydraulic oils using New Zealand Transport Authority data on the current vehicle fleet. We also undertook desktop analysis of existing literature from Europe, the USA, Canada and Asia. Time constraints and limited data sources led us to focus primarily on petroleum-based used oils rather than used cooking oils.

ABOUT ENERLYTICA

Enerlytica is an independent research house and corporate advisor that provides specialist energy sector-specific advice to its clients.

Enerlytica counts most of the largest upstream, midstream and downstream energy companies active in the New Zealand energy sector as current clients of its services. Most government and quasi-government entities involved in the New Zealand energy sector are also Enerlytica clients.

For more information see enerlytica.co.nz

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CONTENTS

EXECUTIVE SUMMARY

Purpose

EECA has engaged Enerlytica to assist in its work to cost-effectively decarbonise process heat technologies and fuels. Specifically, EECA seeks to improve its understanding of the use of used oils in New Zealand, including used lubricants, hydraulic oils and cooking oils, as a fuel for process heat applications. EECA has asked Enerlytica to analyse and estimate for the available supply, demand and pricing of used oils and to gather and review environmental and regulatory considerations associated with the recovery and use of used oil as a fuel.

Used oil supply and pricing

Used oils predominantly refers to petroleum oils such as lubricants, hydraulic oils and other non-fuel applications which have reached the end of their useful life. Options to manage used oils include disposal to landfill (the least desired option), processing them into fuels for combustion or re-refining into base oils that can be recycled back into non-fuel applications. Used cooking oils (UCO) and oily waste from the maritime sector (known as "ship slops") can also enter the used oil supply stream but are often treated differently due to their different sourcing and final consumption characteristics.

We estimate New Zealand demand for non-fuel petroleum oils totalled 54 million litres in 2023. Of this amount, around 60% or 32 million litres is recoverable as used oil with the remainder lost in use.

The recovery of used oil is facilitated by eight major used oil collectors operating in the North and South Islands. These operators usually collect used oil for free and supplement local supply with 2.8 million litres of used oil imports from the Pacific Islands. Separately, 20 million litres of ship slops from domestic and imported sources are estimated to be processed in New Zealand each year. Supplies of UCO are estimated at 16.7 million litres with recovery rates suggested to be in the range of 70-90%.

Excluding ship slops, which are largely assumed to be re-exported as fuel oil, 35 million litres pa (or 1.3 PJ pa) of used oil is available be used as fuel in New Zealand. Of this, 1.6 million litres per annum is estimated to be lost to landfill due to contamination or illegal dumping, a further 4.8 million litres (or 0.2 PJ) is assumed to be consumed onsite by sources of used oil such as rural garages that may retain the used oil to fuel space heaters over winter, and 600,0000 litres of transformer oil is collected and recycled back into usable transformer oil.

Of the remaining 28 million litres pa (or 1 PJ pa) of recovered volumes of used oil, pulp and paper mills in Kawerau are the largest consumer and take over 15 million litres pa. Other major single-site or single-company users are Fulton Hogan (2.5 million litres pa) and Gloriavale (3 million litres pa). The remaining 7.7 million litres pa of consumption is largely assumed to be horticultural and related industries which value the low relative cost of used oil of $7-14 per GJ and ease of operation in boilers versus coal. By comparison the commodity costs excluding carbon of natural gas, diesel, and coal are estimated to be between $11-15/GJ, $29-33/GJ and $10/GJ respectively.

While there is some use of UCO as a biofuel in New Zealand, the quantities used are not estimated to exceed 3 million litres pa. Instead the vast majority of UCO is exported where it is ultimately converted into biodiesel for subsidised markets in Europe and the US. UCO collectors are thought to pay between $0.4-0.8 per litre with prices for processed UCO reaching as high as $1.80 per litre which, even before processing into biodiesel, is higher than local diesel prices.

The supply of used oils in New Zealand is expected to decline over time given the majority of demand for lubricants, hydraulic oils and other non-fuel applications come from the automotive sector and in particular internal combustion engine (ICE) vehicles. Our analysis suggests that the increasing penetration of EVs will see demand for these oils in New Zealand reduce to 21 million litres pa by 2050 with the decline in automotive oils demand only being partially compensated for by increased demand for transformer oils, which will grow as the New Zealand economy continues to electrify, and minor growth in industrial oils demand. After accounting for losses, we expect total used oils available for fuel use in 2050 to total 14.3 million litres pa or 0.5 PJ pa.

While quantification is difficult, anecdotal evidence suggests the collection of ship slops within New Zealand has been reducing in line with higher fuel standards and a trend towards greater offloading overseas, however we estimate that ship slop supplies from Pacific Islands will decline very slowly if at all by 2050. This is because the ship fleet that operates in the Pacific is smaller, less regulated and likely to be the last to switch to alternative fuels such as LPG, LNG and methanol which produce few oils in their ship slops.

Used oil regulation

The main area of regulatory focus in the used oil sector is increasing requirements from Worksafe for used oil to be managed in line with more volatile fuels such as gasoline and diesel. If enforced this would require significant investment from both used oil collectors and potentially customers to meet new minimum compliance standards. Longer-term there are concerns from operators in the sector about the prospect of carbon pricing being attached to used oil combustion. If this does happen, carbon-inclusive pricing of used oil products would approximate those for and natural gas. Assuming the low-end of our commodity price ranges and a $50 per tonne carbon price, the bundled carbon-inclusive price for used oil equates to $10.80/GJ versus $13.70/GJ for natural gas, $14.20/GJ for coal and $32.90/GJ for diesel. At $70 per tonne carbon the used oil price rises to $12.65/GJ compared to $14.80/GJ for natural gas, $16.05/GJ for coal and $34.25/GJ for diesel. There is a risk that, if customers for used oil are not found and therefore used oil collectors cannot make a margin on sales, then suppliers of used oil will be charged for collection. In this situation there would an incentive for users to combust used oil themselves unless their emissions could also be covered within the ETS.

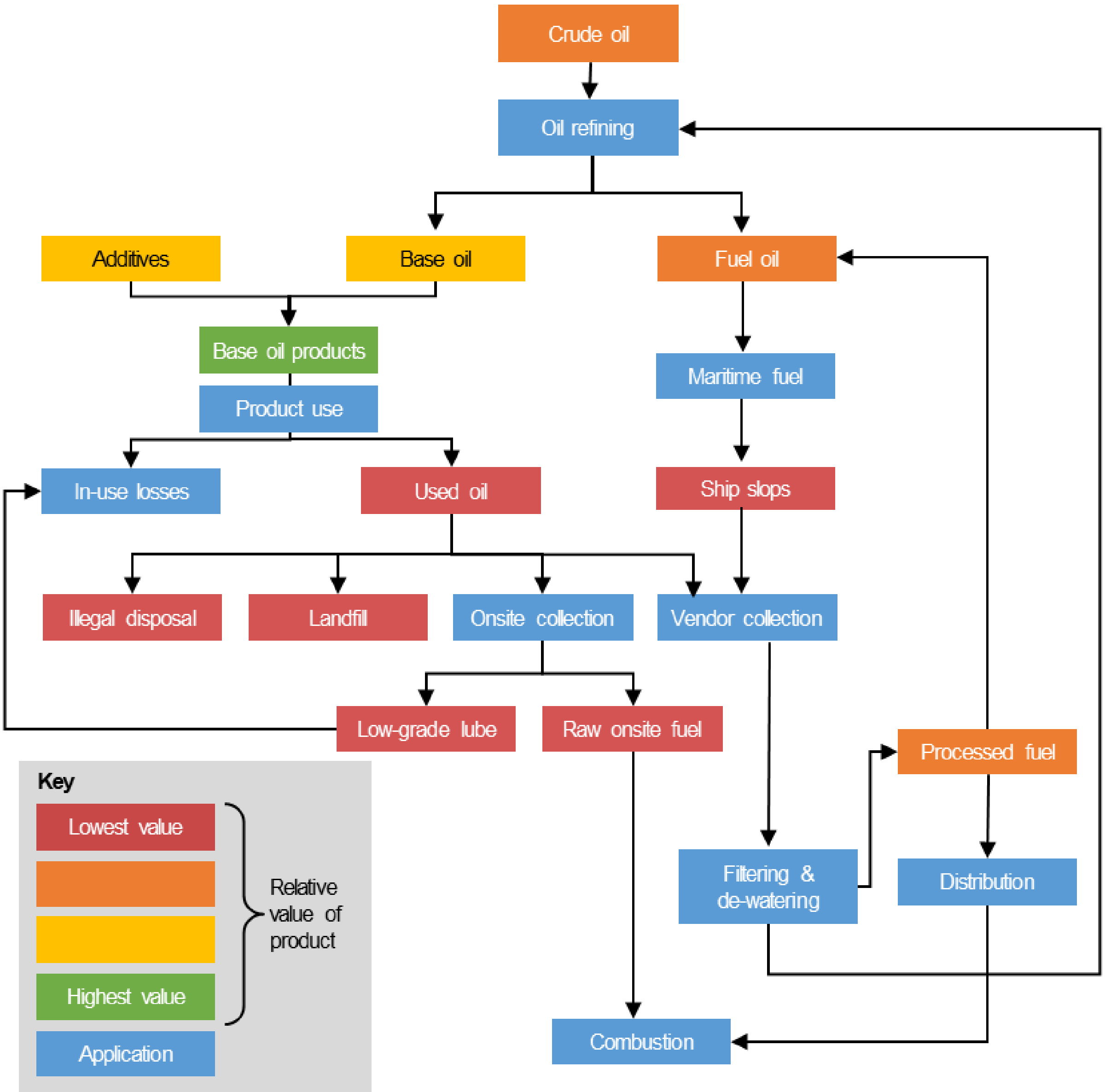
Despite these complexities, our discussions with operators indicate the sector is open to further scrutiny and collaboration to reduce emissions. In particular, used oil collectors and processors are keen for greater oversight of fuel standards to ensure customers are provided with fuel that is low in water and particulates to enable a clean and efficient burn. In addition, some used oil collectors are keen to explore the potential of re-refining used oils back into base oils which can then be blended into non-fuel applications such as lubricants and hydraulic oils. Studies abroad have shown this to reduce emissions by 0.1 to 0.4 kg of CO_2e for each litre of used oil recycled versus combusted with additional savings of up to 2.4 kg of CO_2e from avoiding upstream oil production and logistics emissions if a litre of oil is recycled up to seven times across its full life cycle. Such re-refining is conducted as standard practice in some parts of Western Europe, Brazil and Saudi Arabia but typically requires legislative support, such as a ban on used oil burning or subsidy schemes to maintain incentives to re-refine used oil in the face of low oil prices which can make the practice unprofitable. Regardless of how used oil is managed there is a clear shared motivation to ensure that the collection and reuse of it is not disincentivised and that, if it is combusted, it is directed to the most efficient users and thereby displacing demand for other fossil fuels.

1. WHAT IS "USED OIL"?

"Used oil", sometimes called "waste oil", refers principally to petroleum-based oils that are at the end of their life as premium non-fuel products, such as lubricants. The term can however also be applied to describe used cooking oils and oils accumulated on shipping slop tanks (called "ship slops"). These oils are typically longer chain hydrocarbons (usually >20 carbon atoms) which have viscosities and flashpoints that are similar to heavier grade fuel oils (>8 mm^2/s at 100°C viscosity and 60°C+ respectively).

As used oils retain much of their original chemical characteristics it is possible for them to be recycled back into a base oil feedstock or, as is more common around the world, to enter the fuel supply chain. In New Zealand, petroleum-based used oils, whether processed or unprocessed by third party collectors, are largely combusted as a fuel to be used locally or exported to be used as fuel abroad.

Figure 1: Used oil supply chain and relative product values



Source: Enerlytica

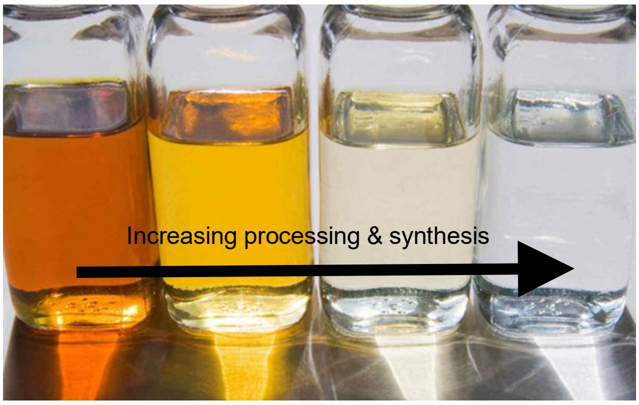
Due to differences in how they are sourced and their final applications, the major sources of used oils can be classified into petroleum-sourced base oil products including ship slops and vegetable and animal-based oils. In this study we focus principally on petroleum-based used oils.

1.1 Base oils

Base oils are petroleum oils, typically of 26 to 40 carbon atoms, that go through processes of de-asphalting, solvent extraction, dewaxing, hydro-finishing and further processes to become feedstock for a range of lubricants, hydraulic oils, transformer oils and more. Some base oils undergo even further chemical modification to become what is described as "synthetic" oils with more desirable and uniform lubrication properties compared to conventional mineral oils.

The use of base oils as lubricants, hydraulic fluids, and other specialist products is enabled by the addition of additives that enhance lubricity, viscosity, and other characteristics. It is the gradual oxidation of the oils and their additives plus gradual contamination by water and solids that requires that base oil products be replaced in applications such as motor vehicles, heavy machinery and transformers. Most used base oil products originate from the automotive sector where mechanics will collect used oil from changes of automotive fluids such as engine oil, transmission oil and brake oil.

Figure 2: Base oil samples



Source: Stock image, Enerlytica

1.2 Ship slops

Ship slops, sometimes also known as "ship sludges", are waste liquids, including oils, generated from within larger maritime vessels and is collected in machinery drip trays, oily ballast water, the cleaning of oil product tankers and the filtration of fuel lines. Because ship slops are sourced from a wide range of port traffic it can be highly variable in composition and may include non-oil substances and heavier fuel oils with 50 or more carbon atoms.

As a result, ship slops are frequently treated as a separate processing stream to other used oils with the resulting processed product typically more suited to re-entering the maritime heavy fuel oil supply chain than onshore process heat applications.

1.3 Vegetable oils

Vegetable oils, animal fats, and tree resins can also enter the wider used oil processing stream however their renewability, low carbon emissions and greater biodegradability mean they are typically treated and managed separately from used base oil products and ship slops so as to be able to present a "green" price premium over petroleum oils.

The largest source of renewable used oils is spent cooking oil from the food and restaurant industry. Other sources include from forestry, tunnelling operations and marine industries where they are used as biodegradable lubricants. Used cooking oil (UCO) is a major source of biofuels for which there is significant demand in Europe and, increasingly, North America where highly supportive climate change policies have driven uptake. Given their biodegradability, UCO can also be processed into biodegradable lubricants and dust suppressants.

Figure 3: UCO being emptied into containers for collection

Source: Stock image

2. VOLUME ESTIMATES & FORECAST

2.1 Base oil products

The closure in 2022 of New Zealand's only oil refinery means that almost all petroleum-sourced base oil products that can become available to use in New Zealand must first be imported. Stats NZ data suggests that supply of oil products into New Zealand totalled nearly 54 million litres in 2023. The notable domestically supplied base oil product is 600,000 litres of transformer oil that is collected and recycled within the country and therefore feeds the supply stream although this does not meet all transformer oil demand in New Zealand.

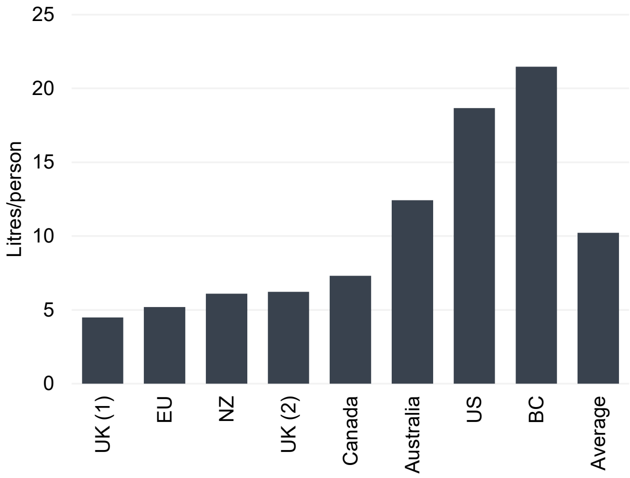
Automotive

Of the 54 million litres of imported base oil products lubricating preparations made up 87%, or around 46 million litres. This volume is largely comprised of engine, transmission and gear oils for the automotive transport sector. Our analysis using New Zealand Transport Agency data suggests this sector accounted for 38.1 million litres in 2023. Hydraulic oils make up 4.1 million litres of imports or 8% of imported base oil supply with an estimated further 1.5 million litres being brake fluid or similar product used by the automotive transport sector. In aggregate, the automotive transport sector therefore accounts for around 40 million litres of base oil product imports. The used oils from this sector are collected from mechanic workshops and garages that recover and retain the oils when carrying out vehicle servicing.

Our forecasts, based on assumptions presented in the Appendix to this report which applies data from the New Zealand Transport Authority data on vehicle fleet composition, Stats NZ population projections and assumptions on the annual mileage of New Zealand's fleet and the share of EVs, expect the volume of base oil products sold to the automotive sector in New Zealand to decline from 40 million litres pa in 2023 to as low as 3 million litres pa by 2050. Assuming a 60% recovery factor infers a volume of 1.8 million litres pa of used oil being recoverable from the automotive sector by 2050.

This declining supply of automotive oils reflects a progressive transition to fully electric vehicles (EVs). We expect EVs to occupy 99% share of the light vehicle and motorcycle fleet, 95% share of the bus fleet, and 80% share of New Zealand's trucking fleet by 2050. With no internal combustion engine (ICE), fewer moving parts in the transmission, and electrical power steering, EVs require minimal fluid changes. When fluids do require changing it is typically the battery coolant which falls beyond the scope of used oils. The only fluid of relevance to the used oil supply chain that needs regular changing in EVs is brake fluid. Current published advice on brake fluid changes for EVs is similar to ICE vehicles in that they should be checked every two years or 50,000 km although this could lengthen given that EVs have regenerative braking systems that reduce the use of hydraulic braking.

Figure 4: Used oil supply per capita in New Zealand vs peer country / regions



Note: Methodologies behind annual consumption figures is largely unknown and may lead to variance as seen in UK figures which come from two separate sources. Our observation is that differences are likely to result from inclusion or not of non-automotive oils.

Source: Enerlytica

It is the transport sector that largely explains how the amount of used oil generated in New Zealand compares to other jurisdictions. On a per capita basis and depending on the source, New Zealand sits above European countries and below Canada, Australia, and the US. This reflects New Zealand's high relative rate of car ownership of 1.1 motor vehicles per person, the 5th highest in the world, while the US, Canada, and Australia are ranked 8th, 10th, and 15th respectively. However, the average mileage of a New Zealand light vehicle at around 10,000 km per year is relatively low compared to these nations. For example, the average annual mileage of a light vehicle in the US is more than double this, meaning fluid changes there occur at twice the rate as in New Zealand. This difference in mileage likely reflects geographical factors including country size and greater degrees of urban sprawl.

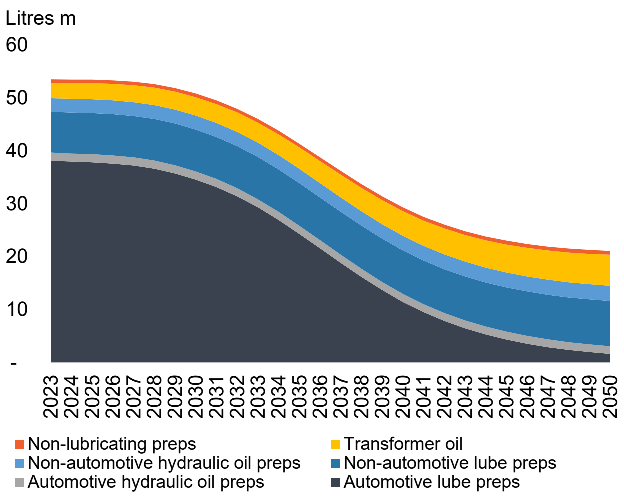
Industrial

Another reason behind differing levels of demand for base oil products is activity involving heavy machinery and industry. For example, the US, Canada and Australia all have larger mining sectors relative than New Zealand and Europe, which likely serves as another major source of demand for base oil products in those countries.

In New Zealand, large industrial sites such as steel works and forestry operations were estimated to be largely responsible for the import and usage of 7.7 million litres of lubricating preparations and 2.6 million litres of hydraulic oils in 2023. We expect industrial activity in New Zealand to grow with population but at a slower rate. This reflects that since the turn of the century New Zealand's industrial energy demand growth has decoupled from wider economic and population, registering a CAGR of 0.4% versus 2.9% for GDP and 1.3% for population.

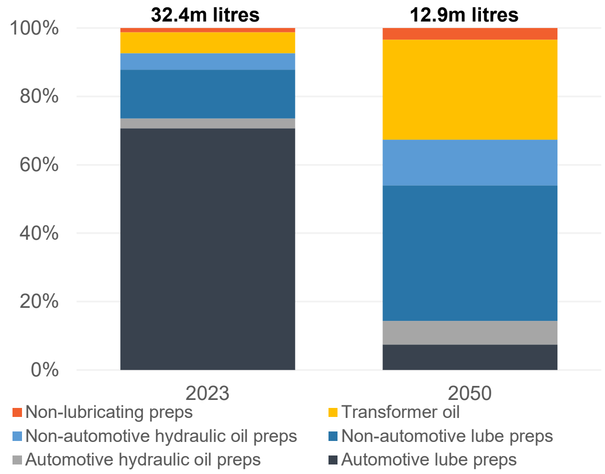
Long-term forecast population growth remains at around 1.2% pa which underpins our assumption that industrial energy demand, and thereby industrial demand for base oil products, will continue to grow at a similar rate of 0.4% pa. Demand for base oil products from this sector is therefore expected to grow from its current 10.9 million litres pa to 12.1 million litres by 2050, equating to 6.5 million litres pa of recoverable used oil from these sources in 2023 to 6.8 million litres pa in 2050.

Figure 5: Forecast New Zealand demand for base oil products



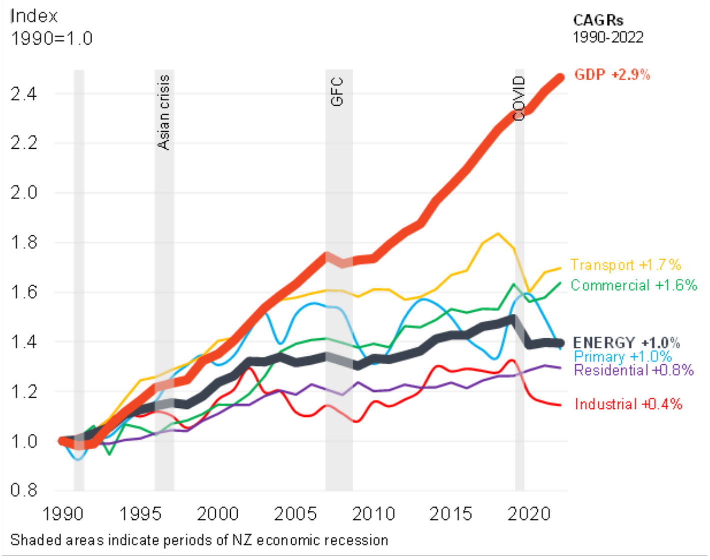
Note: including lubricants, hydraulic oils, transformer oils, and non-lubricating preparations
Source: NZTA, Stats NZ, Enerlytica

Figure 6: Forecast change in source mix of recoverable New Zealand used oil



Source: NZTA, Stats NZ, Enerlytica

Figure 7: New Zealand GDP vs energy demand growth



Source: Stats NZ, MBIE, Enerlytica

Transformer oils

2.3 million litres, or 4% of total base oil product imports, are transformer oils for the electricity sector. Industry sources suggest 16-20 million litres of transformer oil is present in New Zealand at any one time with Transpower operating 30% of the New Zealand's transformer fleet and single lines companies potentially holding up to half a million litres of transformer oil in their transformers at any one time. Individual generation units and similar assets are also likely to maintain large quantities of oil, with the largest likely being the HVDC cable which holds 650,000 litres.

Transformer oil volumes are expected to grow as the New Zealand economy electrifies. Indexing transformer oil imports to forecasts of electricity generation capacity growth as outlined in the Appendix, we estimate that the total volume of transformer oil imports into New Zealand will grow to 5.4 million litres by 2050. Assuming 60% of this is recoverable and adding the 600,000 litres that is already recycled each year in the country suggests that from 2030 to 2050 the volume of recoverable used transformer oil will increase from 2 million litres to 3.8 million litres pa.

Recovery rates

The estimates of the percentage of oil recoverable from the above applications varies between 50-70%. In other words, 30-50% of these volumes are lost through oxidation, leaks and applications that do not allow for recovery. Applying that to our estimate for New Zealand volumes including a small amount of other non-lubricating oils that make up the final 1% of imports and adjusting for recycled transformer oil suggests that around 32 million litres of used oil is currently recoverable in New Zealand.

Imports

As well as locally sourced used oil, New Zealand collection businesses import used oil from a number of Pacific islands including Tahiti, New Caledonia and Fiji. Stats NZ data suggests 2.8 million litres of waste oil was imported into New Zealand in 2023. We assume that Pacific Island demand for base oil products will decline at a similar rate to New Zealand's total demand albeit with a 10 year delay which reflects expected barriers to electrification on the islands such as the better range and variety of ICE boats and ships available, which is better suited to interisland traffic. As such, we expect the total volume of imported used oils to decrease from its current level of 2.8 million litres pa to 1.4 million litres pa in 2050.

Note that exports of used oil product is also possible (see section 4).

2.2 Ship slops

Ship slop volumes collected in New Zealand are difficult to quantify for several reasons including that:

- only a small number of companies are currently collecting ship slops and when they do they are simultaneously handling ship slops from Pacific Islands.
- commercial sensitivities surrounding the disclosure of processed slops volumes.
- reported volumes likely include water also collected in slop tanks and there is significant variance in the oil to water ratio that ships can deliver.

For example, ship slops collected in ports that have more coastal, diesel-fuelled shipping traffic can have up to a 95% water cut in their slops while long distance shipping traffic which uses heavier fuel oils may only have a 25% water cut. A review of customs codes, MBIE data and theorised volumes by former industry participants suggest the onshore collection of ship slops and their collection from the Pacific islands may not be captured by customs data or otherwise be readily quantifiable.

Best estimates suggest that up to 20 million litres pa of ship slops is processed in New Zealand although volumes collected from within New Zealand are understood to be in significant decline due to:

- the imposing of cleaner fuel standards by the International Maritime Organisation (IMO) resulting in long-distance shipping traffic visiting New Zealand increasingly being fuelled with lower sulphur, lighter and higher quality fuel oils that produce lighter oil residue.
- domestic shipping increasingly being fuelled with diesel or diesel equivalents which yield mostly water into their ship slops.
- cheaper costs to dispose of ship slops in other ports outside of New Zealand.

Industry sources suggest that imported ship slops are typically heavier than most base oil products and are in line with number 6 bunker oil which is known for its viscous composition. As such, much of the ship slops processed outside of the South Island are re-exported back to Pacific islands where they are recovered and fed into power generation facilities and ships fuelled by heavy fuel oil. Within the South Island, Gloriavale is known to consume some ship slop volumes although exact amounts are difficult to estimate for, but are also expected to be in decline.

Figure 8: Number 6 bunker oil sample

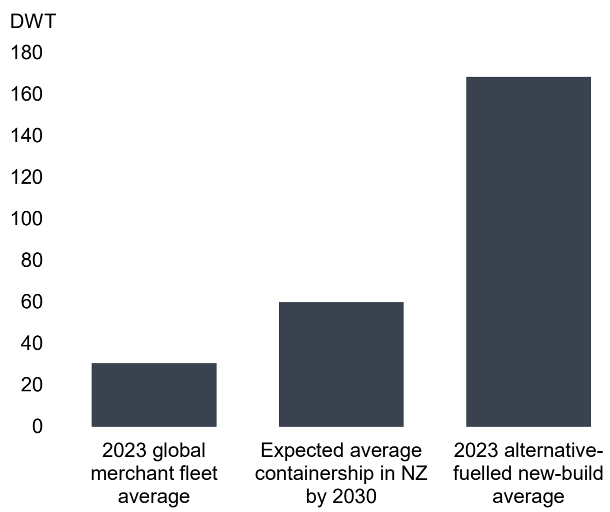
Source: Stock image

Looking ahead, the IMO is leading a move away from the use of heavier fuel oils by shipping operators. This should see the amount of oil captured in ship slops and imported to New Zealand from the Pacific islands decrease over time. The shipping industry is however notoriously cost-sensitive, difficult to regulate and to decarbonise. That said, the IMO has already successfully implemented policy (known as the IMO 2020 regulations) to require operators to reduce the sulphur content in fuel oil from 5% by mass to 0.5% across most nations, with some emission control areas (ECAs) going further to require a limit of 0.1% by mass.

The IMO has also separately set a target to reach 5% of energy used by the international shipping industry to come from lower carbon fuels by 2030, with an aspirational target of 10%. Lower carbon fuels currently available are LNG, LPG, methanol and battery/hybrid technologies with ammonia likely to become available soon. Presently only 1.2% of vessels and 5.5% of shipping tonnage in service are alternatively fuelled and this total is overwhelmingly composed of LNG carrier vessels which can use their cargo as fuel.

To meet these targets it is in the interest of the shipping industry to move the largest ships to alternative fuels to drive more rapid decarbonisation. As such, the average deadweight tonnage (DWT, the weight of cargo a ship can carry) of all alternatively fuelled vessels currently being built is 168,000 DWT. By contrast, the larger ships that regularly visit the waters of New Zealand and the Pacific Islands are between 30,000 and 60,000 DWT. The prospect of significant reduction in fuel oils from ship slops out to 2050 is therefore likely to be slow and relatively immaterial to the New Zealand market for used oils.

Figure 9: Vessel size benchmarks



Source: UNCTAD, Enerlytica

2.3 Cooking oils

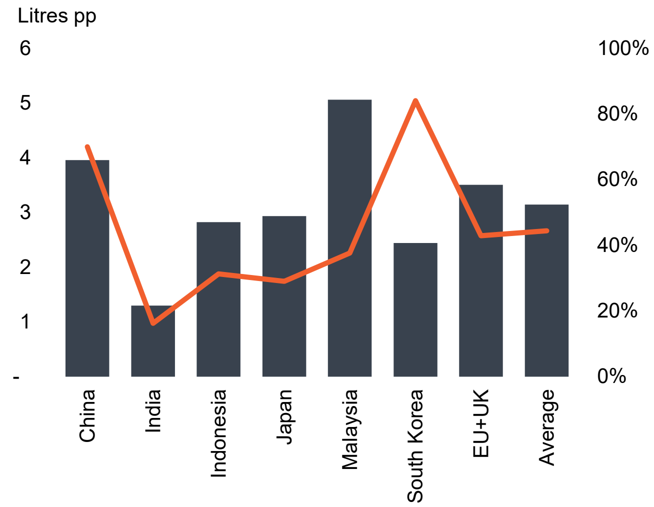
Industry estimates suggest that somewhere in the region of 12-15 million litres of UCO are collected in New Zealand each year. This is in line with an estimate of total UCO available in New Zealand derived from applying the average UCO potential per capita in 2022 from across several other peer countries.

Using the median of the sample peer country average and weighted average UCO supply, we infer a benchmark of 3.2 litres of UCO generated per capita per year in New Zealand, thereby totalling an aggregate 16.7 million litres pa.

Figures from other countries assume that almost all UCO available from food processors and restaurants is collected while collection from urban households is 50% or lower. Our discussions with UCO collectors in New Zealand suggest very little household UCO is collected locally and that local food processors leave a significant portion of residual oil in their produce. It is possible that the quantity of restaurants and number of food processing businesses in New Zealand are higher than in the peer jurisdictions we sampled, therefore keeping New Zealand quantities of UCO supply in line with that of the peer country sample.

Looking ahead, assuming our estimate for UCO volumes increases in line with forecast population growth infers that by 2050 New Zealand is expected to produce more than 21 million litres of recoverable UCO.

Figure 10: Per capita UCO availability in peer countries

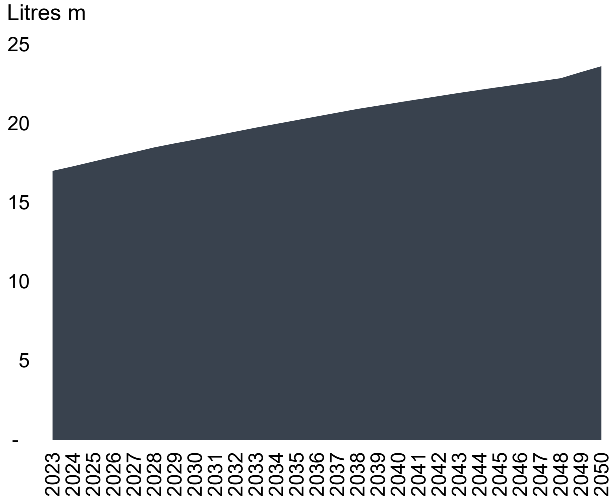


Note: Median of sample average and sample weighted average of UCO per capita were used to estimate total NZ supply.
Source: International Council on Clean Transportation (ICCT), CE Deflt, Enerlytica

Data on volumes collected by region are not complete but it is understood that the Canterbury region alone produces around 2.5 million litres pa which, with a population of 600,000 people, suggests a UCO availability per capita of close to 4.2 litres. This is >30% above the 3.2 litre per person benchmark we used to calculate our estimate for national quantity of available UCO per annum. This could suggest that actual UCO volumes produced nationally are higher than our initial estimate and this may be the case given that, if we accept the industry estimate of 12-15 million litres being collected annually, New Zealand's collection rate is between 70-90%. This is in line with South Korea at 92%, the highest-ranking country in our peer country sample in terms of UCO recovery.

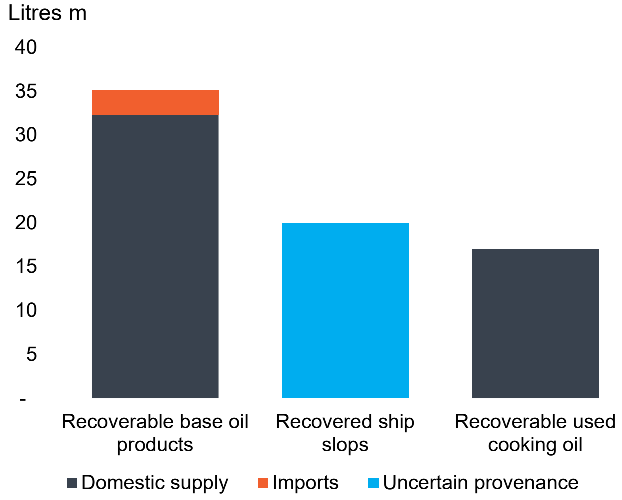
Our discussions with UCO collectors suggest however that it is likely that, outside of households, more than 90% of UCO available for collection is indeed being collected. This likely reflects that the residual value of the oils is high and that suppliers of UCO are sought out and compensated with multi-year contracts at attractive prices.

Figure 11: New Zealand UCO supply forecast



Note: Forecast assumes per capita UCO supply is constant and total supply is in line with population growth as forecast by Stats NZ.
Source: Stats NZ, ICCT, Enerlytica

Figure 12: New Zealand used oil sources in 2024



Source: Enerlytica, Stats NZ

3. USED OIL COLLECTION & PROCESSING

3.1 Used base oil products

Collection

A handful of players currently dominate the collection and processing of used base oil products and ship slops in New Zealand. While exact processing capacities and quantities are unknown it is widely accepted that Salters Cartage and WPC Oil Recovery are the two largest collectors of used oils. Salters Cartage operates two depots and processing facilities in the North Island and one in the South Island and therefore has a national operation. WPC focuses on collecting used oils the North Island and splits its operations across two facilities in Auckland and Palmerston North. Based on the Pareto principle and our discussions with industry, we estimate more than 80% of used oil from within New Zealand, excluding ship slops, is processed by these two firms.

Smaller players in the collection of used lubricants and hydraulic oils are Waste Management and Fulton Hogan. Fulton Hogan collects used oil in several areas close to its asphalt plants while Waste Management collection is largely supplemental to its processing of ship slops from across the North Island at a facility in Tauranga, New Zealand's largest port. Waste Away South is another collector of ship slops but focuses on the South Island and is currently building its own processing facility in Timaru. It is understood that the Gloriavale Community on the West Coast also has its own used oil processing facilities and, in addition to being the main receiver of ship slops, including from other smaller players operating at smaller ports, collects used oil from within and near its community.

The collection and recycling of transformer oils is more specialised and there appear to be only two players operating in this market: ESI Group and Enzoil. Each use different techniques to recycle the oil they recover. Notable is that ESI Group also collects other used oils for processing into fuels and industrial lubricants.

In the North Island, used oil collectors typically do not charge for collection. In return, collectors can optimise their collection routes and frequencies of collection to minimise logistics costs to their favour. Collection of used oil is typically only charged when volumes collected are small (typically less than 400 litres), are outside of established collection routes or if collections are urgently required, such as when garages are nearing tank tops which would impede their ability to undertake further fluid changes in vehicles.

In the South Island, lower population densities and greater geographical spread of businesses sees charges for used oil collection being more common. Charges reflect the cost of truck logistics of around $200 per hour for a 16,000 litre truck. Assuming a 2 hour round trip to collect a minimum of 400 litres suggests collection costs could be as high as $1 per litre.

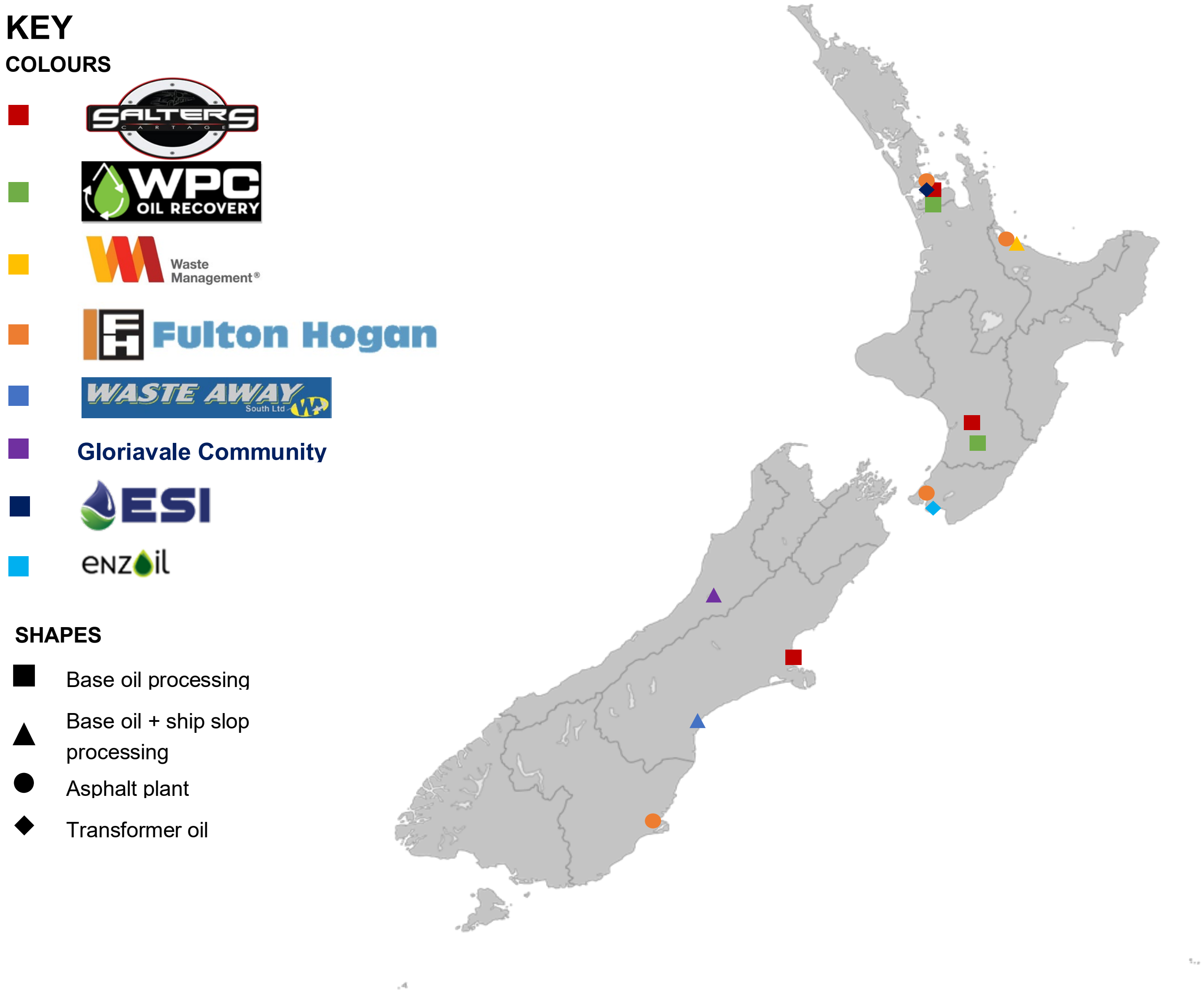
While it is understood that little margin is currently made on collection fees, a low crude oil price environment would likely see collection costs levied onto customers. This is because used oil boilers are capable of switching to alternative fuels such as diesel and other fuel oils. The decreasing price of these "virgin" fuels (in contrast to "used" oils) would squeeze sales margins on used oil to the point that used oil collectors and processors would need to make margins on collection fees.

Processing

Once collected, used oil typically undergoes a process of filtering to remove unwanted solids followed by demulsification (breaking the oil into oil and water phases) and de-watering. The filtration process removes impurities, particularly metals collected in automotive oils, that can lead to harmful emissions during combustion. Centrifuges and gravity tanks are used to undertake de-watering, taking advantage of the lower density of oil compared to water. This de-watering is particularly important to delivering a more efficient and cleaner burning fuel, as too much water can impede combustion.

Further processes such as mixing with other fuels to control viscosity, de-mineralisation with acids to further remove solids, de-asphalting and vacuum distillation are also possible to produce fuels of specific qualities or higher quality recycled base oils. In New Zealand, the only oils to undergo this further processing are recycled transformer oils which undergo similar process to deliver the higher purity, electrical resistance, heat conductivity, and more specific viscosity requirements required of finished product. Enzoil states that it uses a lower energy consuming "depolarising reactor" process to achieve the desired properties.

Figure 13: Petroleum used oil and ship slop collectors and processors



Source: Enerlytica

3.2 Used cooking oil

Collection

The UCO market also has relatively few participants and is dominated by only a handful of players. A major point of difference to the market for used petroleum oils is that many of the players that produce, import and sell seed and vegetable oils in New Zealand also collect UCO, using their knowledge of upstream sales to identify the largest sources of UCO.

Direct Fats and Oils is largely accepted to be the largest supplier and collector of UCO nationally, operating under its own known name and the Cookright brand of which it is a majority owner. Flower Power is another major player and runs two facilities in the North Island that reprocess seed oils into environmentally friendly lubricants with any waste from the process (assumed to be 5-10% of inputs) sold as animal feed. Full Drum also collects from the wider North Island while Dawson Waste Services and The Oil Man collect UCO from sources more local to Wellington and Auckland respectively. Southern Biofuels covers the Canterbury area of the South Island with Pure Oil, local to Rolleston, also starting to collect UCO although starting at small volumes.

Processing

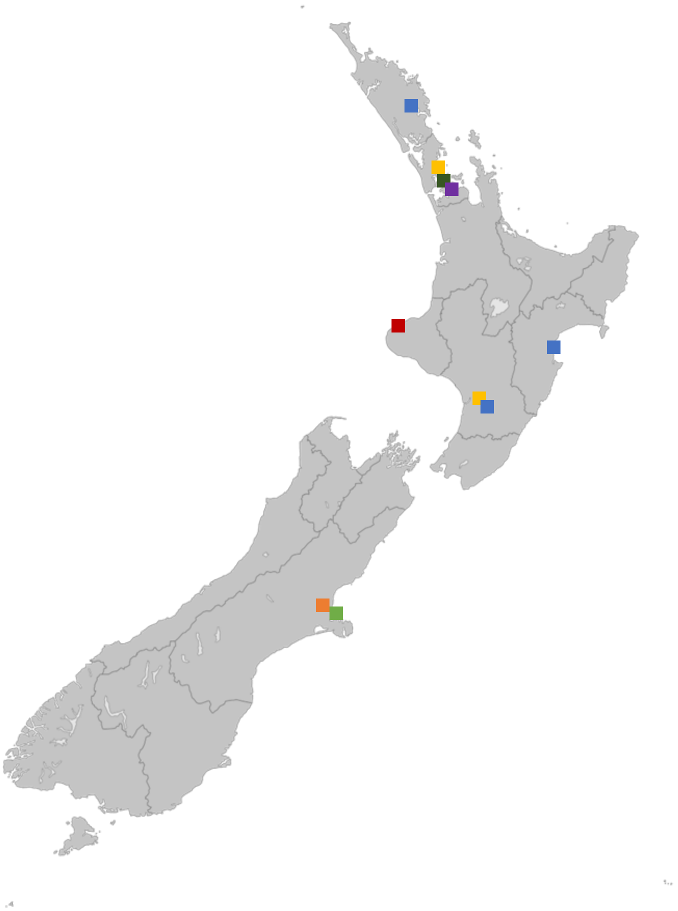
Once collected UCO can undergo several treatment processes depending on desired use case however all involve filtering for solids and de-watering. Further processes may include:

- Degumming to prevent oil decomposition and thermal instability.
- Neutralisation with caustic soda to remove fatty acids with a byproduct being soap stock.
- Bleaching using clay adsorbents to remove residual contaminants.
- Deodorisation via vacuum heating to remove odours from volatile compounds.
- Winterisation via cooling to remove waxes before they are likely to appear in cold conditions.

Accounting for UCO processing capacity in New Zealand is not part of the scope of this study but is likely to be relatively limited with only Southern Biofuel, Flower Power and Pure Oil likely to use any of the above processes given they supply processed UCO for biofuels use as well as industrial lubrication for the domestic market. As there is a strong UCO processing supply chain in Southeast Asia where UCO is converted into biofuels as well as feedstocks for soaps and other chemical products, it is likely that the majority of UCO is exported from New Zealand in unprocessed form.

Figure 14: UCO collectors and processors

Company	Head office	North Island collection?	South Island collection?
DIRECT FATS AND OILS LTD	New Plymouth	Yes	Yes
PureOil NEW ZEALAND LTD	Rolleston	No	Yes
Flower Power "The Good Oil"	Silverdale	Yes	Yes
DAWSON WASTE SERVICES LTD	Wellington	Yes in Wellington	No
Southern Biofuels Ltd	Christchurch	No	Yes in Canterbury
The Oil Man	Auckland	Yes in Greater Auckland	No
Cookright	Napier	Yes	Yes
FULL DRUM	East Tamaki	Yes	No



Source: Enerlytica

4. USED OIL DEMAND & PRICING

4.1 Used petroleum oils

We estimate more than 55 million litres pa of used oils and ship slops are currently available in New Zealand. This is composed of around 32 million litres of recoverable oils from within New Zealand, 3 million litres of imported oils and 20 million litres of ship slops which are a mix of local and imported volumes.

While some oils are collected and re-applied as lubricants to lower and lower grade applications such as chain oils at the end of their useful life, non-fuel base oil products typically meet one of three ends:

1. **Disposal** both legal and illegal.
2. **Recycling** back into a base oil product
3. **Combustion** as end use

Disposal

Industry sources suggest disposal into the environment as likely to account for around 5% of used base oil collected in New Zealand, or 1.6 million litres pa. In most cases the need for disposal involves used oils being contaminated by mixing with other disposed liquids and solids to the extent that the used oil collectors and processors are unable to remove impurities. In such circumstances the used oils are either disposed of illegally into waterways or turned into a semi-solid sludge with the addition of sawdust, sand, and other particulate wastes. This sludge can then be disposed of into landfills.

Recycling

Of the 35 million litres pa of used base oil supply we estimate that only 600,000 litres pa of transformer oil is recycled with potential capacity to recycle up to 100,000 litres pa more. This oil is both collected from and returned to the electricity industry.

Combustion

The vast majority of used base oils and ship slops recovered in, imported to, and processed in New Zealand enter the fuel stream to be combusted, however there are nuances of supply chain based on the source. For example, we assume that ship slops are largely exported to be used as fuel abroad although a small portion of used base oil products enter Waste Management's ship slop processing stream. Simultaneously, some South Island ship slops enter the domestic fuel stream, particularly to Gloriavale.

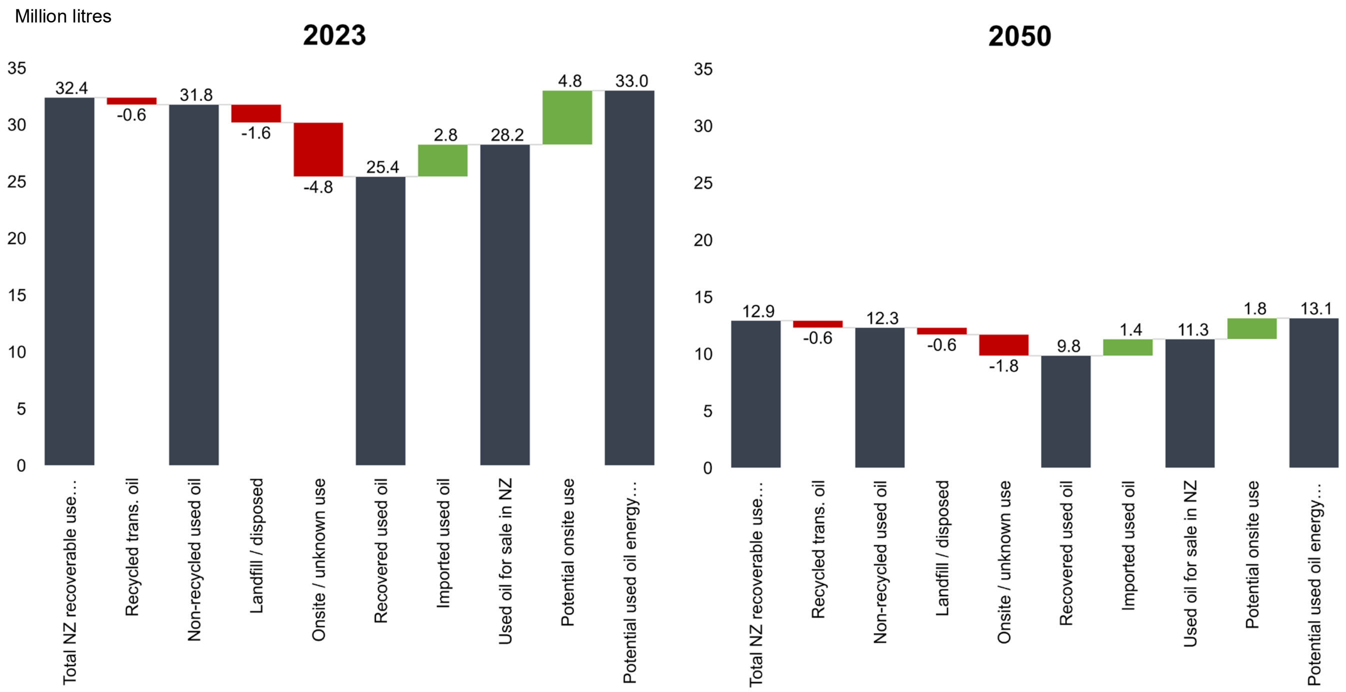
While we cannot decipher exact volumes, we assume these volumes to balance out, such that domestic and imported used base oil volumes of 35 million litres pa meet domestic combustion, recycling, and disposal volumes. There are also limited exports of used base oil products however our research suggests that these are only undertaken on an opportunistic basis as described below.

After accounting for ship slops, recycled transformer oil and used oil consumed onsite, a balance of 28 million litres pa of used oil therefore remains. This used oil is collected, processed, and sold by the used oil collecting companies primarily to industrial sources of demand. Of this, the largest single site consumers are the two pulp mills at Kawerau operated by Oji Fibre Solutions which consume an estimated 15 million litres pa between them as an ancillary fuel. Gloriavale Christian Community is also understood to be a major demand centre of used oils, likely consuming 1-3 million litres pa. Exact use cases for the used oil at Gloriavale are unknown but it is expected to serve as fuel for industrial boilers in food processing and manufacturing businesses and for residential heat boilers. Fulton Hogan is estimated to be the next largest user, consuming 2.5 million litres pa of used oil across four asphalt plants for an average of 0.6 million litres pa of used oil consumed per site.

The final 7.7 million litres pa of used oils sold by used oil processors and collectors are consumed by small industrial users, vineyards and orchards, horticulture businesses and a small number of residential users for home heating. Vineyards and orchards apply used oil heaters to prevent frost damage to their produce over winter while horticulturalists use it to maintain their greenhouses at specific temperature ranges to grow their desired produce. Cited as being particularly cost-conscious by boiler engineers and some used oil sellers, horticulturalists have traditionally used natural gas and coal with coal users in particular pivoting to used oil in the face of recent-year inflation in coal and carbon prices, the latter of which does not feature in the economics of used oil.

In addition, the ease of use of used oil as a fuel is particularly valued by horticulturalists, which has seen it emerge as the major source of used oil demand growth in recent years. Used oil boilers require no coal shovelling, have simple start and shut down procedures, and existing boilers can be converted to the fuel relatively easily with no specialised storage tanks required due to the high flashpoint of used oil. The only cited drawback is that the quality of used oils procured can vary significantly, leading to clogged fuel lines and significant ash residue. If boilers have sufficiently sized fuel lines and regular maintenance, severe malfunction is understood to be avoidable.

Figure 15: Waterfall charts showing current and forecast supply make up of used oil combusted as fuel in New Zealand



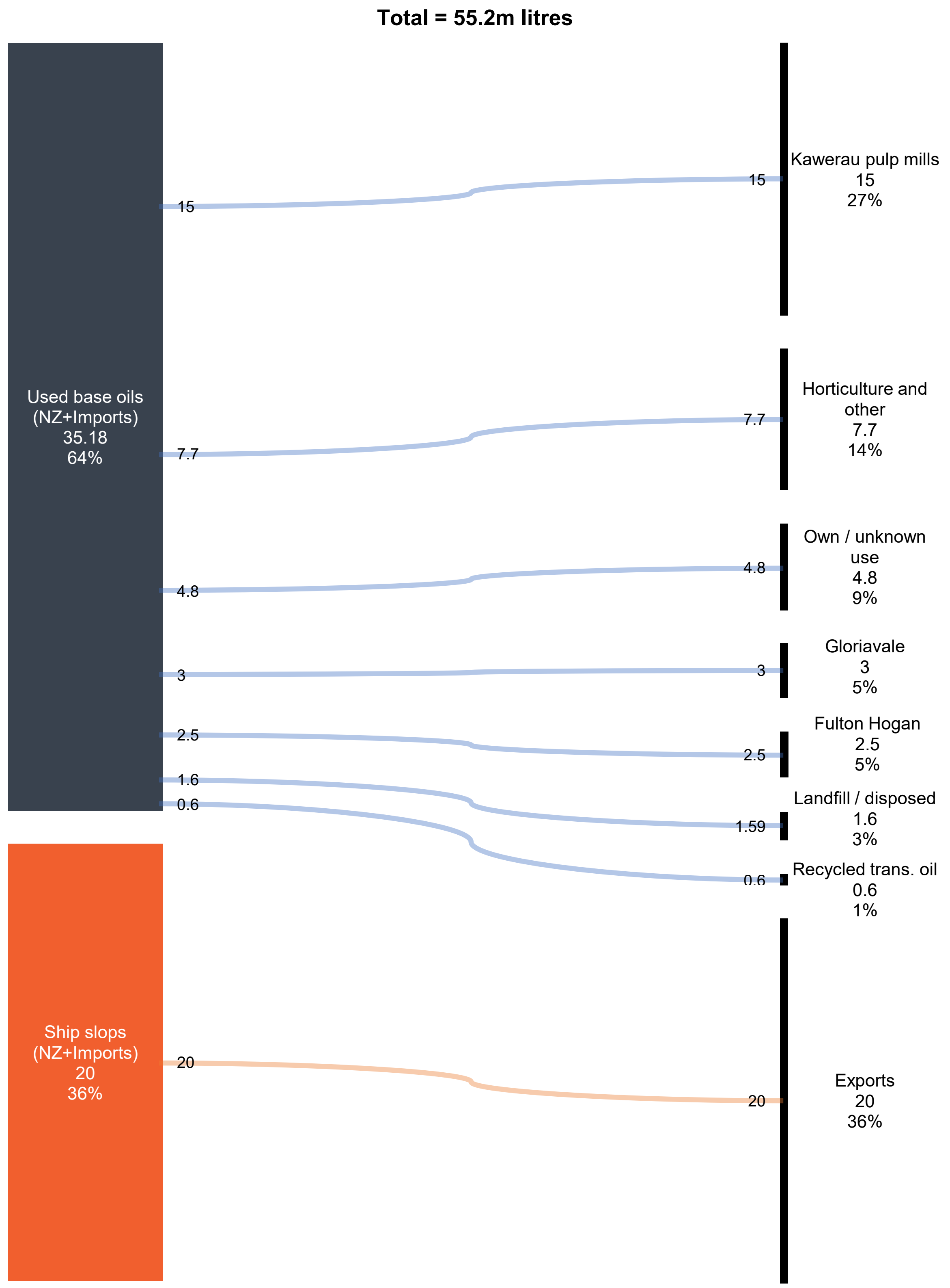
Source: Enerlytica
Note: "Onsite / unknown use" and "Potential onsite use" refer to the same exact volumes. It is portrayed twice to reflect the fact it escapes the collection supply chain but still contributes to the supply of used oil as a fuel

Notable from our discussions with horticulturalists is that the capture of CO_2 from boilers to improve greenhouse yields appears to be limited to only the largest of greenhouses which are more likely to use natural gas as a fuel than used oil or coal.

Also notable regarding demand from vineyards, orchards and greenhouses is that demand for used oil as a fuel will vary significantly with weather conditions. For example, summers and warm winters will reduce demand for used oil fuel with the result that stocks of used oil in the country can build to the point that used oils are exported, mainly to South Asia. In such circumstances the used oil is exported in bullet tanks or bladder tanks inside ISO containers. While such exports are more common in summer, they are also described as relatively sporadic and exact numbers are difficult to ascertain given these exports do not appear to be classified as used or waste oil in customs data. As such, they may fall under exports for fuel oils however the only full year of data for them contains data during the period that Marsden Point refinery was operating and so it is difficult to distinguish volumes even though, given differences in quality, the fuel streams are likely kept separate.

Our discussions with collectors and boiler engineers suggest that significant growth in demand for used oil as a fuel is not currently expected. Boiler engineers note that used oil boiler installations and conversions were always a minority of their business and that wood pellet-based installations have been where growth has been centred over the last five years. While there is concern that the end of the Government Investment in Decarbonising Industry (GIDI) fund has reduced the incentive to continue further investing in wood pellet conversions, boiler engineers describe businesses as remaining conscious that there is always potential for carbon costs to be attached to used oils and many businesses are looking to "future-proof" their industrial heat requirements. It is also worth noting that what unites current demand centres for used oils is that they do not need to be particularly demanding towards fuel efficiency and fuel quality given their demand is for basic or ancillary heating requirements. Despite this, efforts are ongoing among used oil collectors and customers to ensure more consistent fuel quality (see section 5, below).

Figure 16: Sankey diagram showing estimated supply and demand sources of used oil and ship slops in New Zealand



Source: Enerlytica

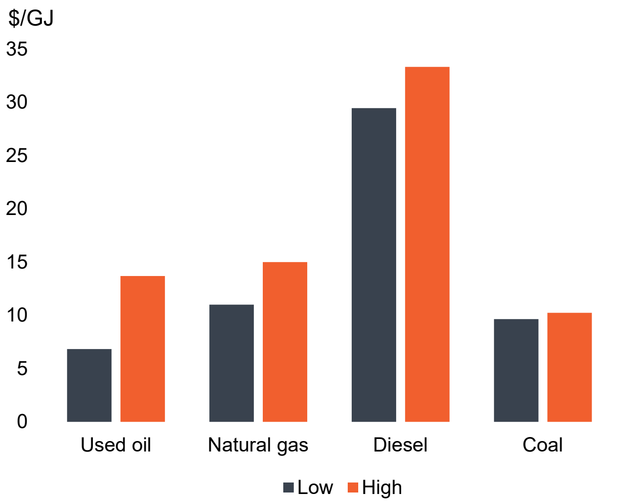
Outside of the sales of used oil collectors is an estimated 5 million litres pa of used base oil not recovered by used oil collectors but assumed to be consumed as fuel at their sources of production or associated sites. These combined sources of, and demand sinks for, used oil are typically outside established connection networks so that consuming used oil onsite saves costs in collection fees. Example sites include rural garages, rural councils and extractive industries such as mines. At such sites the used oil would serve to heat facilities over winter such as garages, mine accommodation and, in one example, council swimming pools. While these sites are unlikely to de-water and filter oils themselves the latest heaters and boilers capable of burning used oils come with their own filters that can filter out solids as small as 100 microns and have drains on the bottom of their tanks that allow for water and sludges to be removed manually from the fuel prior to entering the burner. These modern boilers also use atomisers to allow for more complete combustion of the oils, resulting in higher efficiency and little smoke than has been the case traditionally.

Accounting for in-country recovered used oils, imported used oils and used oils consumed onsite, we estimate 1.2 PJ pa of used oils is used as fuel in New Zealand. We expect this volume to decline to 0.5 PJ by 2050. We note that this demand is particularly concentrated, with the Kawerau pulp mills accounting for close to 50% of demand. Should the mills switch fuel or close then we expect one of two outcomes. The first and likely immediate short-term effect is that the 15 million litres pa of locally available used oil will likely be exported. The second potential outcome is a demand-side response by other industries to take up this readily available fuel. This is what happened following the closure of the Cape Foulwind cement works in Westport, which we understand at one point consumed half of the country's used oil supply. As it gradually reduced its demand for used oil other industries such as the Kawerau pulp and paper mills increased their demand. Should something similar happen today, other large industrial energy users may step in to swap-in used oil to substitute for their current fuel supplies.

Pricing

Used oil prices, like with other commodities, appear to vary with contracted quantities, logistics costs and the price of alternative fuels such as fuel oil and some forms of diesel that some customers can switch to. Our discussions with industry suggest current prices to be as low as $0.25 per litre for large contract quantities and as high as $0.50 per litre for smaller quantities, but with most sales falling within a range of $0.30 to $0.40 per litre. Compared to the current range of industrial natural gas, diesel futures and coal futures prices, used oil prices are at or near the bottom on a $/GJ cost base, excluding carbon costs.

Figure 17: Commodity costs of used oil vs other fuels



Note: Natural gas prices are based on Enerlytica estimates for industrial gas prices noting it is presently a particularly tight market, diesel prices are based on the current range in the 1-year futures curve for Southeast Asian diesel with $0.20 per litre added to reflect shipping costs to New Zealand, and coal prices are based on the 1-year futures curve for Newcastle coal.
Source: Industry sources, MBIE, LSEG, Enerlytica

4.2 Used cooking oils

Demand

Although exports of UCO do not appear in Stats NZ data, discussions with industry suggest that the vast majority of UCO collected in New Zealand is exported. Exact numbers of domestic demand for UCO are therefore difficult to source or estimate. Southern Biofuels, based in Canterbury, is one of the few collectors that is specifically converting UCO into a fuel for the New Zealand market and is estimated to deliver around 1 million litres pa, however demand for UCO fuel is described as coming from a minority of businesses that go out of their way to meet low emissions standards and for whom "green marketing" is important. It is noted as well that some UCO is known to be used as fuel by some of the collectors themselves to power their processing plants although exact quantities are unknown.

Of UCO exports, it is understood that exports have historically been directed mostly to Southeast Asia, with Singapore, Malaysia, Thailand the major destinations. We note however that recent UCO research out of the US suggests that New Zealand began exporting UCO to the US in 2022 with more volumes forecast. Demand for UCO and biofuels has accelerated under US President Biden's Inflation Reduction Act which provides strong incentives for low carbon fuels. Exact numbers however are not readily available and those supplied in available sources appear unreliable given they suggest the US is importing UCO at many times the level that UCO appears to be produced in New Zealand.

Pricing

While used petroleum oil collectors will collect used oils for little to no cost depending on the location of collection, UCO collectors will pay suppliers for the right to collect their UCO. For low volume suppliers the prices offered are circa $0.40 per litre but large restaurant chains can expect prices up to $0.80 per litre for the right to collect all their volumes if they agree to multi-year contracts. This is consistent with offered prices for raw UCO from Asia which are thought to sit at US$250-300 per tonne.

International prices for processed UCO vary but discussions with industry and our research suggests pricing as currently at around $1.80 per litre, or US$920 per tonne. This implies that, even before full conversion to biofuel, UCO is significantly more expensive than diesel whose current wholesale import costs are around $1.20 per litre. Even with ETS charges and taxes added (with the exception of GST), diesel remains cheaper at around $1.70 per litre and it would be expected that UCO and biofuels would retain their “green premium” over diesel should diesel prices rise.

5. ENVIRONMENTAL IMPACTS OF USED PETROLEUM OILS AND REGULATORY CONCERNS

5.1 Environmental impacts of used petroleum oils

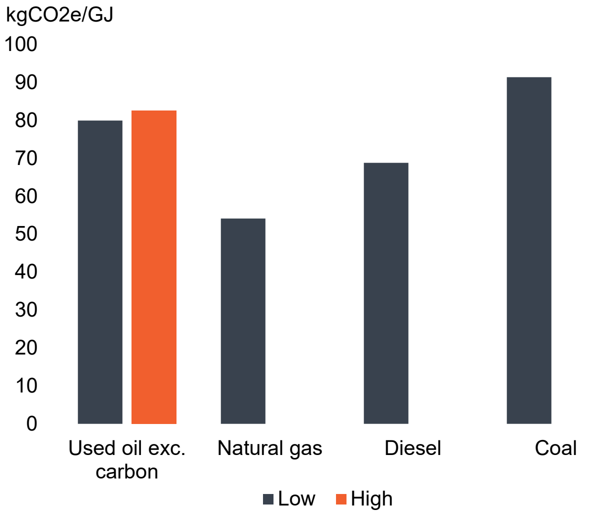
Environmental impacts of used oils arise from their combustion and disposal into the environment, both legal (landfill) and illegal. Disposal of used oil into the environment is universally seen as the least desirable outcome, particularly if occurring outside of landfill, as the oils are difficult to clean and can have immediate, long-lasting and potentially fatal impacts on plant and wildlife. As such, regulators in many jurisdictions around the world see the conversion of used oils into fuels as helpful towards avoiding illegal discharges and do not discourage the sector given that removing the need of lubricants and hydraulic oils is not a feasible alternative. Noting the risk of potential discharges into the environment in the event of a road accident with a used oil collection tanker, it has been suggested that the combustion of used oil onsite at locations such as mechanics' garages as also helpful for the environment and reduce emissions from used oil collection.

Despite these benefits versus the alternative of disposal, the combustion of used oils results in the release of various pollutants including sulphur dioxides, nitrogen oxides, particulates, metals and carbon dioxide which can affect air quality. Proponents of used oil as a fuel point to evidence that these emissions are significantly reduced by the latest burner technology which, through using very fine filters and fuel atomizers (as opposed to vaporisers), enable very complete combustion which reduces nitrogen oxide, particulates and metals emissions while improving fuel efficiency. In addition, wider initiatives to reduce sulphur in refined oil products (see references to the IMO in the previous section) have also resulted in reduced sulphur dioxide emissions. Proponents of used oil as a fuel note however that some education of potential customers and local councils remains. Councils provide the air discharge permits for the combustion of used oils and it has been stated they retain their perceptions of previous burning technologies which indeed created high quantities of soot.

What remains an issue with using used oil as a fuel is its carbon emissions which rank second only to coal even at the bottom end of their range. We estimate that used oil emissions in New Zealand currently total between 96,000 to 100,000 tCO_2e per annum. Our forecast of used oil availability in New Zealand suggest this will fall to between 38,000 to 40,000 tCO_2e with the range reflecting the differences in quality that can be derived from used oils.

Assuming current consumers of used oil can be switched to cleaner burning alternatives, the emissions of combusting used petroleum oils can be at least partially avoided by recycling used oils back into base oil products, particularly if renewable energy is used to power the process. In addition, by displacing base oils derived from the refining of crude oil, re-refining used oils back into base oil stock reduces emissions from crude oil production, logistics and refining.

Figure 18: Comparison of used oil carbon dioxide emissions per GJ versus other popular fuels

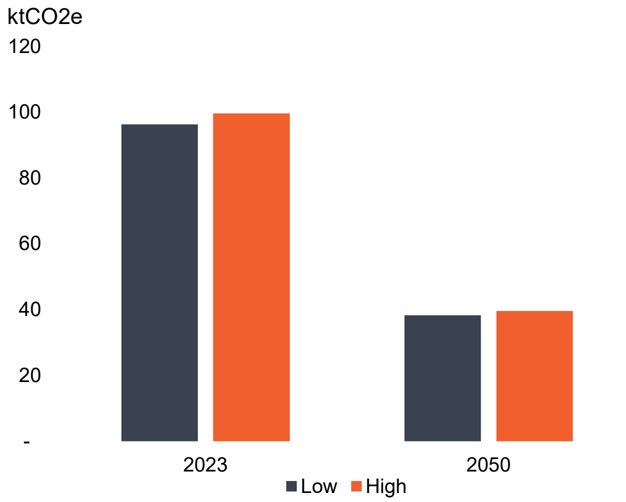


Note: Emissions factors are from the MFE.
Source: Industry sources, MBIE, LSEG, Enerlytica

According to a US Department of Energy review of studies into used oils, exact emissions savings from used oil re-refining's reduction of virgin crude oil demand and from avoiding combustion can vary greatly depending on refining processes and energy inputs used given some re-refining processes may use more electricity or heat than virgin petroleum oil refining.

Regarding emissions savings from avoiding virgin crude oil production, one study reviewed suggested the lifecycle carbon footprint of continuously re-refining base oils, which has potential to provide over seven units of use for every one unit of virgin crude oil input over its lifetime, is over 80% lower than refining the additional six units of virgin crude oils that otherwise would be required to meet supply. We note however the reviewers of the study suggested the extent of re-refining assumed is likely optimistic and that any savings will vary with the source of energy inputs for the re-refining process.

Figure 19: Estimated annual carbon dioxide emissions in New Zealand of used oil combustion in 2023 vs 2050 forecast



Note: Given variation in qualities of used oils their carbon emissions can vary and both the low and high range are seen here.
Source: Industry sources, MBIE, LSEG, Enerlytica

The emissions savings from avoiding combustion of used oils by re-refining back into base oil products is suggested to save between 0.1 and 0.5 tonnes of CO_2e for each tonne of used oil recycled, however re-refining used oils into other fuel varieties also led to emissions savings, albeit lower. It should also be noted that combusting used oils also saves emissions by reducing demand for virgin crude oils and the associated emissions of oil production and each tonne of used oil combusted is estimated to save around 0.2 tonnes of CO_2e compared to if it were simply disposed of.

Around 25% of used oils collected worldwide are re-refined back into base oils, supplying 8% of base oil stock globally, however this total likely varies with oil prices. High oil prices will encourage re-refining and discourage it when prices are soft. The highest level of re-refining occurs in countries where it is supported by subsidies or other legislative means, such as Western Europe and Brazil. Brazil bans combustion of used oil while countries such as Italy and Spain subsidise used oil re-refining, as does Australia. To avoid the impact of oil prices on incentives to re-refine used oil back to base oils, European subsidies are indexed to oil prices to ensure refiners are not overly rewarded.

5.2 Used oil regulations

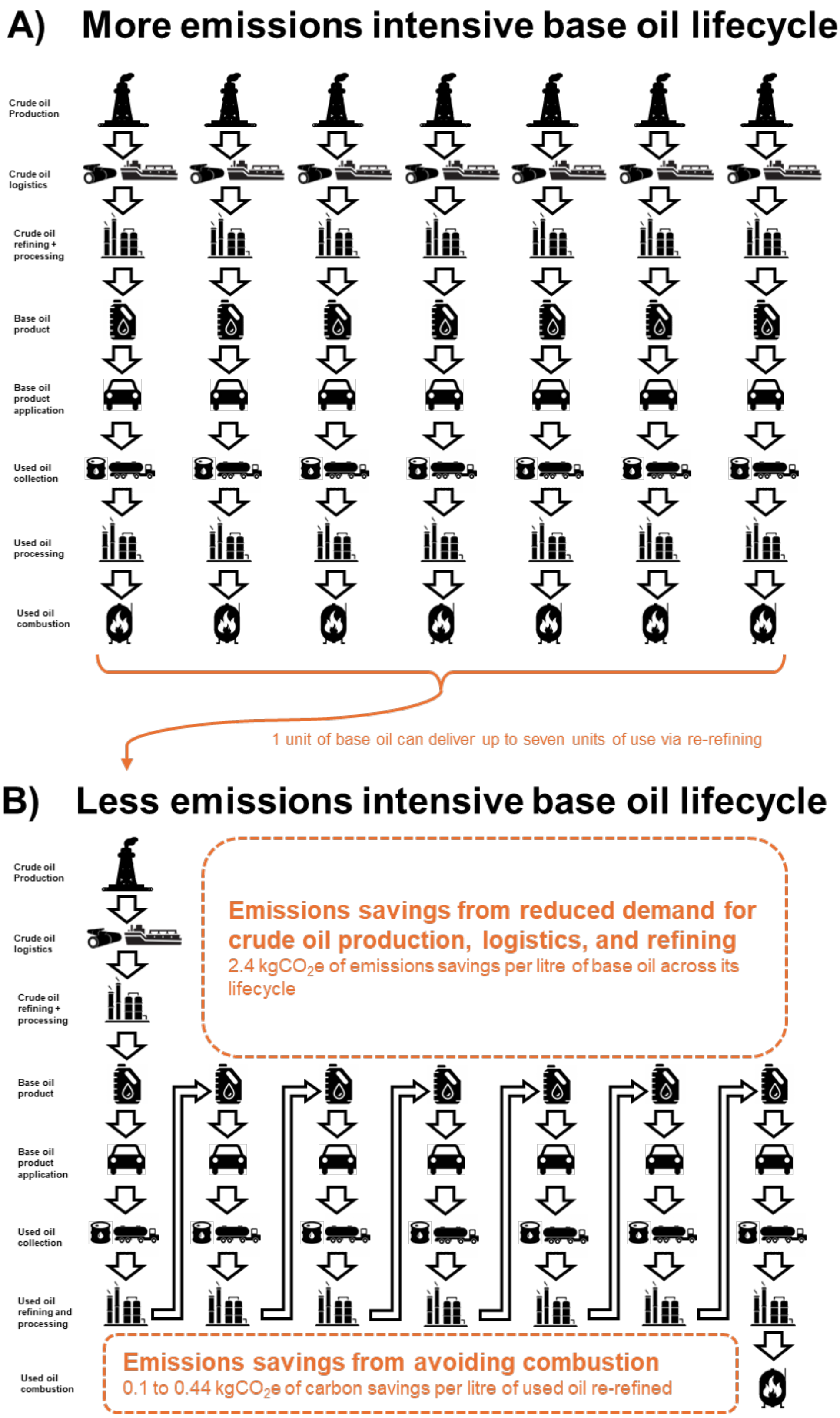
Regulation of the used oil market largely involves:

1. Regulation of the storage, handling, and quality of used oil which falls into the Hazardous Substances and New Organisms (HSNO) Act and the oversight of both the Environmental Protection Authority (EPA) and Worksafe.
2. Regulations on the combustion of used oil as a fuel as authorised under local council air discharge permits.
3. Regulations on the emissions on used oil as a fuel as per possible expansion of the Emissions Trading Scheme (ETS).

Currently, significant focus and attention is being directed towards the storage and handling of used oil, particularly by Worksafe. This follows a major health and safety incident in 2015 when the welding repair of a storage tank led to an explosion and a fatality. The mixing of volatile fuels with oils inside the storage tank is understood to have contributed to the severity of the incident. While used oil collectors will test and refuse collection of batches of used oil that have been mixed with diesel and petrol there is concern among the regulators that ensuring no mixing is difficult and that, to avoid further incidents, all collections, storage, and handling of used oil must be done in accordance with those of more volatile fuels such as gasoline or diesel.

This has significant implications for both collectors and users of used oil. Assuming it has not been contaminated with volatile fuels, used oils have a flash point above 60°C which enables them to be kept in unsophisticated and readily available storage tanks. Putting the handling of used oils in line with standards for gasoline and diesel requires that used oil collectors and their customers undertake major upgrades on their facilities which could include keeping storage tanks at safe distances from buildings, providing secondary containment in case of a spill and upgrading the tanks themselves to contain vapours and prevent mixing with oxygen. Some used oil collectors themselves say that any suggestion to impose similar requirements on used oil customers can be avoided by increasing vigilance on the quality of used oils supplied. This responsibility currently lies with the Environmental Protection Authority however it is understood that a consistent and widespread testing regime is currently not planned.

Figure 20: Diagram of emissions savings from re-refining oil versus combusting it and requiring virgin crude oil create new supply of base oil products



Source: Enerlytica, Grice et al and Geyer et al as cited by the US Department of Energy report to Congress on Used Oil Management and Beneficial Reuse Options

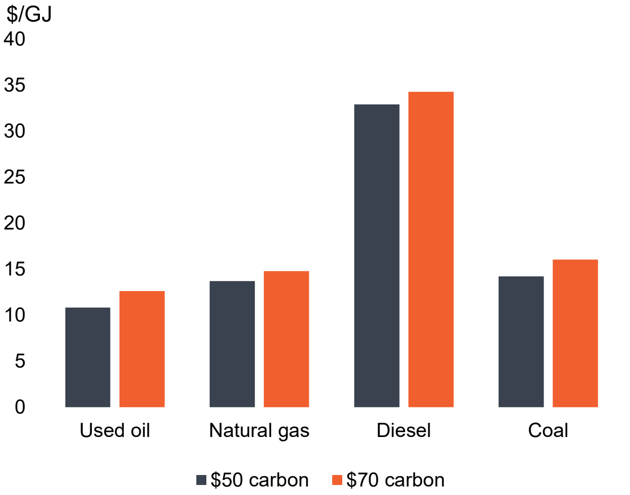
While used oil sellers and burners note that air quality emissions of used oil burners attract the attention of local councils, the capability of modern burners mean that threats to air quality are less of a concern. Instead, attention is increasingly being drawn to whether used oil will fall under the remit of the ETS. If carbon costs are added and using commodity costs shown, the full costs of used oil then fall into line with those of natural gas and coal.

This increase in costs would likely need to be borne entirely by used oil customers rather than collectors, reflecting not only that it is customers burning the fuel and releasing carbon, but also that there is little room for used oil prices to fall further noting that, when an average sales price of $0.35 per litre is assumed, all sales of used oil in New Zealand, excluding ship slops, total around $10m. This revenue total may not leave sufficient room for operating margins to remain economically viable after considering the capital and operating costs of collecting and processing used oil.

Should carbon costs be imposed and the all-in price of processed used oils rise significantly, established used oil consumers could shift away to other fuels. If no export market is subsequently found, which is more possible in a low crude oil price environment, then used oil collectors may have to charge suppliers collection fees. Sources of used oil may then opt to simply burn used oil themselves or, potentially, dispose of it into the environment. As such, emissions may not necessarily reduce unless the sources of used oil can be effectively monitored and included in the ETS. Ensuring the effectiveness of a carbon cost imposition to reduce emissions may require additional administration and incentives such as a stewardship scheme which charges buyers of base oil products and then refunds them per litre of used oil returned.

We note that some used oil collectors we spoke with support the idea of such stewardship schemes, particularly if applied to support the re-refining of used oils back into base oils. The argument is that simply discouraging the consumption of used oil as a fuel in New Zealand will merely lead to it being exported and combusted elsewhere. Given New Zealand's relatively low carbon intensity energy mix, it should be possible to re-refine used oils at low carbon intensities. This will not only reduce emissions but would also help reduce New Zealand's trade deficit and improve its balance of payments.

Figure 21: Commodity costs including carbon of used oil and other comparable fuels



Note: Natural gas commodity prices are based on Enerlytica estimates for industrial gas prices noting it is presently a particularly tight market, diesel prices are based on the current range in the 1-year futures curve for Southeast Asian diesel with $0.20 per litre added to reflect shipping costs to New Zealand, and coal prices are based on the 1 year futures curve for Newcastle coal.
Source: Enerlytica

6. OBSERVATIONS ON USED OIL SUPPLY AND EMISSIONS

In considering how to approach the use of waste oil as a fuel, EECA's statutory objective "*to encourage, promote, and support energy efficiency, energy conservation, and the use of renewable sources of energy*" presents it with several dilemmas. Perhaps the most fundamental of those is that while increasing the uptake of used oil would serve some environmental and trade benefits by displacing further liquid fuel imports, used oil remains a carbon-intensive fuel for which cleaner burning alternatives are widely available, even if those alternatives are more expensive.

In addressing this dilemma we expect that policy positioning will need to be considered in a number of areas. Those areas include:

1. Balancing environmental concerns
2. Emissions leakage
3. Industrial competitiveness
4. Improving used oil fuel use efficiency

Balancing environmental concerns

The primary environmental concern involved with producing and managing used oil in New Zealand is to prevent it from being discarded illegally into the environment. The important role that the existing chain of used oil collectors, consumers and boiler suppliers play in managing the collection of used oil volumes and creating a valuable commodity out of it should therefore be acknowledged.

In addition, it should be understood that interventions that discourage the combustion of used oil as an industrial fuel in New Zealand in favour of encouraging cleaner burning alternatives to support emissions reduction could impact the economics of collecting used oil, which is a service that is provided for free to many used oil sources. This would particularly be the case if international oil and refined product prices are low as this would erode the export market and price for used oils, which is the alternative sink for used oil volumes in New Zealand when the domestic market is fully supplied. To cover their costs under these circumstances used oil collectors may need to start charging providers of used oil to collect product from them. Those providers are both numerous and difficult to monitor and it is possible that to avoid incurring costs these sources could instead look to dispose of used oil by other means including illegally or burn the used oil themselves for more inefficient and less productive purposes such as space heating.

A similar outcome could result if other external costs are applied to use cases for used oil including if it was to be included in New Zealand's ETS. Penalising the uptake of used oil could feasibly increase New Zealand's gross emissions if users instead opt for cheaper but higher emission alternatives.

Emissions leakage

If efforts to discourage used oil combustion in New Zealand result in more used oil being exported this could increase global emissions associated with used oil as the exported used oil is ultimately still likely to be combusted but the emissions of transporting the used oil abroad will be added. It could also be argued that exporting used oil is exporting or outsourcing New Zealand's emissions footprint. While it is possible for used oil exports to reduce gross emissions associated with used oil globally, particularly if used oil is replaced with lower emissions sources of energy here in New Zealand and the exported used oil replaces coal abroad, any net benefit would be difficult to measure and would likely fall short of the wider ambition of global emissions reduction targets.

Industrial competitiveness

By shifting local industrial consumers away from used oil and encouraging the export of it, local industry could potentially be helping foreign competitors also using used oil by increasing its availability and, therefore, reducing its cost. An international, coordinated response to used oil combustion could be a means to address this but would be difficult and time consuming to enact.

Furthermore, some segments of industrial used oil demand, such as the horticultural sector, are described as being particularly cost sensitive by their fuel and engineering service providers. For such consumers used oil may be the only fuel under which they can profitably operate. Attaching a ETS cost to used oil could therefore weaken the viability of these industrial consumers unless they are able to seek relief as a emissions intensive and trade exposed (EITE) business or access funding to undertake the capital work required to change to lower emissions alternatives.

Improving used oil fuel use efficiency

Given the complications outlined above, the reality that used oil combustion only accounts for 0.1% of New Zealand's annual emissions of 70 million tCO_2e pa, and that emissions from used oil combustion are likely to decline in line with our forecast 60% decrease in the domestic supply of used oil by 2050, the administrative cost and effort that would be required to effectively manage emissions produced by used oil combustion while avoiding unintended consequences could exceed the potential benefits. That said, there are actions that can help improve energy efficiency of used oil combustion.

For example, we estimated that 4.8 million litres of used oil are assumed to be combusted at source or used as low grade lubricant each year. Some of this is burned as fuel for space heating in place of heat pumps which are lower emission and are better suited to this purpose. Encouraging and enabling this used oil to be collected, processed, and sold to industrial consumers would improve the value add of used oil combustion and reduce emissions per unit of industrial output and potentially gross emissions if the additional used oil volumes available are serving to displace inferior alternatives such as coal. Enforcing and standardising used oil quality requirements, particularly its water and ash content, would also likely go some way towards improving combustion emissions and therefore reducing emissions per unit of industrial output.

Finally, there may also be merit in investigating the potential for further re-refining of used oils in New Zealand, particularly transformer oils, the demand for which we expect to nearly double as New Zealand's economy electrifies. As the re-refining of transformer oils already occurs in New Zealand the in-country expertise already exists and its link with electrification provides a strong fit with EECA's electrification work programme. The potential for including re-refining of used oils from the automotive and industrial sectors should not be excluded, however, given automotive used oil volumes look set to decline with increasing EV penetration, there is an argument that from a long-term planning perspective current volumes of used automotive oils should be given secondary priority. Regardless, we note that many industry members we spoke with expressed eagerness to liaise with EECA and discuss their own ideas for initiatives that could help reduce emissions while creating a valuable market for used oils.

APPENDIX

Assumptions on forecasting used oil supply from the automotive transport sector

To develop a forecast for the demand of lubricants and hydraulic oils for the automotive transport, data from the New Zealand Transport Authority (NZTA) on the composition of the New Zealand vehicle fleet up to 2022 was used with 2023 data filled in from quarterly data provided through the year. The NZTA data differentiates between light fleet vehicles, trucks, motorcycles, buses and EVs, and provides estimates for the total number of vehicles and total kilometres driven throughout the year. This enables estimates of lubricants and hydraulic oil demand to be applied to each vehicle class according to average annual mileage.

For each vehicle class (light, motorcycles, trucks, buses) and drivetrain type (ICE and EV), the volume of lubricants and hydraulic oils required for each change and the frequency of changes (as applied to annual distances driven) was based on the below range of assumptions in figure 18 derived from a range of manufacturer and mechanic guidance. The average annual mileage for each vehicle class into the future was estimated by continuing the long-term trends shown in the historical data which suggests a reduction in annual mileage by a rate of 1.2% for light vehicles, 1.9% for motorcycles, 0.7% for trucks, and 1.5% for buses. These assumptions were then applied to projections of total annual fleet size which were estimated as below.

Figure 22: Table of assumptions on automotive fluid change frequencies and volumes

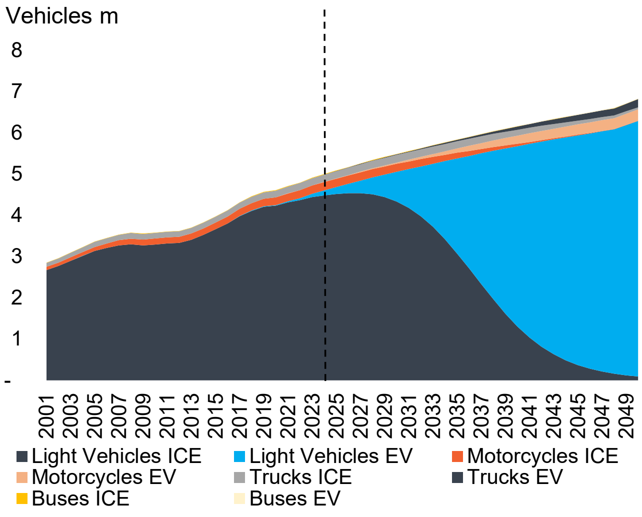
		Light ICE vehicle	Light EV	ICE Motorcycles	EV Motorcycles	ICE Trucks	EV Trucks	ICE Buses	EV Buses
Distance driven between each fluid change, km	Engine oil	8,000	NA	8,000	NA	20,000	NA	20,000	NA
	Trans. oil	75,000	NA	NA	NA	60000	NA	60,000	NA
	Brake fluid	50,000	50,000	10,000	20,000	50,000	50,000	50,000	50,000
Low case quantities for fluid change, litres	Engine oil	4	NA	1.5	NA	15	NA	15	NA
	Trans. oil	9	NA	NA	NA	15	NA	20	NA
	Brake fluid	1	1	0.2	0.2	2	2	2	2
High case quantities for fluid change, litres	Engine oil	6	NA	2.5	NA	30	NA	25	NA
	Trans. oil	12	NA	NA	NA	25	NA	40	NA
	Brake fluid	2	2	0.4	0.4	4	4	4	4

Source: Enerlytica

Total vehicle fleet size projections assume that the rate of fleet size growth would be the same as population growth with the ratio of the total number of vehicles to the total population size remaining stable at 0.93 vehicles per person. The forecast population growth is derived from Stats NZ's 2020 population projections with the highest population growth projection, which estimates New Zealand will have a population of 7.3 million people by 2050, used. This is because data from 2021 to present trends towards the top end of Stats NZ's projection ranges. With the fleet sizes estimated to 2050, the rate of EV penetration within each class of vehicle (light, motorcycle, trucks, buses) is based on fitting an S-curve formula that meets a target level of EV penetration by 2050, when net zero targets are due to be met. For light vehicles and motorcycles, the target is for 99% of vehicles to be EVs. This reduces to 95% for buses and 80% for trucks on account of the fact EV technology may struggle to penetrate some vehicle applications such as those for trucks hauling heavy loads over long distances.

It should be noted that our assumptions and projections do not take into account the major uncertainty and potential of networked autonomous vehicles. Although still in their early growth stages and limited by regulatory restrictions on their deployment, such vehicles could reduce the total vehicle fleet by economically optimising fleet utilisation and their progress would likely mirror the rapid improvements we are seeing in other areas of artificial intelligence. As such, our assumed ratio of 0.93 vehicles per person, already quite high by global standards and having risen from 0.73 vehicles per person in 2002, could decline. However, if our assumed vehicles per person ratio is offset by our expectation that trends resulting in declining annual mileage will continue.

Figure 23: NZ vehicle fleet growth by class (light, motorcycles, trucks, buses) and powertrain (ICE and EVs)

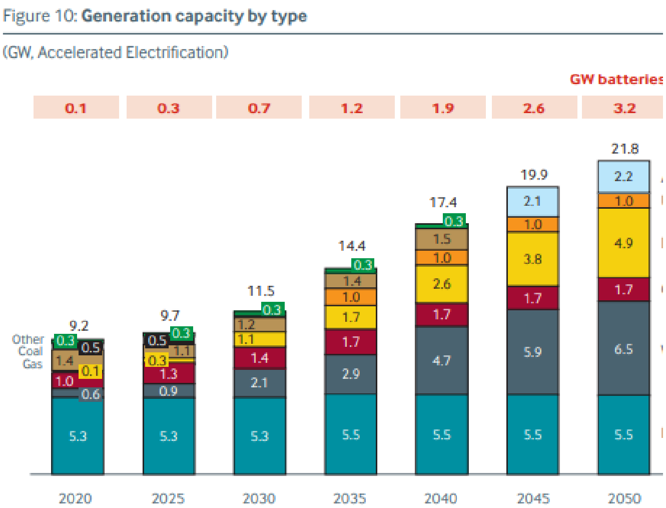


Source: Enerlytica

Assumptions on forecasting used oil supply from the transformer oil sector

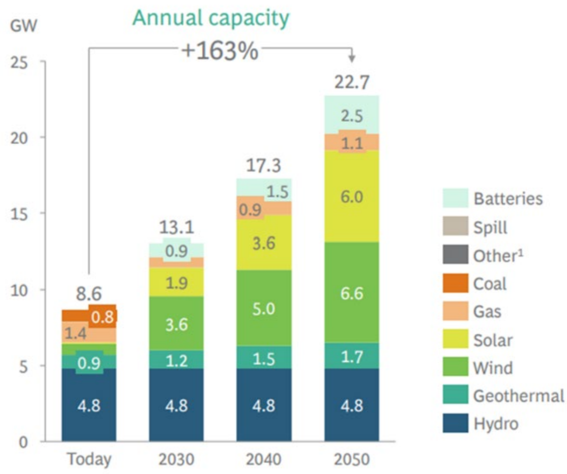
Transformer oil usage will grow with increasing electrification of the economy and we assume that transformer oil demand will grow in line with electricity generation capacity. We have applied forecasts for electricity generation capacity from two sources: Transpower's 2020 Te Mauri Hiko Energy Futures paper and BCG's 2022 The Future is Electric paper. Transpower's paper estimates that installed generation capacity will grow from 9.2 GW in 2020 to 21.8 GW in 2050 with BCG's paper assuming growth from 8.6 GW to 22.7 GW across the same period (with differences in current generation capacity likely due to different treatments of cogeneration facilities). The growth rate across both papers is averaged and then applied to 2023 transformer oil demand to project imports of the oil to 2050. The current quantity of recycled transformer oil, estimated to be 600,000 litres pa, is then added on to this and assumed to be unchanged to 2050.

Figure 24: Transpower generation capacity forecast



Source: Transpower

Figure 25: BCG generation capacity forecast



Source: BCG

GLOSSARY

bbl	barrel, equal to 42 US gallons or 158.987 litres
Brent crude	a major oil marker price for sweet light crude oil and the leading global price benchmark for Atlantic basin crude oils. Almost 70% of the world's internationally traded crude, including most New Zealand crude, is priced against a Brent crude benchmark.
CAGR	compound annual growth rate
CO_2	carbon dioxide
crude	see *oil*
GIDI	Government Investment in Decarbonising Industry fund
GJ	gigajoule (10^9 joules)
GWh	gigawatt hour
hydrocarbons	an organic compound consisting entirely of hydrogen and carbon, the majority of natural variations of which occur in crude oil
IMO	International Maritime Organization
JV	joint venture
$kgCO_2e$	Kilograms of carbon dioxide equivalent, a measure of the global warming potential of greenhouse gas emissions as compared to a kilogram of carbon dioxide
km^2	square kilometres
kt	thousand tonnes
ktpa	thousand tonnes per annum
kWh	kilowatt hour
LNG	liquefied natural gas
LPG	liquefied petroleum gas, being mainly propane (C_3) or butane (C_4) or a mixture of both
LRMC	long run marginal cost
m	million
MBIE	Ministry of Business, Innovation and Employment
methanol	methyl alcohol (CH_3OH), a colourless liquid produced from natural gas and is the raw material for many chemicals, formaldehyde, dimethyl terephthalate
mt	million tonnes
mtpa	million tonnes per annum
MW	megawatt (10^6 watts)
natural gas	a term most commonly used to describe gas that meets specification standards to be injected into a pipeline for reticulation to end users. In New Zealand, the specification for reticulated natural gas is set out in national standard NZS 5442
NPV	net present value
oil	a generic term to describe oil products in various forms including crude oil, condensate and naphtha. In this report the term *oil* is used interchangeably with *condensate* and *crude*
opex	operating expenditure
pa	per annum
PJ	petajoule (10^{15} joules)
PJe	petajoules-equivalent
PPA	power purchase agreement
SRMC	short run marginal cost
T	tonnes
TJ	terajoule (10^{12} joules)
TJe	terajoules-equivalent
tpa	tonnes per annum
tpd	tonnes per day
US$	United States dollars

CONVERSIONS

OIL

1 mmbbl of crude equals	6.29	million m^3
	178.08	bcf
	1.00	mmboe
	0.15	mtoe
1 PJ of crude equals	21.27	kt
1 tonne of crude equals	6.85	bbl

USED OIL

1 litre of used oil equals	0.87	kg
	36.5	MJ
1 tonne of used oil equals	42	GJ
1 PJ of used oil equals	27.4	million litres

GAS

1 PJ of gas equals	0.16	mmboe
	38.81	million m^3
	0.91	bcf
	947.82	billion btu
1 btu of gas equals	1.055	KJ

LNG

1 tonne of LNG equals	13.8	bbl
	2.2	m^3
	55	GJ
	9	boe

LPG

1 tonne of LPG equals	11.78	bbl
	1.87	m^3
	49.7	GJ
	8.15	boe

VOLUME

1 cubic metre equals	35.31	ft^3
1 barrel of oil equals	0.16	m^3
	5.61	ft^3
	159	litres

enerlytica