MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Ministry of Transport
TE MANATŪ WAKA

Increasing the use of biofuels in transport: consultation paper on the Sustainable Biofuels Mandate

CONSULTATION PAPER

13 June 2021

New Zealand Government

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Ministerial Foreword

New Zealanders alive today face the strong likelihood that during their lives they will experience the catastrophic effects of climate change. The Government is committed to preventing this and has prioritised action on climate change.

Last term, the Government put in place the institutional framework to address climate change. This framework sets the legally binding requirement to limit global warming to 1.5 degrees above pre-industrial levels. This requirement will be met through 5-yearly emissions budgets and reduction plans that work to keep our emissions within those budgets.

This term, on 2 December 2020, Parliament formally acknowledged the severity of the climate crisis by declaring a climate change emergency.

Our focus now is on getting the first emissions reduction plan in place with strong effective policies that we can be confident will tackle the climate emergency.

Action in transport is already underway to switch New Zealand's light vehicle fleet to electric. We are also making it easier for New Zealanders to choose low carbon transport by increasing investment in public transport and walking and cycling. However, getting people to switch to electric vehicles and low-emission modes is only part of the change needed to combat climate change.

We need to lower the emissions of the conventional vehicles in our fleet because they have relatively high emissions and each one is likely to be driven until it is 20 years old. We also need low carbon solutions for heavy road freight, aviation and shipping.

Sustainable biofuels are a practical low-carbon solution for these areas of transport.

However, globally the experience is that unless government intervenes in the fuel market the entrenched advantages of fossil fuels prevent any significant deployment of biofuels. New Zealand is testament to this. Our use of biofuels is extremely low by international standards, and last year saw Z Energy hibernate its Wiri biodiesel plant and Gull stop its biodiesel imports.

Internationally, biofuels mandates are the most successful way to overcome the market advantages fossil fuels have. Their effectiveness in increasing the uptake of biofuels and reducing transport emissions[1] is why they are in place in 68 countries[2]. New Zealand is very much out-of-step in not intervening to realise the biofuels opportunity.

Nevertheless, the silver lining in being out-of-step in mandating biofuels is that we can learn from other countries' experiences. Mandates around the world, particularly in Europe, the United States and Canada have been refined over time.

By drawing on international best practice we can design and implement an effective mandate of our own; adding to our arsenal of low-carbon solutions to decarbonise transport.

If biofuels are locally produced they will facilitate low-carbon growth and employment creation that will help future-proof our economy. Domestic biofuels would also reduce our reliance on imported fuel, and would create new value streams for waste products.

The Sustainable Biofuels Mandate outlined in this paper builds on and improves the 2008 Biofuels Sales Obligation. If the fifth National Government had not repealed this 2008 mandate, by 2020 we could have avoided around 6 million tonnes of CO_2 emissions.

1 IEA Bioenergy Task 39 – Implementation Agendas – 2018 Update
2 International Energy Agency

Biofuels have great potential and we are keen to see their increased use in transport as soon as possible. We invite you to engage with the proposed Sustainable Biofuels Mandate. We want to work with you to make it as effective as possible.

Hon Dr Megan Woods
Minister of Energy and Resources

Hon Michael Wood
Minister of Transport

Contents

Make your view heard

We want to know what you think about the proposed Sustainable Biofuels mandate. To make your view heard, you can respond to our consultation questions by going to www.mbie.govt.nz/have-your-say.

Or you can write your response to the consultation questions and email the pdf or word document to energymarkets@mbie.govt.nz.

Submissions close at 5pm on Monday 26 July 2021.

The detail of the proposed Sustainable Biofuels Mandate is outlined in Part 3 of this document. Part 3A outlines the key elements of the Mandate. Part 3B has more information about how the Mandate would be implemented. You are welcome to provide feedback on both sections.

Part 1: Reducing transport emissions is a priority

We have to largely decarbonise transport if we are to meet our climate change commitments

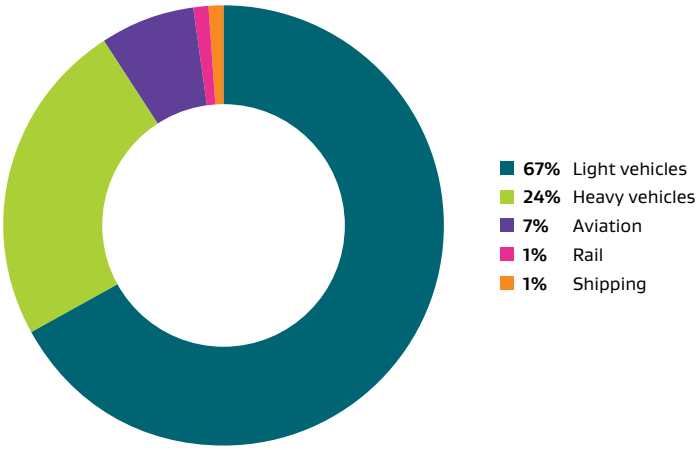
Transport contributes over 21 percent of gross domestic greenhouse gas (GHG) emissions. About 48 percent of our emissions come from agriculture, 19 percent from other energy use, 7 percent from industrial processes and 5 percent from waste.

Globally, reducing carbon dioxide (CO_2) emissions to net-zero is the highest priority among the GHG gases because it stays in the atmosphere for hundreds of years. This priority is reflected in the Climate Change Response Act's two split gas targets. The targets require emissions of:

- biogenic methane to reduce to at least 10 percent below 2017 levels by 2030 and to at least 24–47 percent by 2050
- CO_2 emissions and other greenhouse gases[3] to reach net zero by 2050.

The second target applies to transport. GHG emissions from transport are nearly all CO_2, and transport accounts for 47 percent of New Zealand's domestic CO_2 emissions. This substantial share means New Zealand cannot achieve its 2050 CO_2 target without largely decarbonising transport.

Road transport is the largest source of domestic transport emissions



Around two-thirds of domestic transport emissions come from the cars, SUVs, utes and vans we drive.

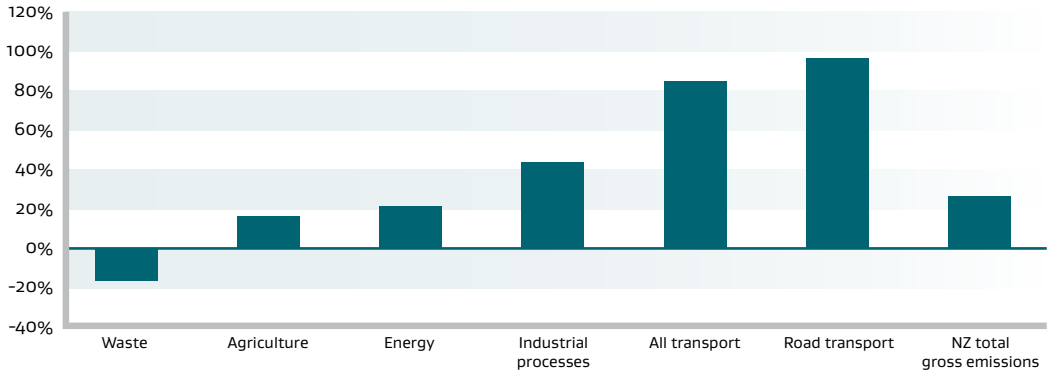
Heavy road vehicles are responsible for around a quarter of transport emissions, even though they only do 6 percent of the annual road vehicle kilometres travelled. Their disproportionate emissions profile reflects that the heavier a vehicle, the more energy it takes to move.

Aviation is the other significant emitting sector in transport. It produces 7 percent of domestic transport emissions.

Shipping and rail account for the remaining 2 percent of domestic transport emissions.

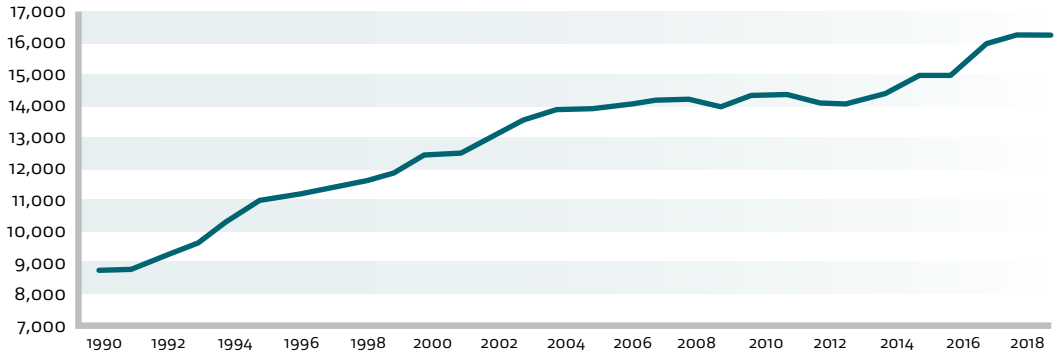
3 In 2018 gross greenhouse gas emissions were made up of 44.5% carbon dioxide, 43.5% methane 9.6% nitrous oxide, and 2.4% fluorinated gases.

Percentage increase in emissions 1990–2019



Transport is New Zealand's fastest growing source of emissions

Transport emissions 1990–2019 (kilotonnes CO_2-e)



Emissions from transport are stubbornly high and continue to grow. This is despite transport being subject to the Emissions Trading Scheme, and the significant investments in public transport and walking and cycling infrastructure.

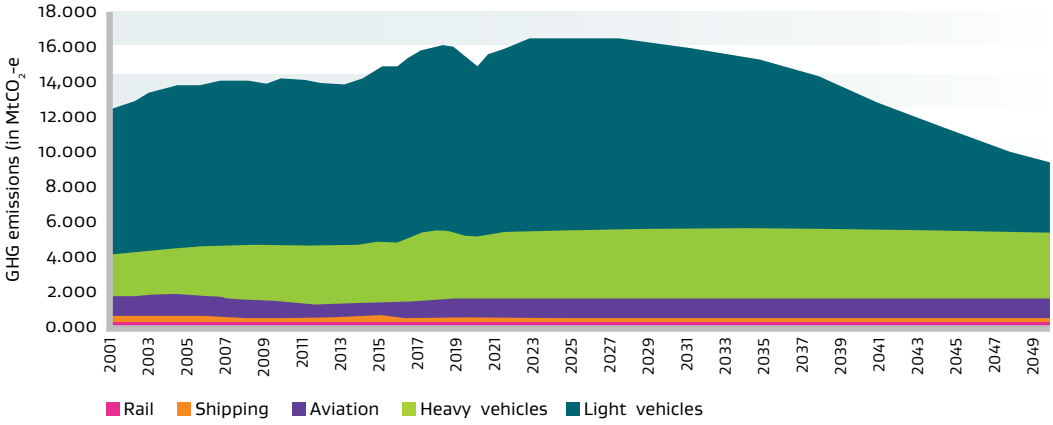
Transport is New Zealand's fastest growing source of emissions. Transport emissions increased 90 percent over 1990–2018. This compares with a 24 percent increase in emissions across the entire economy over the same period.

Within transport, road transport emissions have grown the fastest, with emissions more than doubling since 1990.

Emissions will eventually reduce with an increasing uptake of EVs in the light vehicle fleet

Under the Ministry of Transport's base case projection, transport emissions are expected to continue to increase until around 2024. Emissions are then projected to plateau before slowly declining from around 2029. This projection assumes the rate of uptake of electric vehicles (EVs) will speed up once EVs achieve price parity with conventional vehicles.

Transport emissions projections



Electrification of the light fleet will not happen fast enough and little decline in emissions is expected in the other areas of transport

It is clear from this projection that EVs and the future possibility of hydrogen will not transition transport fast enough to help meet our 2030 and 2050 emission targets. Our first commitment is to reduce emissions to 30 percent below 2005 levels for the period 2021–2030. To contribute to this target, road transport emissions would have to be lower than they were in 2005 in each year of the period 2021–2030. In 2030 transport emissions are expected to be around 18 percent higher than in 2005.

Also, under existing policies, emissions from heavy trucks can be expected to remain above 2005 levels even by 2050. Levels from aviation, ships and rail are also not expected to decline significantly between now and 2050.

A stronger and more comprehensive set of measures are needed to effect rapid cuts in transport emissions to the level recommended by the Climate Change Commission. The magnitude of their recommended decline is marked on the graph above.

Part 2: Biofuels have a key role to play in decarbonising transport

Sustainable biofuels are an achievable low-emissions solution available now. They are a practical alternative to fossil fuels where low-emission vehicles and aircraft are prohibitively expensive or are still being developed. Biofuels could also play a transitional role in reducing the emissions from New Zealand's 3.9 million cars, SUVs, utes and vans as they are gradually replaced by EVs.

The Ministry of Transport estimates that had the 2008 Biofuels Sales Obligation remained in place to 2020, New Zealand would have reduced emissions from road transport by over 6 million tonnes.

The Climate Change Commission recognises the role biofuels could play in decarbonising transport. In its 2021 Draft Advice for Consultation it recommends, as a necessary action, steps be taken to support the use of low carbon fuels, such as biofuels.

Biofuels can reduce emissions because they cycle CO_2

Biofuels are fuels made from renewable biomass, such as plant material. The most common biofuels are ethanol, which is a petrol substitute, and biodiesel, which is a diesel substitute.

Biofuels can reduce emissions because they cycle CO_2. When the biomass a biofuel is made from grows, it absorbs CO_2. Roughly the same amount of CO_2 is released when the biofuel is combusted for transport. This is a short-term cycle of carbon; the carbon released during combustion is effectively recaptured by the biomass as it grows.

This is in contrast to the ancient carbon released from the combustion of fossil fuels. This carbon has been underground for millions of years. When it is released through combustion it accumulates in the atmosphere; this accumulation is what is altering the climate.

There are CO_2 emissions from the production of biofuels, including from cultivation of their feedstocks (the type of biomass a biofuel is made from). Yet even when these emissions are accounted for, many biofuels provide a substantial reduction in CO_2 emissions compared to fossil fuels over their life cycle.

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WHAT ARE LIFECYCLE EMISSIONS?

Lifecycle emissions are the total amount of GHG emissions generated in the course of production, transportation and usage of a fuel. They cover the complete "wells to wheels" life cycle of a fuel from production, to distribution, to final use. They include direct and indirect effects, such as land use changes that contribute to GHG emissions, and fertiliser use in the cultivation of the feedstock. Lifecycle emissions give us a way to measure and compare the impact different fuels have on climate change.

Advances in biofuel technology have made them better at reducing emissions with a lower environmental footprint

Biofuel technologies have progressed markedly over the last decade. Advanced biofuels are becoming available which have smaller environmental impacts and greater emissions reductions than conventional ones.

Some advanced biofuels do not need to be blended with fossil fuels to be used in conventional vehicles and fuel infrastructure as they are chemically almost identical to fossil fuels.

The table below provides more information on these two broad biofuel groupings.

CONVENTIONAL BIOFUELS:	ADVANCED BIOFUELS:
Are produced almost exclusively from the human food chain e.g. biodiesel produced from vegetable oils and animal fats and ethanol produced from sugars and starches e.g. sugarcane, corn, wheat	Are produced from non-food feedstocks, such as agricultural and forestry residues, grasses, algae, industrial and organic municipal waste Some use feedstocks that can be grown in most locations worldwide, including in deserts and salt waste
Can only be used in low-level blends with fossil fuels	Some are "drop-in fuels" i.e. they are fully compatible with existing fossil fuels, conventional vehicles/aircraft and fuel infrastructure
Are typically not suitable for use in aircraft, as they do not meet the high performance and safety specifications for jet fuel	Sustainable aviation fuels are available
In some cases, have raised concerns about changes in the use of agricultural land, the effect on food prices and the impact of irrigation, pesticides and fertilisers on local environments	Are environmentally superior, have lower lifecycle CO_2 emissions and cause zero or low indirect land use change. They also have the potential to deliver large quantities of greener transport fuels at more stable prices.

There are opportunities to use biofuels across the transport sector

Sustainable biofuels could play a number of roles in decarbonising transport. They could be deployed in:

- **conventional light vehicles.** EVs are the lead opportunity to decarbonise light vehicles. However, biofuels could be used as a transition fuel to lower emissions from conventional vehicles until they are replaced with EVs. This role is important: new vehicles bought in New Zealand are driven until they are, on average, 20 years old. For today's new vehicles, it will not be until 2041 that there is another opportunity to switch them to electric.
- **heavy vehicles, especially heavy freight trucks.** Conventional biofuel blends as high as 20 percent can be used in some large trucks and buses[4]. Drop-in biofuels offer the opportunity to use higher percentage blends, including up to 100 percent. Major truck manufacturing companies like Scania, are now producing truck engines capable of running entirely on biofuels. Green hydrogen is also an option for heavy vehicles, however, vehicles are not yet being sold commercially and they have a much higher upfront cost[5]. They also require infrastructure investment.

4 *Green Freight – Strategic Working Paper,* Ministry of Transport 2020.
5 A 50-tonne diesel freight truck costs in the order of $250,000–$300,000. Hiringa Energy advises that the hydrogen trucks it will receive from US-based Hyzon Motors will each cost $750,000.

- **aviation.** Air New Zealand has explored how it could decarbonise its operation to support the national and Paris agreement targets. It considers the largest mitigation opportunity to be sustainable aviation fuel, as electricity and hydrogen are not suitable for long-haul flights. Air New Zealand has said sustainable aviation fuel has the potential to provide at least 50 percent of its required decarbonisation by 2040-2050, if production facilities are established in New Zealand, and if it can manage the increased costs associated with sustainable aviation fuel.
- **rail.** The cost of electrifying rail freight is extremely high and biodiesel could offer a more cost-effective alternative. Kiwirail is testing Neste's 100 percent drop-in renewable diesel in one of its shunter locomotives. The testing will take 3 months and look at whether the fuel provides the same level of performance and reliability as mineral diesel.
- **shipping.** As a transition fuel, ships are well-suited to biofuels as marine fuel specifications are much more flexible and biofuels produce much less sulphur pollution. However in the long term, ammonia and hydrogen are likely to be the best low-carbon solutions for shipping.

Biofuels create opportunities for green economic growth and employment

A move to biofuels could support the transition to a net-zero emissions economy in a way that stimulates regional economic growth and employment.

For example, Air New Zealand, Z Energy and Scion estimate that domestic production of sustainable aviation fuel would, by 2050, enable 1,800 new permanent direct jobs, over 5,000 additional indirect jobs and another 6,400 temporary infrastructure development jobs.

The Government is currently investigating how advanced biofuels can be produced in New Zealand. The New Zealand Wood Fibre Futures Project is seeking detailed commercial insight and assessment of the business case for investing in four priority products, including biocrude oil, liquid biofuels, and solid biofuels. The fourth priority product is the manufacture and processing onshore of wood-based products. The production of the latter products could supply a large amount of woody residues that could be the feedstock for the production of biofuels.

The report will include analysis of broader forestry industry enablers including at least two specific production systems. It will also detail the potential role for government in supporting the commercial success of the investments and improving the efficiency of production systems. It is anticipated that biofuel production in New Zealand will support regional economic development with biofuel manufacturing clusters being co-located where forestry and sawmills are prevalent to encourage industrial symbiosis. Te Uru Rākau is leading this work as part of the Forestry and Wood Processing Industry Transformation Plan. It expects the final report to be delivered in mid-2021.

Sustainable biofuels have environmental benefits beyond CO_2 emissions reduction

The main environmental benefit of biofuels is a reduction of CO_2 emissions, but they have other benefits. Biofuels can improve air quality in urban areas by reducing vehicle exhaust pollutants, such as sulphur dioxide, carbon monoxide and particulate matter that are harmful to human health. In 2012 the annual social cost of the damage from transport air pollution was estimated to be $2.1 billion[6].

They can contribute to a circular economy by recycling waste streams that are currently sent to landfill, or are left to degrade land and water resources, such as forestry slash. As well, replacing diesel with biodiesel reduces the degradation of aquatic and marine environments. The values of these co-benefits have not been quantified.

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6 Kuschel G, Sridhar S and Metcalfe J (2020). *Domestic Transport Cost and Charges: Working Paper D4 - Air quality and greenhouse gas emissions.* Report for NZ Ministry of Transport prepared by Emission Impossible Ltd, September 2020

We are not realising the biofuels opportunity because of the substantial challenges that limit uptake

Despite the potential, New Zealand's use of biofuels is low by international standards and we have little production capacity. Liquid biofuels make up less than 0.1 percent of our total liquid fuel sales[7]. This compares with about 4 percent globally[8]. Some countries, typically those with biofuels mandates, have achieved higher shares. For instance, the share of biofuel in Sweden's transport sector was 18 percent in 2017[9]. Finland plans to lift the share of biofuels blended in transport fuel from 13.5 percent now[10] to 30 percent by 2030[11].

Our low use reflects the number of challenges limiting the production and use of biofuels. The key ones are that:

- **sustainable biofuels are not cost competitive with fossil fuels at market prices.** Biofuel suppliers struggle to operate at a sufficient scale to achieve economies of scale that reduce costs. Biofuel prices can also be driven up by the cost of feedstocks, which can be kept high because of demand for them from other uses7. For example, Covid-19 has increased the demand for ethanol, which is used in hand sanitisers.
- **domestic production has reduced and is likely to reduce further because of high international demand for feedstocks.** For example, Z Energy was producing biodiesel from animal tallow without government support. However, in May 2020 it hibernated its plant. It could not afford the increase in the international tallow price that was bid up by international producers of renewable diesel operating with government subsidies. Fulton Hogan's GreenFuels faces similar challenges in maintaining access to domestic sources of vegetable oil.
- **advanced drop-in sustainable biofuels are preferable but developers face high financial and technical barriers.** New conversion technologies have to be proven to operate reliably at scale before commercial deployment can occur. Proving a technology can create a catch-22 situation. To convince investors to fund construction and operation of a large-scale production facility, developers effectively need to have a large-scale production facility in place to persuade them that their conversion technologies will be successful and cost effective at scale. Then, as for any other investment, larger-scale development is dependent on the economics of biofuel production stacking up.
- **production faces significant co-ordination challenges.** Feedstock producers are unlikely to commit to growing a crop for a biofuel producer without a guaranteed market. A producer would not build a conversion plant without guaranteed supply of a sustainable feedstock, nor would producers invest without a guarantee of demand from customers.
- **use of conventional biofuels is limited by "blend walls" that deter investment.** Unmodified road vehicles can only use conventional biofuels in low-percentage blends. Higher blends risk engine damage and void vehicle manufacturers' warranties. For bioethanol, there is a "blend wall" of 10 percent, and retail sales of biodiesel are limited to blends of 7 percent. However, the potential for uptake is greater in the heavy road freight, buses, rail, and maritime sectors where higher blends can be used.
- **there is a lack of significant incentives and past uncertainty in biofuels policy.** The removal of the Biofuels Sales Obligation in 2008 and the Biodiesel Grants scheme has made the market wary of biofuels. The main biofuels policy measures that remain in place include R&D funding and a fuel excise duty exemption for bioethanol. This is a particular challenge for the forestry and biofuel sectors in pursuing the commercial opportunity of turning woody biomass into liquid biofuels. Without the right policy environment we are unlikely to attract the international investment and expertise needed to help us realise this opportunity.

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7 Scion, New Zealand Biofuels Roadmap Summary Report.
8 ibid
9 https://www.connaissancedesenergies.org/sites/default/files/pdf-actualites/Energy_Policies_of_IEA_Countries_Sweden_2019_Review.pdf
10 https://www.iscc-system.org/wp-content/uploads/2017/04/9_Jaaskelainen_FI_Ministry_of_Transport_and_Communications_ISCC_Conference_150217.pdf
11 http://www.reuters.com/article/finland-energy-biofuels-idUSL8N1DP2F8

Despite the best efforts of companies like Z Energy, Gull, Fulton Hogan and Air New Zealand these challenges have subdued the production, supply and use of biofuels in New Zealand. For example, in December 2020 Gull withdrew the biodiesel blend it was providing in 5 of its 99 outlets. For the last 6 years it had imported biodiesel from Australia as it was unable to find a consistent domestic supplier. In recent years, the lack of scale has removed Gull's option to automate blending and lower cost.

Government intervention is needed to overcome the challenges limiting biofuels

In theory the Emissions Trading Scheme (ETS), by zero-rating the biofuel component of transport fuels, could create a sufficient financial incentive to sustain a domestic market for biofuels. However, transport has been part of the ETS since its inception. To date, the ETS has not provided a sufficient incentive to increase the use of low carbon fuels, or to reduce transport emissions. This is because the current emissions price of around 9 cents per litre for diesel, and 7.8 cents for petrol[12] is a very small component of fuel prices and is less than the marginal abatement cost of available biofuels.

The effectiveness of the ETS in driving fuel switching will also be diluted by global subsidies on oil and the production of fossil fuels, and more generally, by significant uncertainty in the range of future global oil prices. Even with very high emissions prices, biofuels could struggle to compete with fossil fuels when oil prices are low.

While the ETS improves the cost competitiveness of biofuels by placing an emissions price on fossil fuels, it cannot sufficiently overcome the challenges to biofuels set out on page 11. Complementary policy measures are needed to create a favourable, stable and long-term policy environment for biofuels.

12 https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/weekly-fuel-price-monitoring/

Part 3: The Sustainable Biofuels Mandate

PART 3A: How the Sustainable Biofuels Mandate would work

Internationally, biofuels mandates have been successful in overcoming the barriers to an uptake of biofuels and reducing transport emissions[13]. They are in place in 68 countries[14]. Their proven effectiveness is why the Government has opted in principle to introduce one in New Zealand.

The proposed Sustainable Biofuel Mandate builds on and improves the previous 2008 Biofuels Sales Obligation in light of international biofuel and policy developments. The two most significant changes it makes are to:

- focus fuel suppliers on reducing the emissions of the fuels they sell through deploying biofuels. This is opposed to requiring fuel suppliers to sell a set percentage of biofuels.
- encourage biofuel use across all transport modes, including aviation. This is opposed to requiring their use in road transport only.

These changes will maximise the potential biofuels offer in decarbonising transport.

We are proposing a GHG emissions reduction mandate

To focus fuel suppliers on reducing the emissions of their transport fuels, the proposed Sustainable Biofuels Mandate would be a GHG emissions reduction mandate. It would require fuel suppliers to reduce the GHG emissions of their fuels by a set percentage every year. Fuel suppliers would do this by blending biofuels into some, or potentially all, of the fuels they sell. Biofuels could be produced domestically or be imported.

By focusing on emissions reductions the Sustainable Biofuels Mandate differs from the 2008 Obligation, which was a traditional volume based mandate. The Sustainable Biofuels Mandate will still cause fuel suppliers to increase biofuel volumes, but critically, it will encourage them to supply biofuels that have relatively low lifecycle GHG emissions.

This is important because biofuels can have markedly different lifecycle emissions and it cannot be taken for granted that all biofuels will reduce GHG emissions. It depends on the biofuel's feedstock, how it was cultivated, including whether there was any direct or indirect land use change which results in GHG emissions, and how the biofuel was produced.

The table in Appendix 1 shows the United States Environmental Protection Agency's estimated lifecycle emissions of a selection of biofuels. The best performing biofuel has 129 percent lower GHG emissions than petrol, but the worst one has 19 percent more emissions.

By encouraging fuel suppliers to favour biofuels with low lifecycle emissions, the Sustainable Biofuels Mandate will facilitate the earlier adoption of advanced drop-in biofuels. These biofuels offer the most benefit as they tend to have the lowest carbon and environmental footprints, and they do not require modifications to engines or fuel infrastructure. However, currently the price of these biofuels is significantly higher than conventional biofuels.

A focus on emissions reductions also allows the Sustainable Biofuels Mandate to be expanded beyond biofuels, at a future point, to include other low-carbon fuels, such as green hydrogen, electricity and synthetic liquid fuels. A review would take place in 2024 to determine whether and when to expand the Sustainable Biofuels Mandate.

The disadvantage of having an emissions reduction mandate is that it will be administratively more complex for fuel suppliers and the government regulator.

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13 IEA Bioenergy Task 39 – Implementation Agendas – 2018 Update
14 International Energy Agency

To comply, fuel suppliers will have to ensure that their fuel blends, which is with a biofuel component, achieve a reduction in emissions that is at least equal to the required emissions reduction. The percentage reduction would be in comparison to the climate impact of fully fossil fuel equivalents.

To be able to do this, fuel suppliers will have to have information on the lifecycle emissions of the biofuels they are looking to sell in New Zealand. This information will inform their purchase decisions, and it will be used to assess whether they have achieved the required percentage emissions reduction.

The calculation that would be done to assess whether or not a fuel supplier has successfully achieved the required emissions reduction is on page 20.

PLEASE TELL US WHAT YOU THINK:

Do you support having a GHG emissions reduction mandate? If not, why?

Fuel suppliers would have the lifecycle emissions of their biofuels independently assessed and audited using a consistent methodology

For the Sustainable Biofuels Mandate to be effective in reducing emissions, and fair across fuel suppliers and biofuel producers, there needs to be a consistent, accurate and reliable methodology to assess the lifecycle emissions of biofuels.

We propose that the Sustainable Biofuels Mandate have associated regulation specifying how the lifecycle emissions of biofuels should be quantified.

There are several established international certification systems which verify GHG emissions reductions and compliance with sustainability criteria for biofuels (see page 24 for a discussion on the sustainability criteria and how the certification process assists with them). For example, the International Sustainability and Carbon Certification (ISCC) and the Roundtable on Sustainable Biofuels (RSB) issue standards which are approved for use by the European Union for the Renewable Energy Directive. Under these certification schemes, a third party certification body carries out an assessment of compliance against the standard (every step in the biofuel supply chain must be certified against the relevant standard).

The specific certification standards that fuel suppliers would need to use to meet the Sustainable Biofuels Mandate would be set out in regulations. The regulator would monitor the application of the international standards and the certifying bodies to ensure that they are consistent with New Zealand regulations.

It is likely that production facilities for established biofuel producers will already be certified against such standards, and therefore they will be able to quantify the GHG emissions. Fuel suppliers would then need to request a copy of the certificates from the producer and supply them to the regulator as evidence of the lifecycle GHG emissions from each biofuel supplied in the New Zealand market.

PLEASE TELL US WHAT YOU THINK:

Do you support the proposal to require certification of lifecycle emissions of biofuels sold in New Zealand using international standards? If not, why?

The Sustainable Biofuels Mandate would apply to all transport fuels and fuel suppliers would decide where biofuels would be deployed

Biofuels offer opportunities to reduce emissions across transport's motorised modes. They are likely to be particularly important in aviation, heavy road freight and shipping where other low emission technologies are less developed. They also offer a way to reduce the emissions of conventional vehicles in the light vehicle fleet.

To make the most of the opportunity from biofuels, the Sustainable Biofuels Mandate would apply to any liquid transport fuel. Fuel suppliers, in response to demand from their customers, would decide where biofuels are best deployed. As long as fuel suppliers operate within the existing fuel specifications regulations, they would choose:

- the type(s) of biofuel they will supply and to what blend levels. For example, suppliers could choose to reduce the emissions of their fuels by predominantly supplying biodiesel and sustainable aviation fuels
- the customers and locations they will supply to. For example, suppliers could choose to fulfil their obligations largely by supplying road freight companies and the aviation sector.

This flexibility would make it easier for fuel suppliers to respond to short-term supply disruptions. It would also help them manage any seasonality in biofuel supply and climatic conditions that can restrict where biofuels are used.

While marine biofuels would be included in the Sustainable Biofuels Mandate, biofuels to displace heavy fuel oil are still a work in progress. Consequently, when the Sustainable Biofuels Mandate comes into effect we will not see an uptake in biofuels across ships that use heavy fuel oil. However, this future biofuel use is provided for.

Any exported fuel would not be covered by the Sustainable Biofuels Mandate. This is because the purpose of the Mandate is to help New Zealand reduce its domestic emissions as it has agreed to do with its 2030 Paris target and the 2050 target in the Zero Carbon Act. Export fuel includes the fuel used by aircraft and ships on international trips.

PLEASE TELL US WHAT YOU THINK:

Do you support applying the Sustainable Biofuels Mandate to all liquid transport fuel? If not, why?

The initial emission reduction percentages would reach 3.5% in 2025

With the Sustainable Biofuels Mandate, every year fuel suppliers would have to reduce the emissions of the fuels they sell by a set percentage. This percentage reduction would be calculated by comparing the emissions of the supplier's fuels with the emissions had all those fuels been 100 percent fossil fuels.

The proposed initial percentages are:

	2023	2024	2025
Required percentage emissions reduction across fuel sales	1.2%	2.3%	3.5%

These initial percentages are low compared to the emission reductions required by countries that are leaders in biofuels. Table 1 shows the recent and current percentages reductions applying in jurisdictions that also have GHG emission reduction mandates.

Table 1: Reductions required by other jurisdictions with emission reduction mandates

Appendix 2 provides more information on international mandates.

The proposed initial percentages are low because biofuel producers and fuel suppliers need time to scale up their volumes. Feedstocks have to be grown and secured for domestic production to expand. Large-scale capital investment may be needed to modify or build processing plants. For new imported biofuels, sources of reliable and affordable supply have to be established. To distribute domestic and imported biofuels, new storage, blending and distribution facilities will be required.

California

- 10% reduction in the carbon intensity of transport fuels by at least 2020
- 20% reduction in the carbon intensity of transport fuels by 2030

European Union

- 6% reduction in the GHG emissions of transport fuels by 2020
- 14% reduction in the GHG emissions of transport fuels by 2030

Sweden

- 4.2% reduction in emissions from petrol in 2021
- 21% reduction in emissions from diesel in 2021
- 40% decrease in emissions from fuels by 2030

As well, the proposed initial percentages will require a higher level of biofuel supply than was sought by the 2008 Biofuels Sales Obligation. With the Obligation, biofuels were to be 0.25 percent of fuel sales in 2008, increasing to 2.5 percent in 2012. At the time this was estimated to be a supply of 0.5 petajoules of biofuels in 2008 and 5.4 petajoules of biofuels in 2012.

With the Sustainable Biofuels Mandate it is estimated that:

- 3.75 petajoules of biofuels would be supplied in 2023
- 7.33 petajoules of biofuels would be supplied in 2024
- 11.08 petajoules of biofuels would be supplied in 2025.

PLEASE TELL US WHAT YOU THINK:

Are the proposed initial emission reduction percentages for 2023–2025 appropriate for New Zealand? If not, what should they be?

Should we have one emissions reduction percentage across all fuels or separate percentages for some or all fuels?

The sections above propose having a single GHG emissions reduction percentage across all fuel types. However, we are seeking your view on whether it would be preferable to have separate percentages for some fuels, or even for all fuels. For example, we could have one target for petrol and diesel and a separate one for aviation fuels.

Separate percentages may be preferable as there are downsides with having a single percentage for all fuel types. These downsides arise from the fact that different types of biofuels have markedly different costs of production. These cost differences could lead fuel suppliers to import the cheapest biofuels to meet the Sustainable Biofuels Mandate.

Currently, conventional ethanol is the cheapest biofuel and is expected to continue to be thecheapest in the period to 2050[15]. Conventional ethanol is blended with petrol and the majority of petrol vehicles are cars and SUVs.

15 Hale and Twomey.

For road and rail freight drop-in renewable diesel is available. It can be used in conventional freight trucks and locomotives without being blended with fossil diesel. Yet, it is currently trading with a nearly three times price premium to fossil diesel. Over this decade a reasonable premium is expected to remain as demand for renewable diesel is high[16].

Similarly, sustainable aviation fuels are also available. ASTM International has approved use of six sustainable aviation fuels in blends of up to 50 percent. However, it is more expensive to produce than ethanol or biodiesel.

While sourcing the least cost biofuels might be desirable in the short term, as it would limit the extent to which fuel prices rise, it could:

- limit the deployment of biofuels in aviation, road freight, rail freight and coastal shipping. If this risk eventuated it would be very detrimental to New Zealand's efforts to reduce CO_2 emissions because these are the hard to abate sectors. This risk is greatest for sustainable aviation fuel as it is more expensive to produce than the other biofuels
- delay the adoption of advanced/drop-in biofuels, which are low carbon solutions rather than just transitional fuels
- provide less of an incentive for domestic production of biofuels, especially advanced biofuels.

Overall, separate percentages would better support the deployment of biofuels in the hard to abate sectors and better support advanced biofuels.

However, the main risk with separate percentages is that it would remove the flexibility suppliers would have in deciding the types and volumes of biofuels they will supply. This flexibility is valuable and removing it would increase compliance costs for fuel suppliers.

PLEASE TELL US WHAT YOU THINK:

Do you support having single GHG emissions reduction percentages across all fuel types, or do you favour separate reduction percentages? Why and how many separate percentages would you suggest we have?

Higher GHG emission reduction percentages would be set beyond 2025 to help provide certainty to the biofuels industry

The low initial emission reduction percentages would be followed by higher ones to support the transition to a net zero emissions economy. To give certainty for biofuel producers and suppliers these future percentages would be notified well in advance. This certainty will help further de-risk investment in domestic production.

The process for setting the future percentages would be tied to the decisions the Government makes on New Zealand's five-yearly emissions budgets. In line with those budgets, provisional emissions reduction percentages could be set for the periods 2026–2030 and 2031–2035 later this year. These provisional percentage sets would be finalised in 2024 and 2029 respectively.

Finalising the provisional percentages in the future recognises that technological advances and market demand and supply become increasingly uncertain the further forward the percentages are set. Future finalisation better allows these critical change factors to be taken into account with greater certainty.

The process for setting and finalising the GHG emission reduction percentages would be managed by the Ministries of Business, Innovation and Employment and Transport as part of the Government's response to the recommendations of the Climate Change Commission.

16 Hale and Twomey.

PLEASE TELL US WHAT YOU THINK:

Do you support provisional emission reduction percentages being set for 2026–2030 and 2031–2035 with the percentages being finalised in 2024 and 2029 respectively? If not, why?

Strict criteria would apply to ensure the biofuels used in New Zealand are sustainable

Internationally there have been examples of biofuel production that have had a detrimental impact, including deforestation, loss of biodiversity, increased greenhouse gas emissions relative to fossil fuels, and competition with water resources and food production. We will not tolerate this, either in New Zealand or, in any country that supplies biofuel to New Zealand. The proposed Sustainable Biofuels Mandate hard-wires in a focus on lifecycle emissions. If fuel suppliers do not supply biofuels with low lifecycle emissions, they are unlikely to achieve the required emissions reduction over the year.

Alongside the focus on lifecycle emissions, for a biofuel to count towards achievement of the Mandate's reduction it would have to meet sustainability criteria. These criteria set an acceptable baseline for environmental performance. The specific standards would be set out in regulation and would focus on ensuring that biofuels and the cultivation of their feedstocks do not:

- compete with food production and where relevant are not grown on land of high value for food production. A case where the latter is not relevant is where an energy crop, like rape-seed, is grown as a rotational crop to improve soil quality as part of usual farming practice
- reduce indigenous biodiversity or adversely affect land with high conservation value
- affect land of high carbon stocks. Although the effects of direct and indirect land use change would be considered when evaluating the GHG emissions reduction of biofuels, land should not be converted for the production of biofuel feedstocks if the stored carbon it emitted upon conversion could not, within a reasonable period, be compensated by the greenhouse gas emission saving resulting from the production of biofuels.

To prove compliance with the sustainability criteria, biofuel producers would need to be certified against an established sustainability standard (see page 18 on how the sustainability standards operate for the assessment of lifecycle emissions).

The regulations would provide a list of sustainability standards which biofuel producers could choose from (some standards are tailored to specific feedstocks, for example palm oil). The regulations may also set out a process where a biofuel producer or fuel supplier could apply to the regulator to use an equivalent standard.

It would be an offence to provide information to satisfy the criteria that was knowingly false or incomplete. We propose fines for this offence of:

- for an individual, a fine not exceeding $100,000
- for a person or an organisation other than an individual, a fine not exceeding $500,000.

PLEASE TELL US WHAT YOU THINK:

Do you support the proposal that biofuel producers must be certified against an established sustainability standard to count towards achievement of the emissions reduction percentage? If not, why?

Informing New Zealanders about the biofuels they will be using

Before the Sustainable Biofuels Mandate takes effect, New Zealanders need to be informed of the benefits of biofuels. As well as how the design of the Mandate avoids the environmental and social issues and risks associated with some biofuels internationally.

Already Z Energy has done some of this in its past advertising for its biodiesel. To broaden the information and audiences reached, the regulator will work with the fuel industry on an information campaign.

Alongside the information campaign we propose having labelling requirements for biofuels at the point of sale. The labels would inform consumers of the:

- percentage of biofuel used in the fuel and the lifecycle emissions of the biofuel
- feedstock and the conversion processes used to produce the biofuel as well as the country of origin
- the environmental sustainability of the biofuel.

PLEASE TELL US WHAT YOU THINK:

Do you support having a joint fuel industry/government information campaign to inform New Zealanders about biofuels and the Sustainable Biofuels Mandate? If not, why?

Do you support the labelling proposal that informs consumers about specific biofuels at the point of sale? If not, why?

The engine fuel specifications would continue to ensure biofuels pose no risk to engines

With the proposed Sustainable Biofuels Mandate, biofuel use will continue to be regulated with the existing Engine Fuel Specifications Regulations 2011.

This regulation sets out the minimum standards for fuel performance and ensures that biofuel blends meet the standards appropriate for New Zealand's vehicle fleet and climatic conditions.

With this regulation, fuel consumers can be confident that an expansion in biofuel supply will not pose risk to vehicles and engines.

Would additional measures be needed to help domestic producers access domestic feedstocks?

The Sustainable Biofuels Mandate will increase domestic demand for biofuels. However, it is unlikely to overcome the challenge that domestic producers face in securing sufficient volumes of domestic feedstocks at affordable prices. This is because international demand for our feedstocks is high and is allowing New Zealand suppliers of animal tallow and vegetable oil to benefit from higher prices.

This market reality will make domestic production challenging. If New Zealand wants to have a strong domestic biofuels industry a solution will need to be found.

PLEASE TELL US WHAT YOU THINK:

Should New Zealand try to overcome the challenges that domestic biofuel producers face in maintaining access to affordable supplies of domestically produced feedstocks? Do you have any suggestions for how this challenge could be overcome?

PART 3B: How could the Sustainable Transport Biofuels Mandate be implemented?

This section contains information on the proposed requirements for how fuel suppliers would comply with the Sustainable Biofuels Mandate. It will be of most interest to people working in the fuel industry.

Who would have to comply with the Mandate?

It is proposed that fuel suppliers that sell more than 10 million litres of transport fuel in New Zealand in a calendar year would have to comply.

With this point of obligation currently the liable suppliers would be: BP, Z Energy, Mobil, Gull, Challenge, Caltex, Gasoline Alley Services, New World, Pak n' Save, McKeown Group, Nelson Petroleum Distributors, Petroleum Logistics, McFall Fuel, RD Petroleum, Southfuels, Northfuels, Waitomo Group, Allied Petroleum.

The Mandate would apply to the liable suppliers' annual wholesale and retail sales of liquid transport fuels. As well as to any fuel used by the liable suppliers during the year[17].

Data on the fuel used by the liable suppliers would be sourced from the fuel (transport fuel) expenses that are included in their financial statements for the relevant period.

PLEASE TELL US WHAT YOU THINK:

Do you think the minimum threshold for compliance of 10 million litres of transport fuel in a calendar year in New Zealand is appropriate? If not, what level would you change it to?

How would a fuel supplier's performance be calculated?

Each year a fuel supplier would have to demonstrate that the percentage emissions reduction it achieved, across its fuels, is at least equal to, or higher than, the required percentage. The percentage reduction would be calculated by comparing the emissions of its fuels (fossil and biofuels) against the hypothetic emissions had all its fuels been fully fossil.

In other words the approach to calculation in a simplified form would be:

Reduction =

$$\frac{\text{Emissions if all supplier's fuels were fossil} - \text{Emissions of supplier's fuel blends (biofuels + fossil fuels)}}{\text{Emissions if all supplier's fuels were fossil}}$$

$$\text{Reduction [\%]} = 100 \times \frac{E_f - E_{b+f}}{E_f}$$

Where:

E_f is Emissions if all the supplier's fuels were fossil
E_{b+f} is Emissions of actual fossil fuels with the supplier's biofuels

As an example, if a fuel supplier opted to meet the emissions reduction through the supply of biodiesel, then its performance would be calculated as follows:

$$\text{Reduction [\%]} = \frac{P \times Gd \times (E_d - E_b)}{(G_d \times E_d + G_p \times E_p)}$$

Where:

P is the percentage of biodiesel blend
G_d and G_p are the energy content of the diesel and petrol respectively supplied in the relevant year expressed in MJ (gigajoules)
E_d and E_p are the specific emissions factors for diesel and petrol respectively expressed in kilograms CO_2-e/MJ
E_b is the specific emission factor for the biodiesel expressed in kilograms CO_2-e/MJ
(The specific emission factor of biodiesel is assumed to be approximately equal to that of diesel)

17 Fuel used by the company during a year would be calculated via the fuel (petrol and diesel) expenses that are included in that company's financial statements for the relevant period.

A worked example of the calculation is in Appendix 3.

Fuel suppliers would supply the energy content values of their biofuels, as they would vary depending on the feedstock used. However, the supplier would be required to have had these values independently verified by an accredited person. If verified values were not supplied, or they were incorrect, default values would apply.

As outlined in Part 3A, fuel suppliers would also be responsible for providing the lifecycle emissions of their biofuels. These values would have been verified by an independent auditor.

The regulator would provide the energy values and emission factors of the fossil fuels. This is to ensure the performance of fuel suppliers is assessed against a common base.

We propose that government officials work with the fuel industry to establish the common energy values and emission factors of the fossil fuels. This would be done before the Sustainable Biofuels Mandate comes into effect.

PLEASE TELL US WHAT YOU THINK:

Do you agree with the method for calculating a supplier's GHG emission reduction? If not, why?

Liable fuel suppliers would have to file an annual return

To enable compliance against the emissions reduction percentage to be assessed, liable fuel suppliers would be required to submit independently audited annual returns to MBIE. This return would include:

- the supplier's calculation showing its performance against the Mandate's required percentage emissions reduction
- notice of any entitlement agreement (this is a flexibility mechanism explained on page 28)

These returns would have to be submitted within three months of the end of each calendar year. The regulator would be empowered to obtain any further information that is necessary to administer and assess compliance.

It would be an offence to file an annual return that was knowingly incorrect, or incomplete. It would also be an offence to fail to keep the necessary accounts, or records, required to provide the annual return. A fuel supplier would be expected to maintain adequate records to be able to prove that the information contained in its annual return is true and correct. These records would be required to be kept for 7 years.

We propose fines for these reporting offences of:

- for an individual, a fine not exceeding $100,000
- for a person or an organisation other than an individual, a fine not exceeding $500,000.

PLEASE TELL US WHAT YOU THINK:

Do you think the annual reporting regime, including its offences and fines, is practical and appropriate? If not, why?

The performance of fuel suppliers would be published to increase public awareness and scrutiny

The regulator would publish the performance information contained in the annual returns. This is to increase transparency and public accountability. It would also create the potential for consumers to reward the industry leaders in emission reductions through increased patronage. To enable this to happen the information would be provided in a way that is easy for consumers to use.

PLEASE TELL US WHAT YOU THINK:

Do you support the performance of fuel suppliers being published to enable consumers to reward the industry leaders in reducing GHG emissions? If not, why?

Penalties would apply for non-compliance with the mandated percentages

To motivate fuel suppliers to comply with the Sustainable Biofuels Mandate, penalties would apply where suppliers fail to achieve the minimum percentage emissions reduction. These penalties would apply for every $MtCO_2e$ that a supplier is short in meeting the required percentage emissions reduction. The proposed penalties are:

- years 1–3, $300 per tonne CO_2-e
- year 4, $375 per tonne CO_2-e
- year 5 and onwards, $560 per tonne CO_2-e

The penalty would be applied using the following formula:

$$\text{penalty} = (a - b) \times c$$

Where:

a is the mandated emissions reduction
b is the actual emissions reduction
c is the penalty rate for the relevant year

The mandated emissions reduction (a) would be converted into tonne CO_2-e through the formula:

Emissions reduction (tonne CO_2-e) = Emissions if all fuels fossil x required % emissions reduction

These penalties would be civil ones imposed by the High Court. The Court would have the ability to reduce the penalty where it was satisfied that the fuel supplier took all reasonable steps to meet the required emissions reduction.

As court action can be time consuming and costly, the regulator and fuel suppliers would have the ability to negotiate a penalty settlement prior to going to court.

Worked examples of the assessment of a suppliers performance and the calculation of penalties are in Appendix 3.

PLEASE TELL US WHAT YOU THINK:

Will the proposed penalties encourage fuel suppliers to achieve the required emission reductions? If not, would level should they be?

For the first two years of the Mandate fuel suppliers could defer meeting their required emissions reductions

During the first two years of the Sustainable Biofuels Mandate, there is a risk that some suppliers may not be able to source sufficient biofuel volumes quickly enough to meet their required emissions reductions. This is because of the long lead-in times associated with increasing biofuel production and supply.

Partnerships with domestic biofuel producers to expand and/or commence production have to be established. Domestic producers have to secure reliable, affordable and long-term feedstock supplies. Large-scale capital investment may be needed to modify or build processing-plants.

For imported product, sources of reliable and affordable supply have to be established or expanded. To distribute domestic and imported biofuels, new storage, blending and distribution facilities may be required.

We propose that the risk that long-lead times pose be mitigated through deferral. Fuel suppliers could defer achieving their emissions reductions for year 1 and/or 2, in full or in part, to the following year.

However, to motivate fuel suppliers to deploy biofuels earlier rather than later:

- approval to defer would need to be gained from the Minister of Energy and Resources. The Minister would have to be satisfied that the fuel supplier was actively taking all reasonable steps to meet the percentage emissions reduction
- an emissions penalty would be applied. This would be to achieve a 0.1 percent emissions reduction in addition to the required emissions reduction. For example, if a fuel supplier deferred meeting year 1 and year 2 emissions reduction percentages until year 3, it would add to year's 3 required emissions reduction percentage the:
  - percentages deferred from years 1 and 2
  - 0.2 percent reduction penalty (0.1 percent for year 1 and 0.1 percent for year 2).

A fuel supplier could apply for deferral at any time during year 1 (for year 1) and year 2 (for year 2).

PLEASE TELL US WHAT YOU THINK:

Do you support the proposal for fuel suppliers to defer achieving their emissions reductions for years 1 and/or 2, in full or in part, to the following year? If not, why?

Suppliers would have a degree of flexibility in meeting the mandated reduction percentages

For the Sustainable Biofuels Mandate to be effective, fuel suppliers need mechanisms that make it easier for them to manage any variability, or fluctuations in biofuel supply. To provide some flexibility for suppliers the following mechanisms are proposed:

- **Banking any surplus emissions reduction:** If a fuel supplier sells more biofuel in a year than it needs to achieve the minimum emissions reduction, it could carry-forward the surplus emissions reduction and use it to reduce the percentage needed to be achieved in the following years. It would be carried forward as an amount of CO_2e.
- **Borrowing for up to a 10% shortfall in emissions reduction:** If a fuel supplier sells less biofuels in a year than it needs to achieve the minimum emissions reduction, it could make-up the short-fall the following year. Borrowing would be limited to 10% of the required emissions reduction.
- **Trading via entitlement agreements:** fuel suppliers would be able to trade with others to meet the mandated emission reduction percentages. Trading would be affected through entitlement agreements between fuel suppliers, or between fuel suppliers and biofuel owners. These agreements would record the transfer of the right to count an amount of biofuel for the purpose of complying with the Mandate, and would be signed by both parties. Fuel suppliers

would document the details of their trades in their annual returns to the regulator. To ensure the integrity of the trades, it would be an offence to sign a false or misleading agreement. This includes entering into more than one agreement for a particular amount of biofuel, or exporting biofuel that was covered by an agreement.

PLEASE TELL US WHAT YOU THINK:

Do you support fuel suppliers banking any surplus emissions reductions in a year and using it to reduce the percentage needed to be achieved the following year? If not, why?

Do you support fuel suppliers borrowing for shortfalls in emissions reductions in a year, and making the shortfall up the following year? If not, why?

Do you agree with the proposal to allow trading through the use of entitlement agreements? If not, why?

The Sustainable Biofuels Mandate would be reviewed in 2024

The Sustainable Biofuels Mandate would be reviewed early in its second year of operation to ensure any unforeseen issues are identified and addressed.

This review would include consideration of whether the emissions reduction percentages for 2024 and 2025 are appropriate. If there are significant supply issues the percentages would be changed. The penalty levels would also be reviewed.

The review would give fuel suppliers and the Government confidence to proceed with the Sustainable Biofuels Mandate.

Part 4: The likely emissions and economic impacts of the Sustainable Biofuels Mandate

The potential emissions and economic impacts of the proposed Sustainable Biofuels Mandate are in the tables below. These have been estimated through computable general equilibrium modelling.

The Sustainable Biofuels Mandate that has been modelled would require fuel suppliers to reduce the emissions of the fuels they sell by 1.5% in 2023, 2.3% in 2024 and 3.5% in 2025.

The tables also give the results for a mandate that is a reinstatement of the 2008 Biofuels Sales Obligation with targets of 0.5%, 1% and 1.5% of fuel sales being biofuels in 2023, 2024, and 2025.

Impact on emissions

Over the first three years, 2023–2025, the Sustainable Biofuels Mandate would reduce emissions by 1,342 kilotonnes. In 2025 annual transport emissions would reduce by over 4%.

	Reduction in transport emissions in 2025	% of transport emissions in 2025	Cumulative emissions reduction
The Sustainable Biofuels Mandate	-708	4.1%	-1,342
Reinstated 2008 Biofuel Sales Obligation	-203	1.2%	-389

Impact on GDP

A biofuels mandate will, however, increase fuel prices as biofuels cost more to produce.

If the Sustainable Biofuels Mandate is implemented as proposed, in 2025 it would result in a 0.2 percent (0.4 cents per litre) increase in baseline petrol prices, a 5.8 percent (7.1 cents per litre) increase in baseline diesel prices, and an 11.2 percent (7.1 cents per litre) increase in baseline jet-fuel prices. The fuel price changes translate to a $7.41 increase in weekly household expenditure in 2025.

The level of price increases rise beyond the above levels as the emissions reduction percentage sought by the Sustainable Biofuels Mandate rises.

These increased fuel prices will have a negative impact on real gross domestic product (GDP) as shown in the following table.

Change	Change in real GDP 2023–2025 %	Change in real GDP 2023–2025 $m
The Sustainable Biofuels Mandate	-0.3%	-$1,245m
Reinstated 2008 Biofuel Sales Obligation	-0.07%	-$269m

The decline in economic activity reflects the cost challenge of having to transition away from fossil fuels at a time when biofuels cost more to produce.

The modelling shows the upper bound of the impact on GDP. In reality the impact is likely to be lower because the:

- projections assume that there is no further technological progress. It is likely that the global long-term policy commitment to biofuels will lead to higher investment in cost-reducing biofuels research and technology
- economic impact is highly dependent on the prices of biofuels and fossil fuels. The modelling's sensitivity analysis shows that when biofuels are relatively less expensive, and/or fossil fuels are relatively more expensive the economic costs of the Sustainable Biofuels Mandate fall. Emissions reductions are also slightly higher
- Sustainable Biofuels Mandate will protect future levels of GDP. Currently, key exporters like the food and fibre sector are concerned that their businesses will lose access to some international markets if we fail to take timely action to reduce emissions[18]
- estimates do not include the potential positive impact on economic activity, and regional economic development, arising from any domestic biofuel production.

While there will be an economic cost, New Zealand has made a commitment to decarbonise and become a net zero emission economy. Moreover, stakeholders have suggested that after electrifying light vehicles, biofuels are likely to be the next lowest cost carbon mitigation opportunity for transport. This is because:

- for aviation and heavy freight there are few, if any immediate other options to reduce emissions other than reducing air travel and freight movements. Air New Zealand has said it is unlikely to deliver further significant carbon emission reductions in New Zealand without access to readily available aviation biofuels[19]
- hydrogen could be an option for heavy freight, however, fuel-cell trucks are not yet being produced in commercial volumes and the overall cost of the trucks and additional infrastructure will be much greater than biofuels, at least initially
- it will take decades to electrify the light vehicle fleet. Mode shift to public transport, walking, cycling and e-bikes will reduce some, but not all, of the travel non-EVs do. Biofuels offer the next least cost option to reduce the CO_2 emissions of this travel.

18 2021 Draft Advice for Consultation, He Pou a Rangi (Climate Change Commission)
19 Covid isn't the biggest threat facing airlines, The Sunday Star-Times, November 22, 2020.

APPENDIX 1 – Lifecycle GHG emissions of a selection of biofuels (kg CO_2e per mmBtu)[20]

Results based on lifecycle analyses conducted for the Renewable Fuel Standard program

Feedstock	Fuel	Production process	Ag impacts	Land use change[21]	Feedstock transport[22]	Fuel production	Fuel distribution & use	Net emissions[23]	Percent reduction[24]
Algal oil	Biodiesel	Transesterification (Open Pond, Mid)	0.0	0.0	0.0	31.6	1.5	33.0	66%
Algal oil	Biodiesel	Transesterification (PBR, Mid)	0.0	0.0	0.0	26.3	1.5	27.8	71%
Barley	Ethanol	Dry Mill (<36,800 Btu/gal NG, <0.19 kWh/gal Elec)	-4.0	11.3	3.6	35.1	2.1	48.2	51%
Barley	Ethanol	Dry Mill NG	-4.0	11.3	3.6	39.1	2.1	52.1	47%
Biogas from landfills	Electricity	Any	0.0	0.0	0.0	12.3	0.0	12.3	87%
Canola oil	Biodiesel	Transesterification	8.2	33.9	1.6	2.9	1.5	48.1	50%
Cellulose from corn stover	Cellulosic diesel	Fischer-Tropsch process	11.6	-11.2	1.2	5.4	2.0	9.0	91%
Cellulose from corn stover	Ethanol	Biochemical enzymatic process	11.2	-10.8	1.2	-32.6	2.1	-29.0	129%
Corn starch	Butanol	Dry Mill Biomass (dry DDGS)	13.3	21.2	2.9	10.1	1.8	49.4	50%
Corn starch	Butanol	Dry Mill, NG Base Plant (dry DDGS)	13.3	21.2	2.9	32.6	1.8	71.9	27%
Corn starch	Butanol	West Mill Coal	13.3	21.2	2.9	51.5	1.8	90.8	8%
Corn starch	Ethanol	Dry Mill Biomass (2022 Average)	16.5	27.8	3.0	11.2	2.1	60.6	38%
Corn starch	Ethanol	Dry Mill NG (2022 Average)	16.5	27.8	3.0	27.9	2.1	77.2	21%
Corn starch	Ethanol	West Mill Coal	16.5	27.8	3.0	67.6	2.1	117.0	-19%
Grain sorghum	Ethanol	Dry Mill, 92% Wet DGS, Biogas, CHP	12.7	27.6	2.4	1.6	2.1	46.4	53%
Grain sorghum	Ethanol	Dry Mill, Dry DGS, NG	12.7	27.6	3.0	31.4	2.1	76.8	22%
Palm oil	Biodiesel	Transesterification	4.8	46.1	1.3	25.1	3.4	80.7	17%
Palm oil	Renewable diesel	Hydrotreating	4.8	46.8	2.0	30.9	2.2	86.7	11%
Soybean oil	Biodiesel	Transesterification	-8.8	33.6	2.7	13.2	1.5	42.2	57%

20 For more information see http://www2.epa.gov/renewable-fuel-standard-program/fuel-pathways-under-renewable-fuel-standard-program. The emissions factors are available at https://www.epa.gov/sites/production/files/2016-07/documents/select-ghg-results-table-v1.pdf.
21 Results include EPA's mean estimate of land use change GHG emissions
22 Includes emissions associated with co-product transport.
23 Results based on lifecycle analyses conducted for the Renewable Fuel Standard program
24 Percent reduction compared to the petroleum baseline fuel replaced. Results include EPA's mean estimate of land use change GHG emissions.

Feedstock	Fuel	Production process	Ag impacts	Land use change[21]	Feedstock transport[22]	Fuel production	Fuel distribution & use	Net emissions[23]	Percent reduction[24]
Sugarcane	Ethanol	Fermentation (Trash, No CBI, Marg. Elec)	39.4	5.3	1.9	-41.5	3.7	9.0	91%
Sugarcane	Ethanol	Fermentation (No Trash, No CBI, Marg. Elec)	38.2	5.3	1.8	-11.0	3.7	38.1	61%
Switchgrass	Cellulosic diesel	Fischer-Tropsch process	6.5	13.1	1.6	5.4	2.0	28.6	71%
Switchgrass	Ethanol	Biochemical enzymatic process	6.3	12.6	1.6	-32.6	2.1	-10.1	110%
Switchgrass	Ethanol	Thermochemical gasification process	6.6	13.1	1.6	3.7	2.2	27.2	72%
Yellow grease	Biodiesel	Transesterification	0.0	0.0	2.7	9.6	1.5	13.8	86%
Petroleum	Baseline gasoline	Refining	0.0	0.0	0.0	19.2	79.0	98.2	0%
Petroleum	Baseline diesel	Refining	0.0	0.0	0.0	18.0	79.0	97.0	0%

APPENDIX 2 – Mandates in selected international jurisdictions

Country/state	Biofuel mandate
Australia	Type – Blend mandate by volume New South Wales: 5% biodiesel and 6% ethanol Queensland: 0.5% biodiesel and 4% ethanol
Austria	Type – Blend mandate by energy content 5.75% biofuels overall with 0.5% advanced biofuels 6.3% biodiesel 3.4% ethanol
Brazil	Type – Blend mandate by volume 27% ethanol and 10% biodiesel 100% ethanol is also marketed in all fuel stations for flexi-fuel vehicles
Belgium	Type – Blend mandate by energy content 9.55% ethanol and 9.55% biodiesel
Canada	Type – Blend mandate by volume until Dec 2021 5% ethanol and 2% biodiesel From 2022 - GHG emission reduction mandate Fuel suppliers must reduce the carbon emissions of the liquid fossil fuels they produce and import from 2016 levels by 2.4 grams of carbon dioxide equivalent per megajoule (grams CO_2e/MJ) in 2022, increasing to 12 grams CO_2e/MJ in 2030.
British Columbia	Type - GHG emission reduction mandate 20% reduction in the carbon intensity of transport fuels by 2030 from a 2010 baseline (with the exception of aviation fuels)
China	Type – Blend mandate by volume No national mandate but seven provinces have mandatory 10% ethanol blending (Anhui, Guangxi, Heilongjiang, Henan, Jilin, Liaoning, and Tianjin). Five provinces have partially implemented ethanol mandates at varying levels (Hebei, Shandong, Jiangsu, Inner Mongolia, and Hubei). Three provinces (Shanxi, Zhejiang, and Guangdong) have pilot programmes in a few cities. Small trial programme using 2% and 5% biodiesel blends carried out in a few provinces.
Denmark	Type – Blend mandate by energy content 5.75% biofuels of which 0.9% must be advanced biofuels
European Union	Type - GHG emission reduction mandate 14% reduction in the GHG emissions of transport fuels by 2030. Within this 14%: › Food-based biofuels are capped at member state 2020 levels with a maximum cap of 7%. Biofuels made from used cooking oil and some animal fats limited to 1.7% in 2030 › Use of high indirect land use change crops should decrease to 0% in 2030 unless they are certified to be low- indirect land use change crops › Advanced biofuels must be supplied at a minimum of: – 0.2% of energy content in 2022 – 1% of energy content in 2025 – 3.5% of energy content in 2030

Country/state	Biofuel mandate
Finland	Type – volume mandate by energy content 20% of fuels must be biofuels from 2020 increasing to 30% in 2029. Within this share advanced biofuels must be 2% in 2023, increasing to 10 percent in 2030.
Germany	Type – GHG emission reduction mandate 6% reduction in the emissions of transport fuels from 2020. Within this share advanced biofuels must be 0.1%
India	Type – Blend mandate by volume 20 percent blending of ethanol with petrol and 5 percent blending of biodiesel with diesel by 2030.
Japan	Type – Blend mandate by volume 500 million litre (crude oil equivalent) ethanol mandate, which equates to an average blend rate of 1.8–1.9%. 10 million litres (crude oil equivalent) must be advanced biofuels.
Netherlands	Type – Blend mandate by energy content 16.4% biofuels of which 1.0% must be advanced biofuels and no more than 3% can be conventional crop based biofuels.
South Korea	Type – Blend mandate by volume 2.5% mandate for biodiesel
Sweden	Type – GHG emission reduction mandate GHG emissions reduction of 4.2% for petrol and 21% for diesel
United States	Type – Blend mandate by volume Volume targets for biofuels including conventional corn-based ethanol and advanced, cellulosic and diesel biofuels
California	Type - GHG emission reduction mandate 20% reduction in the carbon intensity of transport fuels by 2030 from a 2010 baseline.
Oregon	Type - GHG emission reduction mandate 10% reduction in the carbon intensity of petrol and diesel by 2025 from a 2015 baseline.
United Kingdom	Type – Blend mandate by energy content Biofuels 10.679% in 2021 increasing to 10.959 in 2030. Development fuels must be 0.556% in 2021 increasing to 3.196% in 2030. A mandatory 10% ethanol blend standard nationwide by September 2021.

APPENDIX 3 – Worked example of the calculation of fuel supplier performance and the penalty calculation

Fuel company A exceeds the required 2023 emissions percentage of 1.2%

In 2023 Fuel Company A supplies:

Fuels	Volume, million litres	Energy content, MJ/L	Emission factors, $kgCO_2$-e/MJ	Actual emissions, tonnes CO_2-e
Mineral Petrol (no blending)	300	33	0.102	1,009,800
Mineral Diesel (no blending)	200	38	0.095	722,000
Ethanol blended petrol, 9.8%	350	20	0.065	1,107,236.2
Biodiesel (FAME) blended diesel, 4.5%	180	37	0.045	634,045.5
Total	**1,030**			**3,473,081.7**

Energy produced by the Fuel Company A's fuels: 35.552 petajoules

Petrol + petrol/ethanol blend 21.120
Diesel + diesel/biodiesel blend 14.432

Volume supplied if all the fuels had been fossil fuels

Fuels	Volume, million litres	Energy content, MJ/L	Emission factors, $kgCO_2$-e/MJ	Emissions if all fossil, tonnes CO_2-e
Mineral Petrol (no blending)	639.99	33	0.102	2,154,199.2
Mineral Diesel (no blending)	379.79	38	0.095	1,371,030.5
Total	**1,019.78**			**3,525,299.7**

Actual emissions reduction achieved: 3,525,299.7 - 3,473,081.7 = 52,148

Required emissions reduction: 42,302.8

Percentage achieved: 1.48%

Fuel company A now has the choice to use the banking mechanism and carry forward 9,845.2 tonnes CO_2-e and use that to offset any future underachievement. Alternatively, before the end of the year in anticipating its overachievement, it could enter into an entitlement agreement with another fuel supplier. It would negotiate a price that the other supplier could count the volume of biofuels associated with the 9,845.2 tonne CO_2-e overachievement. That amount of biofuels would be deducted from its own volumes in its annual reporting and performance assessment.

Fuel company B does not achieve the required 2023 emissions percentage of 1.2% and incurs a penalty of $1,376,400

In 2023 Fuel Company B supplies:

Fuels	Volume, million litres	Energy content, MJ/L	Emission factors, kgCO_2-e/MJ	Actual emissions, tonnes CO_2-e
Mineral Petrol (no blending)	350	33	0.102	1,178,100
Mineral Diesel (no blending)	270	38	0.095	974,700
Ethanol blended petrol, 9.8%	180	20	0.065	569,435.8
Biodiesel (FAME) blended diesel, 4.5%	230	37	0.045	810,169.2
Total	**1,030**			**3,532,405.0**

Energy produced by the Fuel Company A's fuels: 36.31 petajoules

Petrol + petrol/ethanol blend 17.32
Diesel + diesel/biodiesel blend 18.99

Volume supplied and emissions if all the fuels had been fossil fuels

Fuels	Volume, million litres	Energy content, MJ/L	Emission factors, kgCO_2-e/MJ	Emissions if all fossil, tonnes CO_2-e
Mineral Petrol (no blending)	524.85	33	0.102	1,766,648.2
Mineral Diesel (no blending)	499.73	38	0.095	1,804,016.7
Total	**1,024.58**			**3,570,664.9**

Actual emissions reduction achieved: 3,532,405.0 - 3,570,664.9 = 38,259.9 tonnes CO_2-e

Required emissions reduction: 42,848 tonnes CO_2-e

Percentage achieved: 1.07%

Penalty

Fuel company B will incur a penalty for the 4,588.1 tonne CO_2-e difference between its actual emissions reduction and the amount it was required to achieve. The penalty rate for 2023 is $300 per tonne CO_2-e. The penalty is: 4,588.1 x $300 = **$1,376,400**