Finding low-cost-to-remove emissions in the operation of the light-vehicle fleet

Why New Zealand's upstream emissions trading scheme fails to reduce emissions from light-vehicle-transport, and what to do instead.

A research report by Paul Minett, Trip Convergence Ltd. December 2025.

Abstract

New Zealand's upstream Emissions Trading Scheme (NZ ETS) is broken. Even if it were not broken, the NZ ETS will continue to fail to achieve emissions-reduction in the operation of the light-vehicle fleet within the timeframes required. This report posits that there are opportunities that are neither expensive nor difficult for emissions reduction in the use of the light-vehicle fleet and proposes a downstream cap-and-trade emissions rights system with a sinking cap to complement the NZ ETS and deliver substantial fiscal benefits. New Zealand is an ideal location for experimentation that could pave the way for a paradigm shift in light-fleet emissions-reduction around the world. The present and forecast future ETS component of the price of NZ fossil fuels is too small to drive much emissions reduction. Emissions reduction from changing the fleet to electric is happening too slowly to achieve net-zero by 2050 because the installed base of fossil-fuelled vehicles does not retire quickly enough. There will be fossil-fuelled light-vehicles in driveways for several decades to come, and the needed focus is on progressively reducing the use of these vehicles.

Executive Summary

This report confronts the challenge of reducing greenhouse gas emissions from the operation of the light-vehicle fleet, a challenge that is not being met successfully anywhere in the world. In New Zealand the only brake on emissions from the light-vehicle fleet is the transition to electric vehicles. The EV transition is not happening quickly enough to meet periodic emissions reduction targets associated with the society-wide goal of net-zero emissions by 2050. But even if the electric transition happened more rapidly, the fossil-fuelled fleet will linger for decades.

In 2023, New Zealand's light-vehicle[1] fleet was responsible for some 8.9 megatonnes[2], or about 12% of gross domestic CO_2-e emissions, and in 2024, transport was the only sector that had not achieved reduced emissions compared with previous years, (New Zealand Ministry for the Environment, 2024a) (Climate Change Commission, 2025).

The genesis of this research was the government's stated intention to switch petrol vehicle owners' share of funding for the transport system from per litre fuel excise duty (FED) to per

[1] Also sometimes referred to as light-duty vehicles. Includes all vehicles with mass less than 3,500 kg. Includes cars, vans, SUVs, utilities, etc., owned by households and organisations.
[2] 1 megatonne is 1 million tonnes, 1 billion kilograms.

km road user charges (RUC) in January 2027, and an expectation that this switch will lead to a blow-out in emissions.

Given the imperative for emissions reduction trending to 'net zero by 2050', especially in the context of the terms of the Paris Agreement obligations, the larger question becomes 'how do we get there, from here?' regarding emissions reduction from the light-vehicle fleet.

New Zealand's upstream emission trading scheme (NZ ETS) is broken. The Climate Change Commission has been calling for something to complement the NZ ETS to reduce emissions from transport. This research finds and explains why the NZ ETS will continue to fail to reduce light-vehicle fleet emissions. Even if returned to credibility, the forecast NZ ETS prices are not high enough, the size of the NZ ETS component of the price of fuel is too small, and the change in fuel consumption in response to changes in fuel prices is too low, to make much difference to light-fleet emissions by 2050. The NZ ETS cost that flows through to individual motorists is too trivial to drive adjustments to trip-making, even though such adjustments would be easy and inexpensive to make.

The situation is compounded by New Zealand's clean car standard (CCS) being in disarray. The CCS is a solution put in place to help the NZ ETS reduce emissions from the light-vehicle fleet, by rewarding low emitting vehicle imports with 'CCS credits' and penalizing high emitting vehicle imports by making them use up CCS credits or buy penalty credits from NZTA. The implementation of the CCS has been described as a diabolical mess because vehicles with the same emissions rating attract a complex range of different quantities of credits and penalties. The government is watering down the impact of the CCS by substantially reducing the price of penalty credits in 2026.

As a result of the ongoing failure of the NZ ETS and the non-workability of the CCS, there is a gap in the policy framework that if not filled could lead to missed emissions targets and many billions of dollars of purchases of international mitigation outcomes at uncertain future prices and prevailing foreign exchange rates.

This report explores the potential for one solution that could fill the policy gap: a downstream tradable mobile emissions rights system (TMERS) that would complement the NZ ETS and deliver reliable quarterly emissions reductions from the light fleet, without imposing new taxes, and potentially be a replacement for the CCS.

There will be pain involved in reducing emissions from the light vehicle fleet. An important question is whether to confront the needed changes sooner, or to leave them until later. There are potentially substantial fiscal and productivity benefits that could flow from confronting the needed changes. By confronting the changes earlier there will be many more years of the benefits – potentially reducing offshore commitments as well as improving domestic productivity. By confronting them later, there is risk of a more disruptive change being needed including greater levels of scrappage of fossil-fuelled vehicles that have not reached the end of their economic life. By confronting the changes gradually but with certainty under TMERS there is a possibility of lower pain in total.

The TMERS described in the report builds on over 30 years of academic enthusiasm for tradable rights as a mechanism for controlling the quantity of a polluting activity, allowing the market for the rights to control the price. This approach is often contrasted with charging a pollution tax, in which a central authority controls the price associated with the polluting activity, and demand at the given price controls the quantity. New Zealand needs to control the quantity of emissions from operating the light-vehicle fleet, and tradable rights will deliver that outcome without the imposition of new taxes. An online international symposium of experts, convened to get input to the TMERS concept, endorsed the approach.

At its simplest level, for the person who is 16+ years and does not wish to engage with the details of the system, the following description would apply.

Having registered for a TMERS account on the app, online, or in person, and completed profile information to ensure they get any equity adjustments they are entitled to; they will see free quarterly deposits of rights into their TMERS account. If owning/operating a fossil-fuelled vehicle: when buying fuel, they will use the quantity of rights automatically advised by the retailer, either by swiping on their phone, or with their TMERS card, and will see the rights being deducted from their TMERS account. If needing more rights than their free quarterly allocations they will buy them from the market at the market price by their most convenient method - on the phone, online, in person at the fuel station, or in person at an NZTA agency. If they have surplus rights – due to having no fossil-fuelled vehicle or making no or few fuel purchases – they can save, gift, or sell the surplus rights, privately or through the market, also by their most convenient method.

The TMERS described in the report makes a free allocation of a quarterly nationwide budget of light-fleet emissions on an equitable basis among almost all adult people, whether they have a driver's license and a car or not. Importantly it makes no allocation of rights to organisations, even though organisations are required to use TMERS rights when they purchase fuel – the same as for individuals – so organisations will need to buy rights. Because the quarterly allocation to individuals is for all light-fleet emissions, on average people will receive more rights than they need and have a surplus available to sell to organisations.

While allowed to trade privately, most people and organisations will trade rights through one or more market makers. The market makers will be required to advertise buy and sell prices and stand in the market to buy and sell and publicly report transaction volumes and prices to ensure transparency.

The retailers of fossil fuels will be required to ensure they receive rights related to every sale of fossil fuel to the light vehicle fleet, based on the emissions content of the fuel involved. Each right will allow the holder to purchase fossil fuel with emissions content of one kilogram. Retailers will then have to account to the government for all the rights they have received, balanced to their total sales of fossil fuels and related emissions content in the period.

Fossil fuels will already have an NZ ETS tax-paid content because fossil fuel companies are required to surrender NZUs annually for the emissions content of the fuel they have sold. The TMERS rights represent a right to purchase the tax-paid fuel, and the result of the TMERS is establishing 'who' can make that purchase.

The nationwide quantity of rights allocated each quarter will be less than the previous quarter so that the target level of light-fleet emissions in 2050 can be achieved. As rights allocations reduce over time, the price of rights will rise if sufficient offsetting reductions have not been made – and the higher price will encourage greater reductions.

There are many additional details. The process for deciding the equitable basis for allocation is expected to have a big impact on the public acceptability of the solution. The report recommends settings for most aspects of the solution, all of which have been based on making the solution as beneficial as possible to the widest number of people, with the idea that they might have the opportunity to choose the solution in a referendum. There is a lift-out draft TMERS specification in Appendix 5, page 82 that includes discussion of issues and uncertainties that need to be addressed.

The report finds there will not be a blow-out in emissions with the switch from FED to RUC and explains why, and how much government revenues will be increased by the switch. But the timing of that switch would be the ideal timing for introduction of TMERS. Owners of high emitting petrol vehicles (dominantly organisations) will receive a reduction in their 'fuel plus RUC' costs with the switch, that could be absorbed by TMERS transactions, easing the transition to TMERS for organisations.

New Zealand is a small consumer of fossil fuels in the global context, and emissions by the rest of the world will drive climate change outcomes in New Zealand regardless of what New Zealanders do. However, New Zealand could lead the way to global emissions reduction from the light fleet, with substantial domestic fiscal and productivity gains for New Zealand. The report finds the present value of emissions avoided by implementing TMERS to be in the order of $16 billion. To this can be added health benefits of decarbonising transport estimated to be in the order of $1.1 billion per year from 2030, and the reduced need for unpredictable offshore payments related to the Paris Agreement if the five-yearly budgets are exceeded.

Further development of TMERS is strongly recommended, and a potential pathway forward is described.

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Introduction

Context

"*Some States have taken fossil fuel phaseout measures but what is needed is priority, comprehensive and coherent action on the fossil fuel phaseout within this decade, to ensure a liveable future for all*." Report of the Special Rapporteur on the promotion and protection of human rights in the context of climate change, Elisa Morgera, 15 May 2025, (United Nations Special Rapporteur, 2025).

New Zealand is a signatory, since 2016, to the Paris Agreement which aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty. As such, New Zealand has legally binding international obligations to reduce its CO_2-e[3] emissions.

Under the terms of the Paris Agreement, the Crown has a potential future obligation to make large, uncertain, offshore cash payments at rising carbon prices to the extent that emissions are not avoided in line with agreed targets, (United Nations 2015). The obligations are stated in quantities of emissions over the 2021 to 2030 budget period, followed by 5-year budget periods *ad infinitum*. The first period of reckoning will be during the early 2030s when emissions for the 2021-2030 period will be accounted for. At that time, and after each budget period following, if there have been excess emissions the Crown will have to purchase internationally transferable mitigation outcomes[4] (ITMOs) equal to the excess, (New Zealand Treasury, 2023).

New Zealand has internally set an objective of 'net zero emissions by 2050', which will require almost full decarbonisation of the transport system by 2050, (New Zealand Ministry of Transport, 2022b). Both of New Zealand's first and second emissions reduction plans emphasize the influence individuals and households have in the direction of the transport system regarding emissions reduction, (New Zealand Ministry for the Environment, 2022, and 2024b). However, the main levers that have been put in place to reduce emissions from transport only tangentially touch individuals and households, and awareness of them is low or non-existent[5].

In 2023, New Zealand's light-vehicle[6] fleet was responsible for some 8.9 megatonnes[7], or about 12% of gross domestic CO_2-e emissions, and in 2024 transport was the only sector that had not achieved reduced emissions compared with previous years. (New Zealand Ministry for the Environment, 2024a) (Climate Change Commission, 2025).

In its July 2025 emissions reduction monitoring report, assessing 2024 progress towards meeting emissions budgets and the 2050 target, noting that there had been emissions reductions in all sectors except transport, the Climate Change Commission recommended implementing additional targeted transport policies to complement the New Zealand

[3] CO_2-e translates to 'carbon dioxide equivalent' and incorporates several different greenhouse gases (GHG) into a single quantifiable metric. Many reports shorten the term further and talk about 'carbon'. In this document these terms (CO_2-e, GHG, Carbon) are interchangeable unless otherwise stated in a specific context.
[4] See https://unfccc.int/process-and-meetings/the-paris-agreement/article-6/article-62
[5] Author's impression, reinforced by comments from vehicle dealers interviewed during the research.
[6] Also sometimes referred to as light-duty vehicles. Includes all vehicles with mass less than 3,500 kg. Includes cars, vans, SUVs, utilities, etc., owned by households and organisations.
[7] 1 megatonne is the same as 1 billion kilograms and 1 million tonnes.

Emissions Trading Scheme and made a strong call for reductions of gross emissions rather than relying solely on 'removals' from forestry in the period up to 2050. The report cites substantial co-benefits from emissions reduction and gives as an example the potential health gain from improved air quality of NZ$1.1 billion per year by 2030 that would result from faster climate action in transport and electrification, (Climate Change Commission, 2025).

Levers to reduce transport emissions

New Zealand's two main explicit levers for transport emissions reduction are the New Zealand Emissions Trading Scheme (NZ ETS) and the Clean Car Standard (CCS). The price of petrol and the fuel excise duty (FED, petrol tax) also combine to be an implicit lever for transport emissions reduction. The National Land Transport Fund (NLTF) has also been identified as a potential financial lever for reducing transport emissions through the infrastructure investments made using NLTF capital.

New Zealand Emissions Trading Scheme

The NZ ETS imposes a cost on major emitters for the CO_2-e emissions related to their products or processes, by requiring them to acquire and surrender New Zealand Units (NZUs, equivalent to 1 tonne of CO_2-e emissions) for their emissions. There is a theoretical though not explicit sinking cap on the number of NZUs the government sells into the market, and hence an expectation that the number of NZUs available will decline over time, causing the price of NZUs to rise, making it economically more compelling to reduce emissions as time passes. Lowest 'cost-to-reduce' emissions would be removed first, wherever in the economy they occur, and as the NZU price rises so more costly-to-remove emissions would come into focus by the same 'invisible' mechanism as it becomes more profitable to remove the source of the emissions than to pay for the NZUs. There is a single price for NZUs for all sectors of the economy. Having a single price ensures that a high cost is not spent removing emissions in one part of the economy while the same overall impact could have been achieved at a lower cost in some other part of the economy.

Fossil fuel importers/distributors are categorized as major emitters even though they have no control over the consumption of their product. The retail price of fossil fuels therefore includes the cost of the NZUs that the importers must surrender. The underlying expectation is that as the price of NZUs rises over time the price of fossil fuels will rise and encourage lower consumption and therefore reduce emissions[8] from transportation.

The Clean Car Standard

The CCS was launched as a major (but not at the time intended to be sole) initiative to help the NZ ETS reduce light-vehicle fleet emissions by encouraging importers to import more zero or low emissions vehicles and fewer high emissions vehicles. The essence of the CCS is the setting of a target average level of emissions per km for the year for all imports, and a) awarding credits for every vehicle imported that has an emissions rating below the target and b) requiring surrender of credits for every vehicle imported that has an emission rating above the target. Each credit represents 1 gram per km, so (for example) importing a vehicle that has an emissions rating 20 g/km below the target would yield the importer 20 credits.

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[8] When consuming fossil fuels, energy efficiency (in litres/100km) and emissions rates (g/km) have a constant relationship for each type of fuel, so any change in consumption delivers a same-magnitude change in CO_2-e emissions, regardless of the energy efficiency of the vehicle fleet.

Similarly, importing a vehicle that has an emissions rating 20 g/km above the target would require surrender of 20 credits. Importing a zero-emissions electric vehicle (EV) earns credits equal to the target. Credits can be traded between importers. If importing vehicles with emissions ratings higher than the target and having no credits to surrender, credits can be purchased from other importers, or from the Government. In theory the CCS should make low emissions vehicles less expensive (by the value of the credits earned) and higher emissions vehicles more expensive (by the value of the credits that must be surrendered).

Fuel excise duty and the price of petrol

In its 2024 report about pricing of greenhouse gas emissions, the OECD considers fuel excise duties (FED) to be an implicit form of carbon pricing, (OECD, 2024). FED is charged on a per-litre basis, such that taking actions to improve the energy efficiency of vehicle-use can be expected to result in less fuel use and lower operating costs on a per kilometre basis. Since emissions are a constant factor for any given type of fossil fuel, improving energy efficiency should be an attractive emissions-reduction opportunity at some level of FED. While the OECD singles out just the FED component of the price of fuel, the entire retail price of fuel can be seen to operate in the same way. A consumer would not know precisely how much the FED is and how much the underlying cost of the fuel is and could be expected to respond to changes in either component in the same way.

In New Zealand FED is charged only on sales of petrol and is used to fund land transport management. Diesel vehicle owners and electric vehicle (EV) owners[9] are required to pay a flat 'per km' road user charge (RUC) as their contribution to the cost of land transport management.

The National Land Transport Fund

The NLTF could be used as an indirect lever for reducing transport emissions if the policies for use of the fund emphasised low-emissions modes such as public transport service improvements, bus fleet decarbonisation, walking and cycling infrastructure, carpooling and vanpooling, and other travel-demand-management activities, and deemphasised road-capacity expansions that tend to increase VKT. The Government Policy Statement on Land Transport sets out political priorities for use of the NLTF.

The questions this research set out to answer

Given the above context, the government's announced plan to switch the petrol light-fleet from FED to RUC caused some concern. The government's explanation is that it wants to 'level the playing field' between highly energy-efficient petrol vehicles, that on a per km basis are paying relatively little in FED, and energy-inefficient vehicles that on a per km basis are paying substantially more. The change would make the cost of motoring (petrol plus RUC) higher than it was before for more energy-efficient petrol vehicles, and lower than before for more energy-inefficient petrol vehicles. The change would remove a significant implicit lever (the FED component of the petrol price) and could result in an overall increase in emissions as petrol-vehicle owners respond to their changes in costs in predictable ways: owners of energy-efficient vehicles experiencing increased costs would reduce their consumption (and therefore emissions), and owners of energy-inefficient vehicles experiencing reduced costs would increase their consumption. The concern is that this

[9] EV owners have been required to pay RUC since April 2024.

change could lead to a substantial increase ('a blow-out') in emissions. The research was therefore designed to answer three questions:

1. Does the price of petrol have any impact on the decision-criteria of vehicle buyers (so will rising prices of NZUs drive a reduction in average emissions of the light-vehicle fleet)?
2. Will there be a blow-out in petrol consumption and emissions when the switch from FED to RUC is implemented? and,
3. Could a downstream[10] tradable mobile emissions rights system (TMERS), with a sinking cap, that issues free "tradable emissions allowances" to people (but not to organisations), that requires surrender of rights by individuals and organisations when they buy fuel for light vehicles, help reduce emissions from the light-vehicle fleet, and if so, what would be involved in putting such a system in place?

Method

The project included:

1. Carrying out a desk-based stock-take of the methods by which New Zealand is managing reductions to light-vehicle fleet emissions.
2. Gathering and summarising international and New Zealand literature about
    a. the elasticities of petrol consumption and vehicle purchase decisions to petrol price changes,
    b. the concepts and experience of tradable mobile emissions rights systems, and
    c. other relevant topics as they arose throughout the project.
3. Gathering and analysing New Zealand vehicle purchase energy-efficiency data and petrol price data series to discover the New Zealand elasticity of vehicle emissions-related purchase decisions to petrol price changes.
4. Interviewing vehicle dealers about the relevant data customers receive regarding the future prices of fossil fuels, and as a result digging deeper into the details of New Zealand's Clean Car Standard.
5. Using New Zealand 'Whole of Government' agreed CO_2-e shadow prices for 2025-2070 to forecast the average price of petrol each year.
6. Using estimated elasticities to predict the impact of changes in the price of petrol on
    a. the overall consumption of petrol each year
    b. the emissions profile of additions to light-vehicle fleets each year.
7. Obtaining the emissions profile of the current petrol light-vehicle fleet and other relevant data and estimating the change in emissions that might occur when there is a change from FED to RUC for petrol vehicles.
8. Estimating the emissions profile of the fleet through to 2050.
9. Developing a strawman downstream tradable mobile emissions rights system.
10. Reaching out to experts in the tradable rights field and together with the Ridesharing Institute hosting an international online symposium of experts to discuss the overall approach and to critique the strawman.
11. Drawing conclusions and making recommendations.

[10] The distinction between 'upstream' and 'downstream' systems is from the point-of-view of the consumer. Upstream systems impact on supply or pricing before goods reach the consumer. Downstream systems impact directly on the consumer. New Zealand's emissions trading scheme is an upstream system.

The various threads of work can be seen in Figure 1.

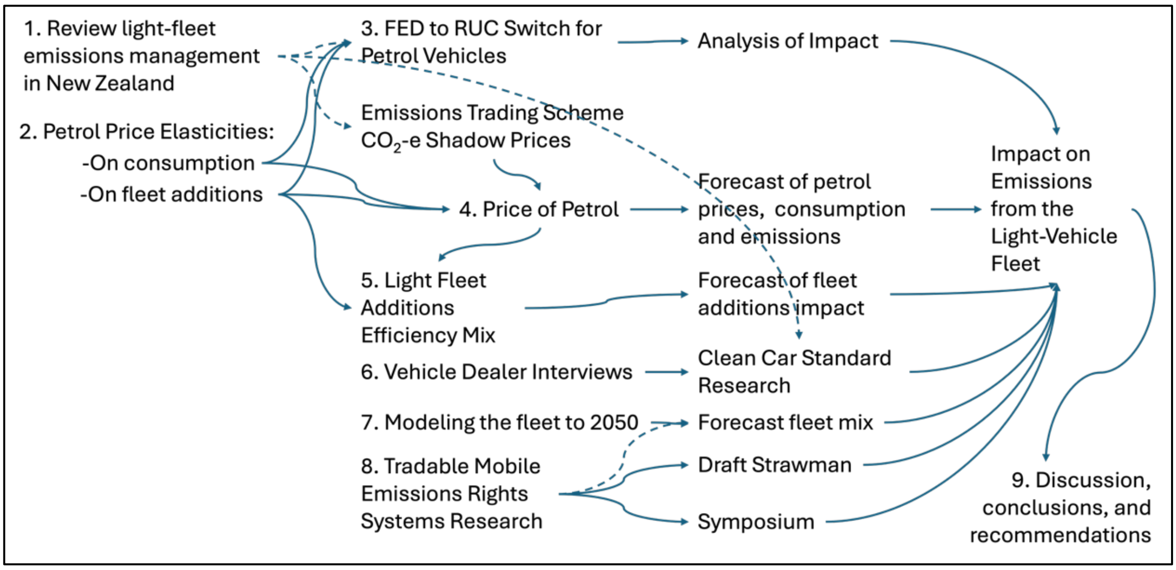

Figure 1: Report schematic, section numbers showing

The report conforms to the logical flow shown in Figure 1. The numbering in Figure 1 corresponds to the sections in the report.

Avoiding spurious precision

Many of the relevant numerical factors that are used in the report, drawn from external sources, reflect a high level of precision, sometimes running to ten or more decimal places. This can give rise to a level of spurious precision when using such factors for broad estimates. This report avoids being overly precise, on the basis that the important conclusions should flow from a compelling feeling about the magnitude and direction of impact, rather than the nth decimal place. The author takes responsibility for any errors of evaluation that might flow from this position. For brevity only the results of calculations are presented. Please contact the author for access to details of the calculations if needed.

A note on the language of transportation energy-efficiency

In some parts of the world, transportation energy efficiency is denoted in miles per gallon (mpg) in which increases are good because the measure is how much distance can be covered for every unit of energy expended. In other parts of the world, energy efficiency is denoted in litres per hundred kilometres (L/100 km) in which increases are bad because the measure is how much energy is expended to cover a given distance. This paper follows the latter schema and tries to avoid inadvertent confusion. Sometimes the mental paradigm gets challenged and the reader is asked to bear this in mind while reading and considering the content.

Project work

1. Light-fleet emissions management in New Zealand

New Zealand has an array of mechanisms in place that could bring about a reduction in CO_2-e emissions, including some that are specific to the light-vehicle fleet. The array includes a scheme (NZ ETS), a standard (CCS), systems (FED, energy efficiency, Transport Project Evaluation), strategies (Emissions Reduction Plans (ERP) for each plan budget period with public consultation), policy statements (the GPS with public consultation), funding mechanisms (the NLTF driven by the GPS), and feedback loops (various evaluation and advice-seeking requirements involving the Climate Change Commission).

However, the NZ ETS appears to be broken; the CCS has been described by vehicle dealers[11] as a "diabolical mess" and appears to have stopped working; the Climate Change Commission laments an apparent over-reliance on "removals of CO_2 via forestry" rather than "reductions in gross emissions" in the government's plans; (Climate Change Commission, 2025), the government plans to switch from FED to RUC, thereby removing an implicit carbon pricing mechanism, and the GPS directs use of the NLTF to expansion of roads and deemphasises cycling and walking infrastructure.

The government has introduced legislation to change several of the mechanisms listed above including the NZ ETS, the CCS, the advisory requirements of the Climate Change Commission, the level of public consultation required to change climate-related targets, (Beehive, 2025a; Hansard Scoop Auckland, 2025), and is preparing legislation for the switch from FED to RUC.

The following paragraphs expand on the apparent issues mentioned above.

Is the NZ ETS broken? In August 2024 the Government stated that the then current price of NZUs (in the \$50 - \$54 range) was "*insufficient to encourage businesses and individuals to reduce their emissions*", and that it intends to return the NZ ETS to credibility by 2030. The government reduced planned quantities of NZUs available at auction each year and raised the floor price, (Beehive 2024). None of the three 2025 auctions of NZUs so far, subject to a floor price of \$68.00, have resulted in sales, and the units offered were passed in, (New Zealand Ministry for the Environment, 2025). In November 2025 the Government announced an overhaul of the Climate Change Response Act, dominated by changes to the NZ ETS and delinking it from international obligations, (Beehive 2025a). Following the announcement, the price of NZUs dropped from recent levels of around \$55 to about \$46 and lower. There is limited information available about the planned changes, but market reaction suggests that at least some holders of NZUs would like to reduce their holdings. It looks as if the NZ ETS is indeed broken.

Burning an average litre of petrol in New Zealand (regular or premium) results in 2.46 kg of CO_2-e emissions[12]. One tonne of emissions is generated for every 406.5 litres of petrol used. The NZU price of \$55, with 15% GST added, therefore imposed a cost on petrol-vehicle motorists of about 15.5 cents per litre[13], or about 5.7% of the current retail price of petrol. This would become 8.6% with the removal of FED. It represents a cost of only about 1.26 cents per kilometre at petrol-vehicle average fuel-efficiency of 8.1 L/100 km. It is difficult to

[11] In interviews for this research

[12] Some people find this surprising, because 1 litre of petrol weighs less than 1 kg. The reason for the added weight is the two atoms of oxygen from the air that bind to each atom of carbon from the petrol as the petrol combusts: hence a molecule of CO_2 has the weight of 1 carbon atom and two oxygen atoms. The full explanation includes the further addition of some other gases. The 2.46 kg/l conversion factor was sourced from https://www.climatiq.io/data/emission-factor/a91a3a47-efe9-4c69-a415-8b02fdd4fa48?. This factor can fluctuate over time.

[13] This assumes the petrol retailer does not seek a margin on this cost over and above their cost price. The research did not include verification of how petrol retailers treat this cost as they set their retail prices.

see how, even if the NZ ETS were not broken and the NZU price was two or three times as high, it would have any material impact on consumer mode-choice.

Is the CCS a diabolical mess? The CCS had some early success, reducing the average emissions of fleet additions (new and used imports) from a monthly range of 189 to 195 g/km in 2020 to a 2025 year-to-date (to end October 2025) range of 148 to 157 g/km, with an average (year-to-date) of 152 g/km, see Figure 2. The year-to-date target for 2025 ranged from 134 to 140 g/km, with an average of 136. The actual is about 12% off the target and represents a consistent failure to meet monthly targets through 2025, (NZ Transport Agency Waka Kotahi, 2025a).

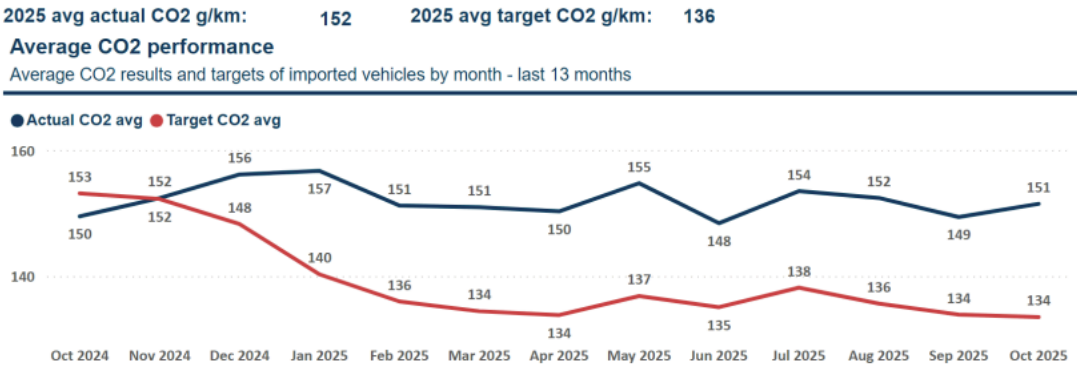

Figure 2: CCS CO2 performance to October 2025. (Source: NZ Transport Agency Waka Kotahi, 2025a)

Under a CCS, it would seem reasonable to expect that all vehicles with the same rating of g/km emissions imported during a year would attract the same number of credits if their g/km emissions were rated below the annual target or require surrender of the same number of credits if their g/km emissions were rated above the annual target. However, the reality is that there is a lot of variability. Based on analysis of CCS data[14], for example[15], 36 different credit quantities were found to apply to zero emissions vehicles (EVs) for 2025, ranging from 100 to 234 credits, and 26 different penalty values were found to apply to vehicles with emissions of 198 g/km, ranging from -62 to -98, and a single credit value of +28. It seems surprising that EVs would earn different numbers of credits, and that a 198 g/km emissions vehicle could earn credits under a Clean Car Standard.

Further, the face value of (the price the government charges for) a CCS penalty credit for new vehicles in 2025 is $54, and for used vehicles it is $27[16]. There is no public register of trades of CCS credits between importers and therefore no market price is available, however importers advised[17] that credits are trading at a substantial discount (>40%) to the face value. In mid-November 2025 the Minister of Transport announced that for 2026 and 2027 the face values of the credits would be reduced by nearly 80%, (Beehive, 2025b). All in all, the CCS does look messy. The Minister of Transport says it is not working, (Beehive 2025b).

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[14] https://importer.fuelsaver.govt.nz/, click on 'Vehicle Emission Examples for CCS', or click https://dealer.rightcar.govt.nz/resources2021/downloads/Reference-File-of-Vehicles-20250430.xlsx

[15] Zero and 198 g/km were the only ratings tested for this work. It is possible that they are the only ones with multiple different credit values, but it seems more likely that further investigation would reveal many more examples.

[16] See https://www.nzta.govt.nz/vehicles/clean-car-programme/clean-car-standard/information-for-importers-how-the-ccs-works/credits-charges-and-payments

[17] During interviews carried out as part of this research.

The switch from FED to RUC will remove an implicit carbon pricing mechanism. What type of impact will it have? Once the change occurs, FED of about 80 cents will be removed from the price of petrol, and petrol will then retail for about $1.80 per litre (based on retail prices in August 2025). It is not known how the budgeting will work in people's minds over time. Immediately after the switch it seems likely people will be very aware and think in terms of total variable motoring costs of "RUC plus petrol". But over time it is possible that the RUC component will fall into a different mental budget, and to the extent it makes a difference to how much petrol people buy, $1.80 per litre might start to feel inexpensive. This might also depend on how RUC payment is implemented, which the government has not yet disclosed. In the system that applies to diesel and electric light-vehicles, motorists buy 1,000 km blocks of RUC in advance, at about $80 per block including admin costs. There is talk of tracking vehicle kilometres in real time and charging for use as it happens, but that sounds very expensive to implement and could raise privacy issues. However, as mentioned above, the remaining price of petrol is also an implicit carbon pricing mechanism.

2. Petrol price elasticities literature

How does consumption of petrol respond to changes in the price of petrol? Economists use the term 'elasticity' to talk about this. Goodwin (1992) calls elasticities "*crude and approximate measures of aggregate response in a market".* Elasticity is stated as a number, being the direction and the percentage, that consumption is estimated to change in response to a 1% change in price. For example, an elasticity estimate of -0.5 would mean that for a one percent increase in price, consumption is estimated to reduce by half a percent, and for a one percent decrease in price, the opposite. Elasticities are always stated as estimates because of the complexity of possible explanations for changes observed.

Products are said to be price inelastic if consumption does not change very much when there is a price change, and highly price elastic if consumption changes a lot. Petrol consumption is price inelastic. In other words, price changes do not have much impact on petrol consumption. But how much is not much? For petrol, economists talk about short run elasticity, meaning what happens right away, and long run elasticity, meaning what happens over the following year or two. This makes intuitive sense: in response to a petrol price increase perhaps in the short run some people make more effort to chain trips or avoid trips or drive more efficiently or catch public transport or carpool some days, before in the longer run changing the type of vehicle they drive or shifting to a closer-in suburb. In general, the estimates of elasticity in New Zealand and overseas find that the long run elasticity is about double the short run elasticity, and the long run effect is mostly felt over the two years following the price change, (Goodwin, 1992) (Hyslop et al, 2023).

Estimating the price elasticity of demand for petrol in New Zealand

There have been several New Zealand studies that estimate the elasticity of New Zealand demand for petrol, and or demand for vehicle kilometres travelled, given changes in petrol prices. Studies generally treat consumption of petrol and consumption of vehicle kilometres (as vehicle kilometres travelled, VKT) as somewhat interchangeable (as does this report as well). Further, each study seems to take a slightly different focus and different methodology making comparison feel less reliable. However, the different studies tend to find results of similar general magnitude. See Table 1.

Table 1: Petrol price elasticities in New Zealand, studies

<table>
<tr><th>Source</th><th>Year</th><th>Short run</th><th>Long run</th><th>Notes</th></tr>
<tr><td>Hughes</td><td>1980</td><td>-0.11</td><td>-0.14</td><td rowspan="5">Petrol consumption estimates, as reported by Kennedy & Wallis (2006).</td></tr>
<tr><td>Waikato University</td><td>1982</td><td>-0.13</td><td>-0.16</td></tr>
<tr><td>Ministry of Commerce</td><td>1991</td><td>-0.03</td><td>-0.07</td></tr>
<tr><td>MED</td><td>2000</td><td>-0.07</td><td>-0.19</td></tr>
<tr><td>Barns</td><td>2002</td><td>-0.20</td><td>-0.07</td></tr>
<tr><td>Wallis</td><td>2004</td><td>-0.15</td><td>-0.25</td><td>Private transport (cars) demand only</td></tr>
<tr><td>Kennedy & Wallis</td><td>2006</td><td>-0.2</td><td>-0.5</td><td>All Light Fleet Fuel Consumption</td></tr>
<tr><td>Kennedy & Wallis</td><td>2007</td><td>-0.15
-0.09
-0.27
-0.12</td><td>-0.3
-0.24
-0.36
-0.19</td><td>Vehicle Kilometres Travelled (VKT)
Urban peak VKT
Urban off-peak VKT
Rural VKT</td></tr>
<tr><td>Sheng & Sharp</td><td>2019</td><td>-0.08
-0.10</td><td></td><td>Petrol VKT
Diesel VKT</td></tr>
<tr><td>Torshizian & Meade</td><td>2020</td><td></td><td>-1.83</td><td>Households only</td></tr>
<tr><td>Hyslop et al</td><td>2023</td><td>-0.30</td><td>-0.66
-0.783
-0.752
-0.685
-0.597
-0.429</td><td>Households, petrol consumption
Lowest household income quintile
2nd lowest quintile
Middle quintile
2nd highest quintile
Highest household income quintile</td></tr>
</table>

The short run elasticity estimate is in the order of -0.1 to -0.2, meaning that for a 1% rise in the price of petrol it is estimated that there will be a reduction of 0.1% to 0.2% in consumption of fuel or VKT (and vice versa for falls in the price of petrol).

The long run elasticity estimate is about -0.5, meaning that over time the short run change of about -0.1% to -0.2% in response to a 1% price change will increase to a total change of about -0.5%. In the first year, some adjustment occurs (-0.2); by the third year the remaining adjustment has occurred, summing to -0.5 (which includes the -0.2 adjustment of the first year).

Note that there is a difference between household consumption and overall consumption elasticity estimates in Table 1, in which the household consumption elasticity estimates seem much higher. It seems reasonable to suppose that commercial/organisational elasticity estimates would approach zero (be almost totally inelastic) such that a weighted average of household and commercial/organisational elasticity estimates would produce the shown lower overall elasticity estimates. For elasticity to be close to zero for commercial/ organisational consumption it seems most likely that the cost of petrol is seen as 'the cost of doing business', and an expectation that changes in that cost could be passed on to consumers or funders.

For modelling the impact of petrol price changes on petrol consumption in this research, the following elasticity estimates are used for all light-fleet petrol consumption following a change in the price of petrol: short run: -0.2, long run: -0.5. The short-run change is modelled to occur in the year of the initial price change, and the long-run change is modelled to occur equally over the following two years. Therefore, for simplicity, the elasticity estimates are applied in the modelling as follows: Year 1: -0.2, Year 2: -0.15, Year 3: -0.15.

Estimating the impact of fuel price rises on the fuel efficiency of the vehicle fleet

The difference between the short and long run impact on petrol consumption of a change in petrol prices relates to the different ways in which people and organisations can respond over shorter or longer time periods. Generally, as the length of time for adjustment increases, the range of possible adjustments increases (Goodwin, 1992) and by implication the cost of adjusting decreases as alternative methods of adjusting become evident. As a result, long run elasticities (in absolute value) are likely to be greater than short run elasticities. As mentioned above, in the short run people might avoid trips, chain trips, or take some trips by shared or active modes, but in the longer run they might replace their vehicle with a more efficient technology, or change their residential or employment location to enable a lower reliance on petrol purchases. A key focus of this report is the possible replacement of vehicles with more energy-efficient ones in response to changes in the price of petrol.

While many people hold the view that petrol prices have no impact on vehicle-efficiency purchase decisions, several international studies have shown that this is incorrect. Stated in various ways, there is evidence that as petrol prices rise, fewer vehicles are purchased overall, and proportionately fewer energy-inefficient vehicles and proportionately more energy-efficient vehicles are purchased. The result is that there is a somewhat predictable reduction in average emissions (in g/km) of additions to the fleet as petrol prices rise; and the scrappage rate of energy-inefficient vehicles can be expected to rise as well. Overseas studies find this elasticity to be very low: in the order of -0.1 or less, depending on the market being studied (see Table 2). No comparable work was found that estimated this elasticity based on New Zealand data, however changes in vehicle technology are often mentioned as a component of the long run impact on petrol consumption in New Zealand, (Hyslop et al, 2023).

Table 2: Reference studies for elasticities of petrol prices on vehicle fleet additions

Study	Data Source and Years	Change in petrol price	Impact on Light Vehicle Purchases	Impact on Whole Light Fleet Economy/emissions*
Li et al (2009)	USA, 1997 to 2005	+10% on 2005 base		Short run 0.22% increase in economy (miles per gallon), long run 2.04% increase in economy
Barla et al (2009)	Canada, 1990 to 2004	+10%		1% reduction in emissions
Klier & Linn (2010)	USA, 1978 to 2007	$1 per gallon increase	Improve economy by 0.8-1 miles per gallon	
Barla et al (2016)	Quebec, 2002 to 2008		Threshold inflection point is 8.65 litres per 100 km	
Xu et al (2023)	China, 2013 to 2019	Rising	Sales >, Threshold inflection point falling over time: 2013-2015 8.6 l/100km 2013-2019 7.4 l/100km 2017-2019 5.5 l/100km	Elasticity of -0.11

*Economy and emissions are inversely related for this purpose

This project attempted to generate fleet-additions fuel-efficiency elasticity estimates for New Zealand without success (see page 25). Therefore, for modelling the impact of a change in petrol prices on additions to the light-vehicle fleet and to whole fleet energy efficiency this research uses an elasticity estimate of -0.1 based on the international findings.

3. Impact of the FED to RUC switch for petrol vehicles

Composition of the petrol light-vehicle fleet.

The composition of the New Zealand petrol light-vehicle fleet by technology and emissions categories at the end of August 2025 is shown in Table 3. The fleet is divided into seven emissions categories.

The FED to RUC switch applies only to the petrol light-vehicle fleet, which by the end of August 2025 comprised 3.4 million vehicles (see Table 3), including pure petrol, petrol hybrid, and plug-in petrol hybrid vehicles. In New Zealand, fuel excise duty (FED) is used to gather revenue from the petrol light-fleet to help fund the transport system budget. It is charged on a per litre basis.

Table 3: Petrol light-vehicle fleet composition by technology and emissions category on 31 August 2025[18]

		Vehicle emissions categories in grams of CO2-e per km of travel							
	Grand Total	Zero (0g/km)	Very low (1-49g/km)	Low (50-99g/km)	Moderate (100-149g/km)	High (150-199g/km)	Very high (200-249g/km)	Extremely high (over 250g/km)	Unknown
Petrol									
Petrol	3,012,324	2	16	1,061	251,421	1,132,380	664,303	413,374	549,767
Hybrid Petrol	356,531	12	1	164,296	167,980	21,335	2,072	303	532
PHEV Petrol	39,472	36	27,431	10,634	115	126	3	11	1,116
Total Petrol	3,408,327	50	27,448	175,991	419,516	1,153,841	666,378	413,688	551,415

Revenue towards the transport system budget from the light-vehicle fleet

Table 4 shows the current rates of revenue towards the transport system budget from the vehicles in the light fleet, together with the situation that will prevail once the switch from FED to RUC has been completed. The current RUC rate for diesel and electric vehicles is based on the average fuel efficiency of the petrol fleet of 9.5 litres per 100 km, that was last updated in 2012. The light-vehicle fleet (vehicles with a mass of less than 3,500 kg) is thought to cause no wear-and-tear damage to the roads, so wear-and-tear costs are recovered only from heavy vehicles, via heavy-vehicle RUC at rates that are higher than for the light-vehicle fleet, (New Zealand Ministry of Transport, 2022a). The government has announced its intention to raise the FED rate (and the RUC rate proportionately) by 12 cents per litre from 1 January 2027 and a further 6 cents from 1 January 2028, (New Zealand Government, 2024)[19].

[18] Source: https://www.transport.govt.nz/statistics-and-insights/fleet-statistics/monthly-mv-fleet/, current fleet summary table tab, reconfigured by the author.

[19] The announced FED increases in 2027 and 2028 have not been factored into the analysis in this report.

Table 4: Current and future light fleet recovery of transport system costs

Source of funds for light vehicle fleet share of transport system operations and management costs							
	Current				Future		
Technology	Fuel Excise Duty (FED)	Rate	Road User Charge (RUC)	Rate	Fuel Excise Duty (FED)	Road User Charge (RUC)	Rate**
Petrol (inc petrol hybrid)	✓	$0.80/litre	✖		✖	✓	$TBA/km
Plug-in petrol hybrid	✓	$0.80/litre	✓	$38/1,000 km*	✖	✓	$TBA/km
Diesel	✖		✓	$76/1,000 km	✖	✓	$TBA/km
Electric	✖		✓	$76/1,000 km*	✖	✓	$TBA/km
*Since 1 April 2024. Previously these vehicles paid no RUC.							
**the future rate of RUC is expected to be the same for all technologies.							

The petrol light-vehicle fleet consumed about 2.4 billion litres of petrol in calendar year 2024[20]. At the rate of $0.80 per litre for FED (inclusive of ACC and GST), the Government will have received revenue of approximately $1.9 billion. See Table 5.

Current emissions, efficiency, and costs for the petrol light-vehicle fleet

Table 5 sets out relevant current data for the petrol fleet. For details of the calculations carried out in this section, please see Appendix 1, page 63.

Table 5: Current emissions, efficiency, and costs for the petrol light-vehicle fleet

Emissions Category	1. Average Emissions in g/km by category based on 2020 - 2025 petrol fleet additions	2. Average energy efficiency in litres/ 100km at category average	3. Current proportion of Distance Travelled per 1,000 km of fleet travel	4. Current emissions in g/km per weighted km of fleet travel	5. Current marginal cost per km @ $2.60 / litre and zero RUC	6. Current FED revenue by Category $million
Very low (1-49g/km)	38	1.5	5.2	0.20	$ 0.040	1.8
Low (50-99g/km)	90	3.7	33.6	3.03	$ 0.095	27.5
Moderate (100-149g/km)	123	5.0	95.9	11.79	$ 0.130	107.3
High (150-199g/km)	176	7.2	236.8	41.67	$ 0.186	379.1
Very high (200-249g/km)	218	8.9	365.6	79.71	$ 0.231	725.1
Extremely high (over 250g/km)	284	11.6	262.9	74.65	$ 0.301	679.1
Total/Average (as applicable)	211	8.6	1000.00	211.05	$ 0.224	1,920.0

The weighting of the analysis by distance travelled computes to average emissions of 211 g/km across all categories, which converts to a fleet average energy efficiency of 8.6 litres/100km. This will be different to the unweighted fleet average energy efficiency and will likely also be different to the average 'in use' fleet average energy efficiency. This is because of the different driving conditions such as hilliness of roads, personal driving habits, and traffic congestion that vehicles are operated within, that are invisible to this type of analysis[21].

Future costs after the change from FED to RUC

In Table 6 the future costs of petrol (excluding FED) and RUC are calculated for each category, and in Column 10 the future marginal cost per km is compared with the current

[20] Per the New Zealand Ministry of Business, Innovation and Employment, https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/oil-statistics.

[21] It is challenging to validate any given estimate of 'in use' energy efficiency. 'Top-down' estimates that take the total fuel used and divide it by the estimated distance travelled probably provides the best reference on an annual basis but is subject to the accuracy of the distance estimates. In Table 5 the distance weightings are based on all light-fleet travel because none of the sources provided this information broken down into travel by emissions category by fuel type. Further analysis is needed.

marginal cost per km from Column 5 in Table 5. All emissions categories experience an increase in marginal costs per kilometre except the 'Extremely high' category, that experiences a 6% decrease in marginal costs. The reason only the Extremely high category experiences a decrease in marginal costs is that the existing RUC rate is based on average energy efficiency of 9.5 litres/100 km, and the average energy efficiency of all other categories is lower than this level. The switch from FED to RUC will increase marginal costs for all emissions categories except 'Extremely high'.

Table 6: Future costs and percentage change by category

Emissions Category	2. Average energy efficiency in litres/ 100km at category average	7.Future petrol cost per km @ $1.80 / litre	8. Future RUC cost per km @ $76 per 1,000 km	9. Future marginal cost per km of petrol plus RUC	10. Percent change in motoring costs per km
Very low (1-49g/km)	1.5	$ 0.028	$ 0.076	$ 0.104	158%
Low (50-99g/km)	3.7	$ 0.066	$ 0.076	$ 0.142	49%
Moderate (100-149g/km)	5.0	$ 0.090	$ 0.076	$ 0.166	28%
High (150-199g/km)	7.2	$ 0.129	$ 0.076	$ 0.205	10%
Very high (200-249g/km)	8.9	$ 0.160	$ 0.076	$ 0.236	2%
Extremely high (over 250g/km)	11.6	$ 0.208	$ 0.076	$ 0.284	-6%
Total/Average (as applicable)	8.6			$ 0.231	
				3.2323%	

Impact of change in terms of distance travelled, emissions, and government revenue

Table 7 shows the calculation of the impact of the change from FED to RUC, on a category-by-category basis. The most important factor in this calculation is the estimated long run elasticity of petrol consumption to changes in the marginal cost of motoring, and the way this is applied to calculate the impact, by recognising that there will be a proportional reduction in the distance travelled (Column 13).

Table 7: Impact of change

Emissions Category	10. Percent change in motoring costs per km	11. Long Run Elasticity Estimate of marginal consumption (to marginal cost of motoring in petrol plus RUC)	12. Estimated Percent Change in distance travelled	13. Future Distance Travelled by category per 1,000 km of of current fleet travel	14. Future emissions by category in g/km per weighted km of fleet travel	15. Future RUC revenue by Category $million	16. Change in contribution to government revenue $million
Very low (1-49g/km)	158%	-0.5	-79%	1.1	0.04	2.3	0.51
Low (50-99g/km)	49%	-0.5	-24%	25.4	2.29	53.9	26.35
Moderate (100-149g/km)	28%	-0.5	-14%	82.7	10.17	175.4	68.10
High (150-199g/km)	10%	-0.5	-5%	224.9	39.59	477.3	98.14
Very high (200-249g/km)	2%	-0.5	-1%	361.7	78.85	767.4	42.31
Extremely high (over 250g/km)	-6%	-0.5	3%	270.1	76.71	573.1	(106.08)
Total/Average (as applicable)		-0.50		965.9	207.64	2,049.3	129.33
				-3.41%	-1.6162%	6.74%	

Overall impact

Table 8 shows the existing and future VKT and emissions by category and in total. Total distance travelled declines by just over 900 million VKT, 3.41%, while total emissions from the petrol fleet reduce by about 0.09 megatonnes, 1.6%.

Table 8: Current and Future totals for VKT and Emissions

Emissions Category	17. Current Km travelled (millions)	18. Future km travelled (millions)	19. Current emissions (mega-tonnes)	20. Future emissions (mega-tonnes)
Very low (1-49g/km)	145	30	0.01	0.001
Low (50-99g/km)	939	709	0.08	0.064
Moderate (100-149g/km)	2,677	2,308	0.33	0.284
High (150-199g/km)	6,610	6,280	1.16	1.105
Very high (200-249g/km)	10,207	10,097	2.23	2.201
Extremely high (over 250g/km)	7,339	7,540	2.08	2.141
Total/Average (as applicable)	27,917	26,965	5.89	5.797
		-3.41%		-1.62%

Sensitivity analysis

Several assumptions have been tested to see if there would be a substantial variation from the above estimates if key values were changed. Changes to the elasticity estimates make little difference. Changes to the proportion of distance travelled by each category per 1,000 km of fleet travel appear to have some impact on the totals. Petrol-fleet-only annual distances of travel by engine size or by emissions category have been found to be unavailable. The data used combines petrol and diesel vehicle distances of travel by engine size. There is no reliable basis for guesstimating what an alternative set of proportions would be. Changes to the average emissions by category, which drives an average in-use energy efficiency of 8.6 L/100km in Column2 of Table 5, would drive modest adjustments to the overall results but is not thought likely to change the conclusions. Adjustments here should be based on reliable knowledge of the actual average rate of emissions by each category.

4. Forecasting petrol prices, consumption and emissions

To model the impact of changes in petrol prices on fuel consumption and the emissions profiles of additions to the fleet, it is first necessary to model the impact of the NZ ETS on petrol prices. This section describes the modelling carried out for this research.

The Monetised Benefits and Costs Manual, published by NZTA, contains a future projection of the 'shadow price' per tonne of CO_2-e emissions, for the purpose of transport system project proposal analysis. Figure 3 shows the price paths and explanations about the intent and use of the shadow prices, (NZ Transport Agency Waka Kotahi, 2025b). The shadow prices, being 'Whole of Government Agreed' are taken as a reasonable estimate of the future NZU price paths and have not been further validated during the research. For ease of reference the table of shadow prices is replicated in Appendix 4 on page 80.

Consistent with the note in Figure 3 the current price of an NZU of about $55[22] (see Figure 4) is well below the central shadow price of $120 in the table (and even well below the low of $80 and high of $161).

As mentioned earlier (page 10), the NZ ETS currently contributes about 15.5 cents to the retail price of a litre of petrol. For modelling purposes it is assumed that the difference between the retail price and the NZU value per litre is the ongoing cost-plus-margin that

[22] As noted earlier, there have been recent reductions to the market price of NZUs in response to Government announcements. The reductions increase the size of the gap. These sections were written before the most recent Government action.

petrol retailers require now and into the future. In other words, petrol prices (less NZU value per litre) are held constant and any other potential impacts on the petrol price from other sources, either up or down over time, are ignored. Further, no margin is included for the petrol retailer in regard to changes in the cost related to the NZ ETS.

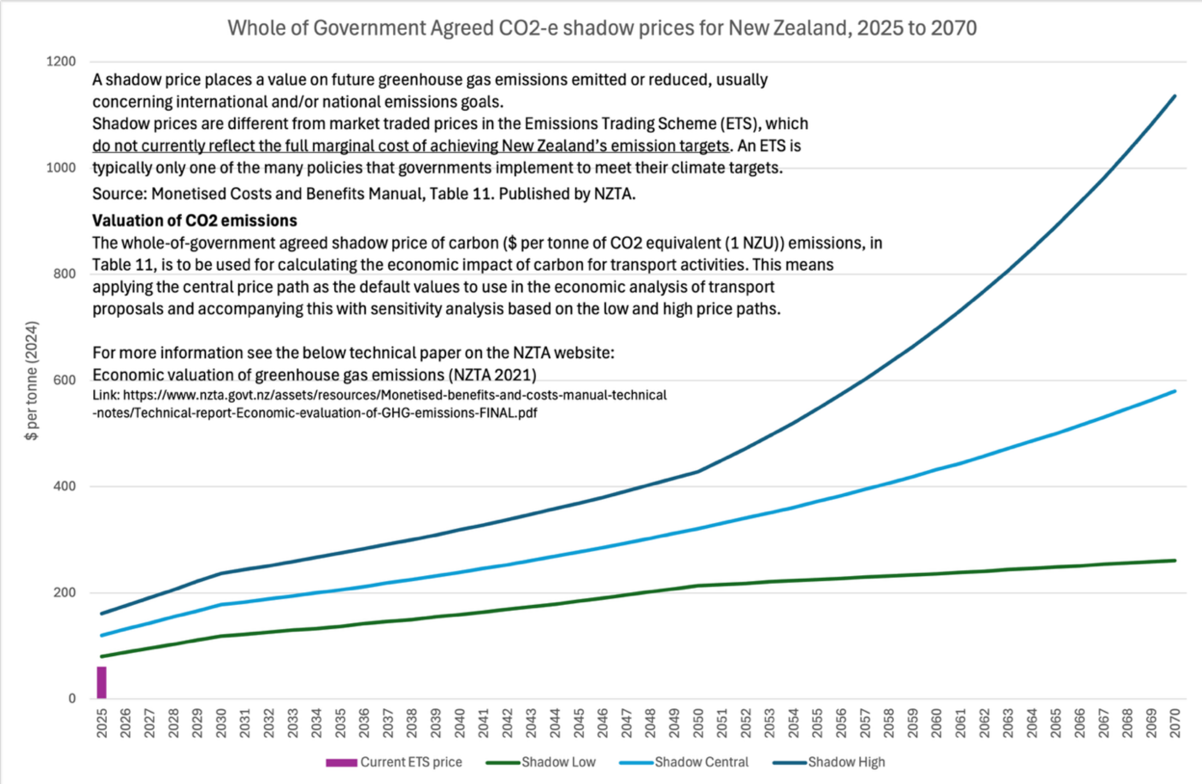

Figure 3: Shadow price of carbon, (NZ Transport Agency Waka Kotahi, 2025b, Table 11, P65)

Further, it is assumed that at some point the NZ ETS price will rise to meet the shadow price and start reflecting the true marginal cost of emissions reduction. For modelling purposes, it is assumed that this 'merging' of the actual price and the shadow price will happen over five years. This is consistent with the Government's stated intention to return the NZ ETS to credibility by reducing the planned quantities of NZUs offered at auction each year from 2025 to 2029, (Beehive, 2024). See Figure 5.

Figure 4: Historic carbon prices. Source: Carbon News[23]

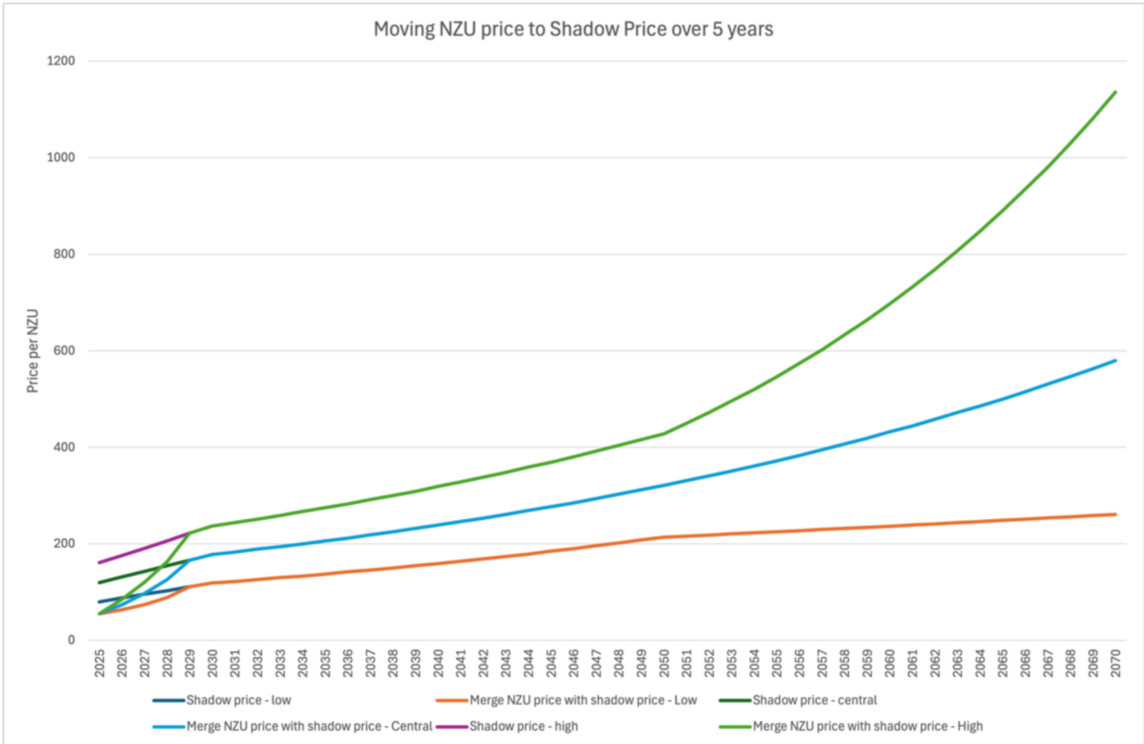

Figure 5: Merging NZ ETS with shadow prices

As the NZ ETS price merges with the shadow prices, and then continues to rise, the NZ ETS will have an impact on the price of petrol. The NZU price is modelled each year, including the merge, and added to the constant petrol cost and margin mentioned above. The resulting

[23] https://www.carbonnews.co.nz/news/fixture/nz-carbon-price

price of petrol including NZUs can be seen in Figure 6. The central shadow price of carbon would cause the current petrol price of about $2.60 per litre to rise to $3.35 by mid-century, and $4.08 per litre by 2070.

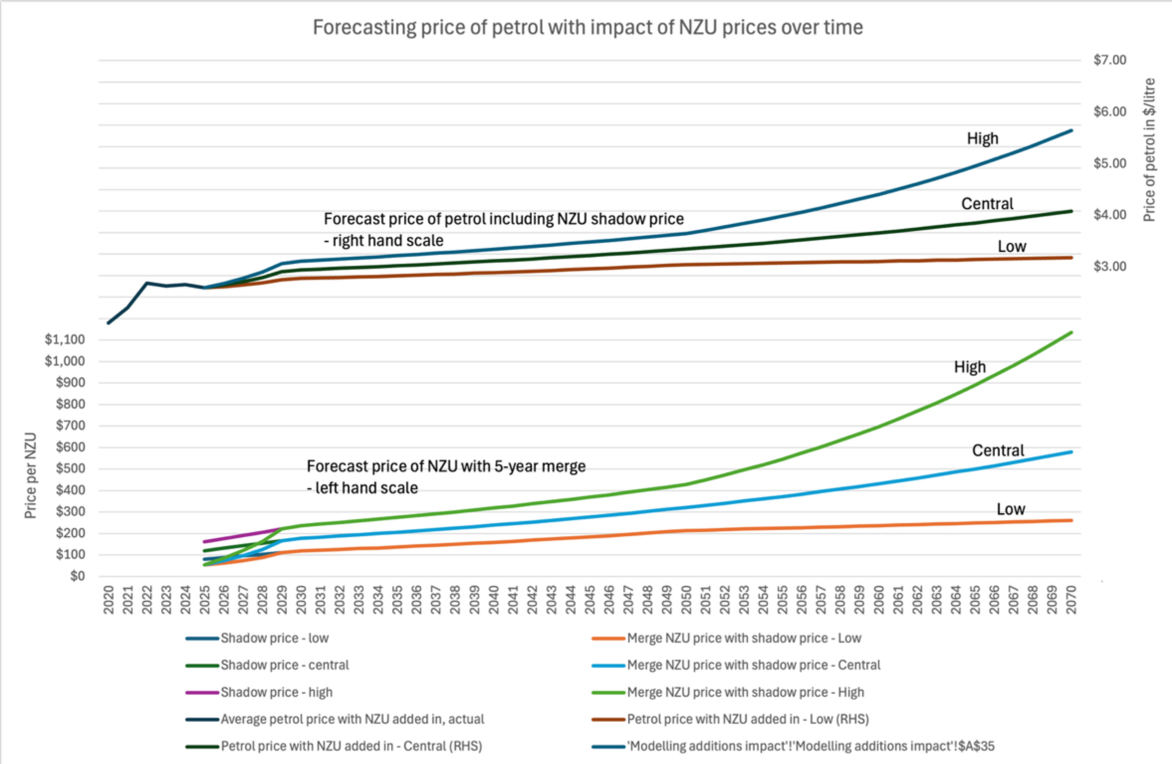

Figure 6: Forecasting the price of petrol incorporating the NZU price to 2070 (from modelling carried out for this research)

The impact of NZU-driven fuel-price rises on petrol consumption and emissions

Fuel-price increases are expected to have an impact on transport-related petrol consumption, and as mentioned above this reflects changes in driving habits, a changing energy-efficiency profile of fleet additions (discussed further below), mode shift, and changes in residential or employment location.

The change in consumption is modelled using a short run elasticity estimate of -0.2, and a long run elasticity estimate of -0.50, with the short run impact being felt in the year of the change in price, and the long run impact being felt equally in the two years following the change in price. The adjustments are therefore: in year 1, -0.2%; in year 2, -0.15%; and in year 3, -0.15%, in all cases these adjustments are applied to the percentage change in the price of fuel caused by the rising NZU component of the petrol price, and the consumption in the year preceding the price rise. Because the relationship between consumption and emissions is a constant, the results can be presented in terms of emissions. Figure 7 shows the results of these calculations.

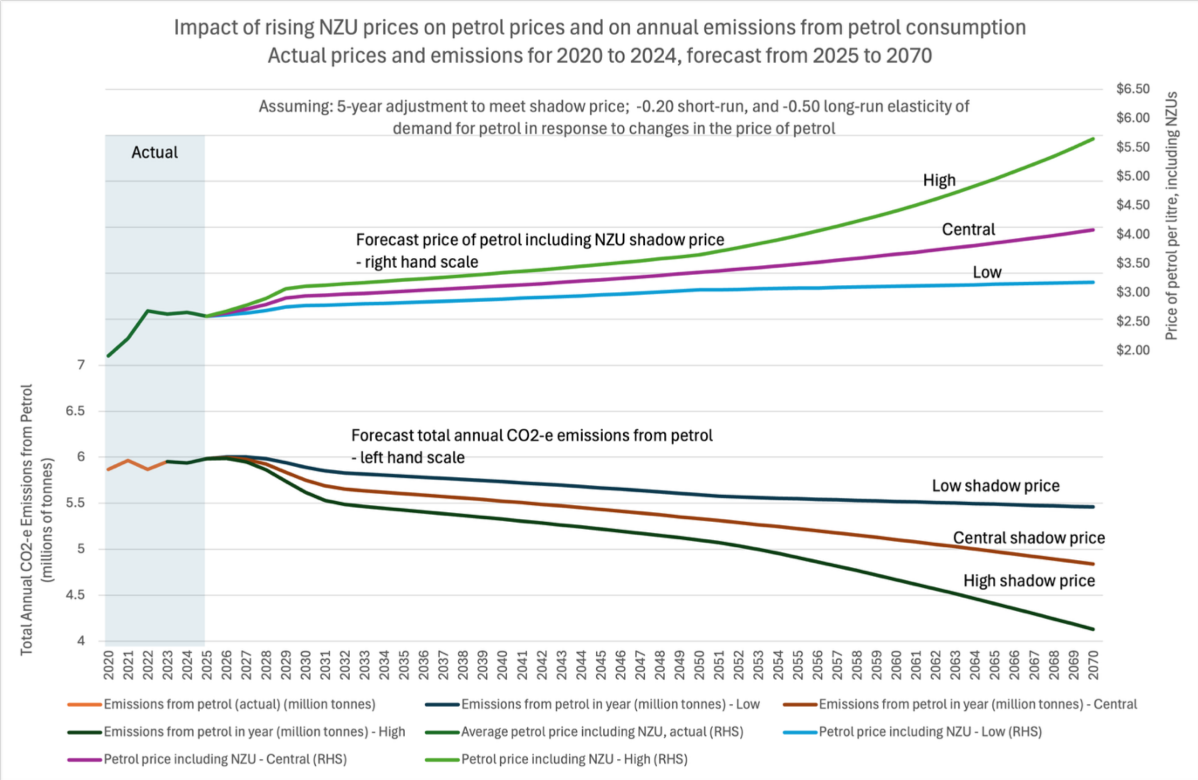

Figure 7: Forecasting total emissions from petrol based on petrol price impacts of NZ ETS

Figure 7 shows that total CO_2-e emissions from burning petrol for transport would reduce, based on central shadow price and the elasticities discussed above, from an estimated current year level of 6.0 million tonnes to 5.33 million tonnes by mid-century, and 4.84 million tonnes by 2070. Even with the high shadow price, the level of emissions in 2050 (the date for the 'net-zero emissions' target), would still exceed 5.0 million tonnes. This demonstrates just how un-responsive petrol consumption is to the price of petrol.

5. Forecast of fleet additions impact of NZU price

The international literature (see Section 2) suggests that there is a measurable (though very low, -0.1) elasticity of energy efficiency (and therefore emissions) of fleet additions to changes in the price of petrol. The evidence of this measurable elasticity had been found by analysing detailed data about fleet additions and petrol price changes over several years. It was desirable to replicate the international analysis using New Zealand data.

The literature described the elasticity in two ways: firstly, an elasticity for changes to the whole fleet, and secondly, a threshold efficiency (or emissions) level around which all vehicle purchases were clustered, and around which decreases in purchases of inefficient vehicles and increases in purchases of efficient vehicles could be observed in response to increases in the fuel price.

Fleet additions data for New Zealand for the period January 2020 to July 2025 (about 1.4 million registrations including new and used vehicles) were downloaded from the NZTA website[24]. Unfortunately, emissions data is not included in the information available from

[24] NZTA Registrations Dashboard: https://qap.nzta.govt.nz/single/?appid=2e5bd26c-5142-485e-a96d-ce0d903b3b5b&sheet=22c77866-93e2-4632-a65f-7b171ae93647&theme=NZTA%20Website%20Theme.

this database. New- and used-vehicle emissions data from various sources[25] were matched with the fleet additions data by lookups based on 'make/model/body-type/year/fuel', and where this information didn't provide a match, on 'make/model/year/fuel', and where this information still didn't provide a match, on 'MVMA Code'. Using this process 98.1% of the records were matched to emissions data, though in some cases the matches were tenuous because there were instances of multiple vehicles with the same 'make/model/body-type/year/fuel' that had different emissions ratings within the same spreadsheet. Weekly petrol price data covering the same period were downloaded from the Ministry of Business, Innovation and Employment website[26].

Relevant policy settings that had changed during the period that might potentially have an impact on the analysis were identified. See Table 9.

Monthly averages were calculated for petrol prices and emissions ratings of new, used, and all newly registered vehicles, and charted together with the policy changes. See Figure 8.

Table 9: Policy changes, dates, and descriptions

Policy Name	Start Date	End Date	Notes
Clean Car Discount Phase 1	01-Jul-21	01-Apr-22	Phase 1 was a rebate-only period that gave a rebate to importers of vehicles that met a certain target level of emissions. Rebates were paid to consumers as first importers of new or used vehicles even though motor vehicle dealers were the ones doing the import activity.
Clean Car Discount Phase 2	01-Apr-22	01-Jul-23	Phase 2 saw the start of charges for vehicles that exceeded the target level of emissions, as well as expansions to the rebates allowed in Phase 1.
Clean Car Discount Phase 3	01-Jul-23	31-Dec-23	Phase 3 saw new vehicle rebates reduced, used vehicle rebates increased modestly, and some mid-range vehicles rebates ended, and then the discontinuation of the whole scheme on 31 Dec 23.
Clean Car Standard Year 1	01-Jan-23	31-Dec-23	Year one of a continuing tradable credit regime in which low emissions vehicles earn credits, while high emissions vehicles require surrendering credits or paying fees. Credits are tradable between MV importers.
Clean Car Standard Year 2	01-Jan-24	31-Dec-24	Year two of the regime that had higher fees for the same level of emissions per vehicle.
Clean Car Standard Year 3	01-Jan-25	present	Year three of the regime, even further tightened by increasing fees for same level of emissions per vehicle.

[25] The sources were: a spreadsheet obtained from https://www.rightcar.govt.nz/ through NZTA; a spreadsheet downloaded from https://importer.fuelsaver.govt.nz/?tab=.cc_calculator, click on "download the CO2 values of recently imported vehicles ; and a spreadsheet downloaded from the USEPA at https://www.fueleconomy.gov/feg/epadata/vehicles.csv.zip.
[26] https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/weekly-fuel-price-monitoring.

Policy Name	Start Date	End Date	Notes
Fuel Excise Tax holiday	14-Mar-22	30-Jun-23	Due to war in Ukraine and resulting uplift in global fuel prices, a 25-cent reduction was implemented to the excise tax included in the price of petrol. It is thought that this resulted in a 25-cent reduction in the pump price, that should be shown in the fuel price data. The adjustment was clearly expected to be temporary.
EVs paying Road User Charge	01-Apr-24	present	EVs had previously not paid either excise tax (because not buying petrol) nor any contribution to transport system costs. This was changed on 1-4-24 when the RUC was implemented for EVs at a rate of about 8 cents per km.
Auckland Regional Fuel Tax	01-Jul-18	30-Jun-24	Regional fuel tax of 10 cents per litre, applicable only to the Auckland Region to raise funds to support Auckland-specific transport projects

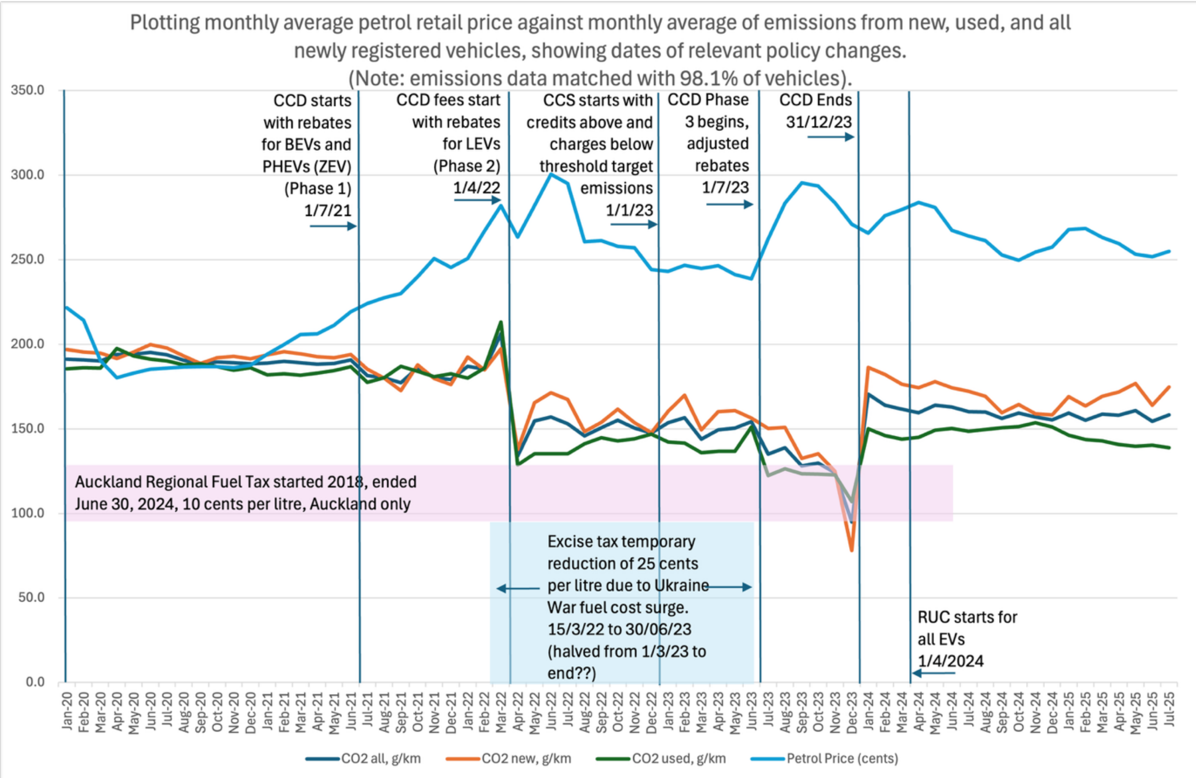

Figure 8: Policy changes, prices of petrol, and average emissions of fleet additions, 2020 to 2025

The approach to modelling for elasticities involves removing known potential distortions by using dummy variables and then letting the analysis software carry out regression analysis.

Using all the above data and appropriate dummy variables no sufficiently reliable estimate of elasticity was found for additions to the New Zealand fleet. Over the period concerned there were proportional increases in purchases of efficient vehicles, and decreases in purchases of inefficient vehicles, but a glance at Figure 8 shows that there were very strong policy settings to encourage this, which might have distorted the results.

Because the international results could not be replicated, but because it is still thought that a New Zealand elasticity estimate can be made, modelling has been carried out using an elasticity estimate based on the international literature; with the intention to adjust the model in the future when a New Zealand elasticity estimate can be established[27].

Based on the international literature an elasticity estimate of -0.10 was used for modelling purposes: meaning that a 1% increase in the price of petrol is estimated to lead to a 0.1% decrease in the average emissions of fleet additions. It was assumed that future CCS settings would be no more stringent than those already in place. See Figure 9 for the impact of NZ ETS-driven price rises on the average emissions of additions to the petrol light-vehicle fleet.

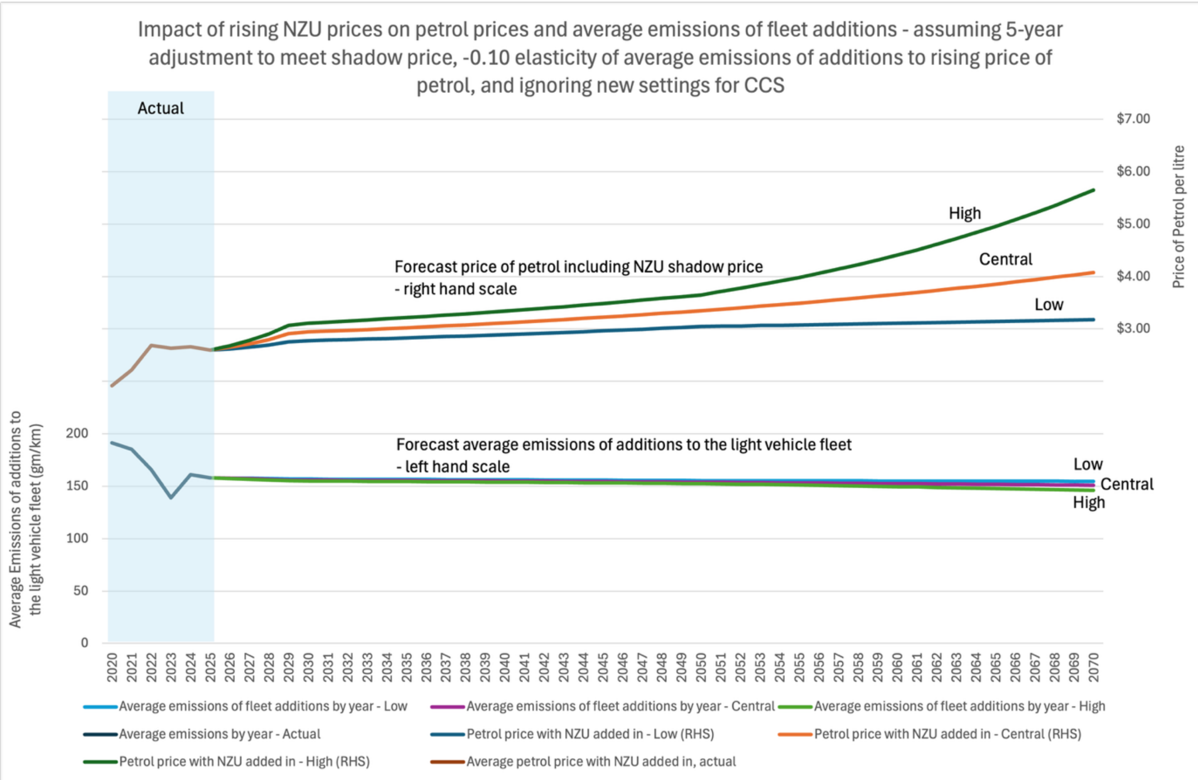

Figure 9: The impact of the shadow price of NZ ETS on average emissions of light fleet additions

Figure 9 clearly shows, using an elasticity estimate based on international experience, that the impact of the NZ ETS on the emissions profile of additions to the light vehicle fleet is likely to be negligible. From the current level of 158 g/km (the year-to-date average to the end of July 2025), using the central shadow price forecast, the modelling predicts a reduction to 154 g/km by mid-century, and 151 g/km by 2070, while the high shadow price would not give a substantially different outcome (152 g/km and 146 g/km respectively).

6. Vehicle dealer interviews, Clean Car Standard research

This research included interviews with motor vehicle dealers[28] to find out their level of awareness of the NZ ETS, and if they were warning customers who were considering buying

[27] Work will continue through a now separate research project to refine this data and extend it over a greater number of years and with more reliable emissions data for each vehicle in the fleet additions database. The results when complete will be published in a separate report by economist Mike Pogodzinski and the author.
[28] Two owners of motor-vehicle dealerships (one a manufacturer-specific dealership selling new and used vehicles, the other a used-import specialist dealership) were interviewed. The intention had been to carry out a

petrol vehicles about potential NZU-driven petrol price rises in the future. In this section the comments from the vehicle dealers are set out, followed by results of efforts to corroborate the observations.

The main observations by dealers in the interviews are that:

- The industry is observing many new makes and models of vehicle entering the market.
- The NZ ETS is having no impact on car purchase decisions because people do not know about the NZ ETS, and there is no effort by dealers to tell them about it. The dealers are not aware of any significant petrol-price impact coming through[29].
- The CCS is having a much greater impact, and its current and planned future settings are currently causing issues.
- The Clean Car Discount (see Table 9 for details), discontinued at the end of 2023, enriched exporters in Japan. Cars imported into NZ were more expensive than they would have been had there not been knowledge in Japan about the rebate that importers would receive.
- Without credits from importing EVs and Hybrids, brands that do not have EV/Hybrid offerings are facing greater costs because they generate no credits to use to offset higher emitting vehicles[30].
- In the coming year the settings of CCS will lead to penalties on most hybrids, therefore raising the costs of all vehicles except EVs, and reducing demand for non-EV vehicles in the car market as a result. There are some types of vehicles for which there is no EV alternative at an acceptable price range (such as people-movers and SUVs). The government (the dealers say) wants all imports to be EVs by 2028[31].
- The result of this trend is that people are keeping older (higher emitting and less safe) fossil-fuelled vehicles for longer. This is already evident (they say) in a reduction in the scrappage rate and that workshops are busy keeping older vehicles operational. They suggested that New Zealand could become like Cuba, where old cars from the pre-Castro era were kept going for decades because alternative imports were not available.
- They raised the question of the availability of a sufficient supply of used low-emissions vehicles to meet New Zealand's market needs, even within the current CCS settings. This concern also extends to EVs as some manufacturers reportedly are backing away from EV production because of poor returns.
- They said they feel the CCS is trying to force a mix of vehicles on people that is not what people in New Zealand want to buy. Unlike countries with domestic vehicle manufacturing, New Zealand importers must import what customers want, or they will not be able to profitably sell the vehicles[32].

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broader survey, but the strength of the responses from the two interviews suggested further surveying would uncover no further insights. The findings were also corroborated by reference to news media reports.

[29] That there is no significant price impact coming through has been confirmed by the analysis above in Section 4 above.

[30] But they can purchase credits from other importers if the other importers are willing to sell.

[31] While this might be the logical extrapolation of the settings being discussed, no corroborating evidence was found of a government intention to import only EVs from 2028.

[32] A CAFÉ-style standard can encourage a manufacturer to modify their fleet offering to achieve a target average efficiency level, and they would do this in the context of what sells in the market. An importer to New Zealand could modify the mix of what they import, but they do not have the capacity to change the mix that is

- They feel the credits system for CCS is heavily distorted and not easy to understand. They say there is no logical basis for the existing structure of credits and charges, and it is a diabolical mess.
- They feel that the CCS, while modelled on overseas systems, does not have a sound theoretical foundation because it applies to both new and used vehicles, and is not able to hold anyone to account for failing to meet the average emissions target. If buyers will pay the price, there is no constraint on importing high emitting vehicles.
- They observe that the price that credits trade for between importers is at a substantial discount (>40%) to the price that would have to be paid if buying the credits from Waka Kotahi[33]. The result of this is that the actual rate of penalty for importing a high-emitting vehicle is somewhat lower than intended by the Standard, and the publicly disclosed penalties are not having the impact on vehicle prices that would be expected.
- They feel that the public is not generally aware of the existence or operation of the CCS.

Further research into the CCS corroborated many of the statements by the vehicle dealers, as follows:

CCS Complexity: Despite its apparent simplicity, the implementation of the Standard has made it somewhat complex, as follows:

- **New vs used.** Credits and penalties for new-vehicle imports are tracked and applied completely separately to credits and penalties for used-vehicle imports. The face value of credits for new-vehicle imports is double the face value of credits for used-vehicle imports. A credit earned importing a low-emitting new vehicle cannot be used to settle the import of a high-emitting used vehicle.
- **The mass of the vehicle being imported**. For each make and model and mass of vehicle being imported it seems a 'personalised' target emissions level is established based on the mass of the vehicle, and the credits or penalties are calculated compared with that 'personalised' target. There is a very broad and varied range of personalised targets.
- **Whether the vehicle being imported is going to be used as a passenger vehicle or a commercial vehicle.** A maximum mass is used in the above personalised target emissions setting process, of 2,000 kg for passenger vehicles and 2,200 kg for commercial vehicles. Examples were found where the same vehicle (make/model/mass) attracted different maximum mass levels, which must have been because of the use (private or commercial) it was intended for. (Example: Ford Transit 2228 kg tare, at CCS mass of 2,200 kg attracted 16 credits, and at CCS weight of 2,000 kg attracted a penalty of 83 credits).
- **Whether 'pay-as-you-go' or 'fleet average'.** Importers have a choice to 'pay-as-you-go' using credits for high-emitting imports at the time of import, or 'fleet average' in which all credits and penalties will be totalled up at the end of the year and settled at

available for them to import – an important distinction. Anecdotally there are large quantities of new vehicles in other countries that cannot be sold at any price.

[33] It is thought likely that the credits are changing hands below 'face value' because there is an 'overhang' of credits carried forward from earlier periods when they were easier to obtain because the targets were higher: more were earned from low emitting imports, and fewer were needed for high emitting imports.

that time. The price of the penalty is greater for 'fleet average' than it is for 'pay-as-you-go' by about 25%. It is suggested that this difference is justified because importers do not need to do the repetitive administration of settling each high-emitting vehicle, and Waka Kotahi might have more administrative effort, and delayed funds remittance, involved in determining the final settlement under 'fleet average'.

- **Whether buying required penalty credits from other importers or from Waka Kotahi.** The market for penalty credits puts a substantially lower value on them than the face-value charged by Waka Kotahi.

Figure 10 shows the complex range of costs associated with paying for penalty credits at any given level of emissions, all reflecting the complexity outlined above. Every point on the chart in Figure 10 would have an additional lower value if buying credits at the market price from other importers. The Minister of Transport's recent announcement of an almost 80% reduction in the face value of the credits, (Beehive, 2025b) will serve to increase the complexity of this system.

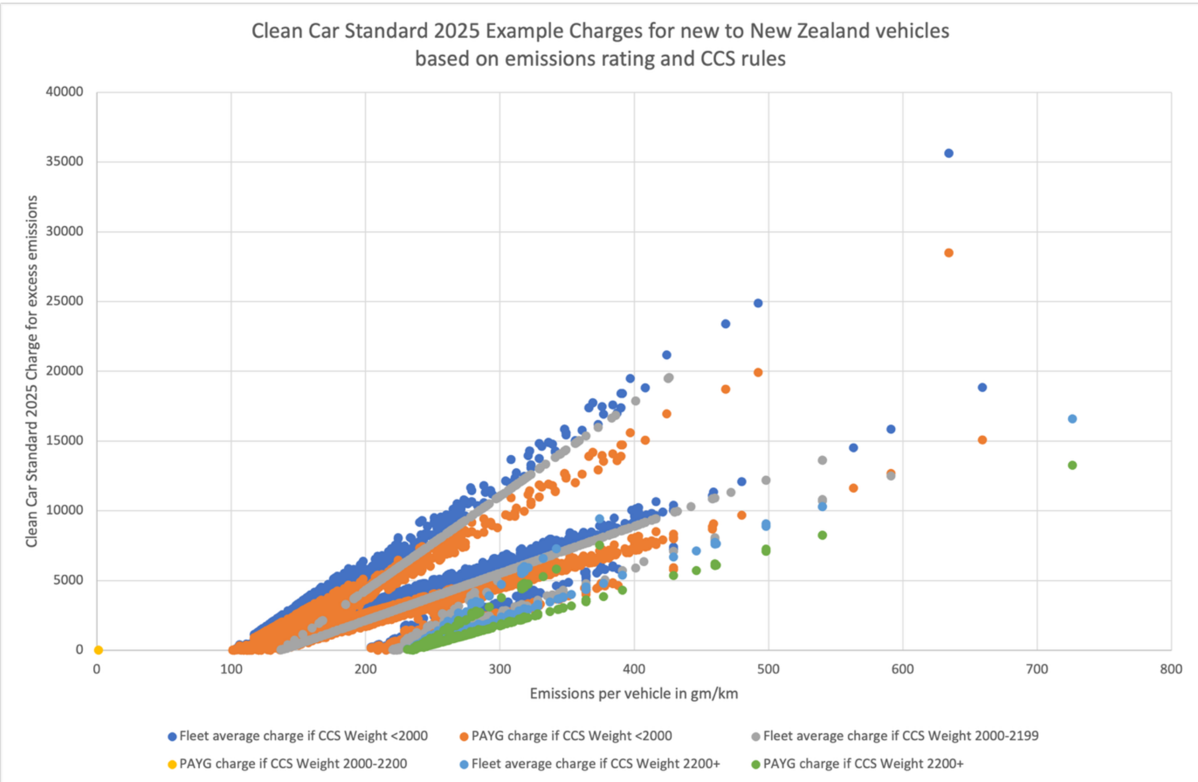

Figure 10: The many different amounts an importer might have to pay for a high-emitting vehicle at a given emissions rating

Availability of low emissions vehicles: From the database of light vehicle fleet additions over the past 67 months, the quantities of new and used light-fleet additions from January to July[34] were extracted for each year. See Figure 11.

[34] The January to July period was used because the analysis was carried out in August 2025, using the most-up-to-date information available at that time.

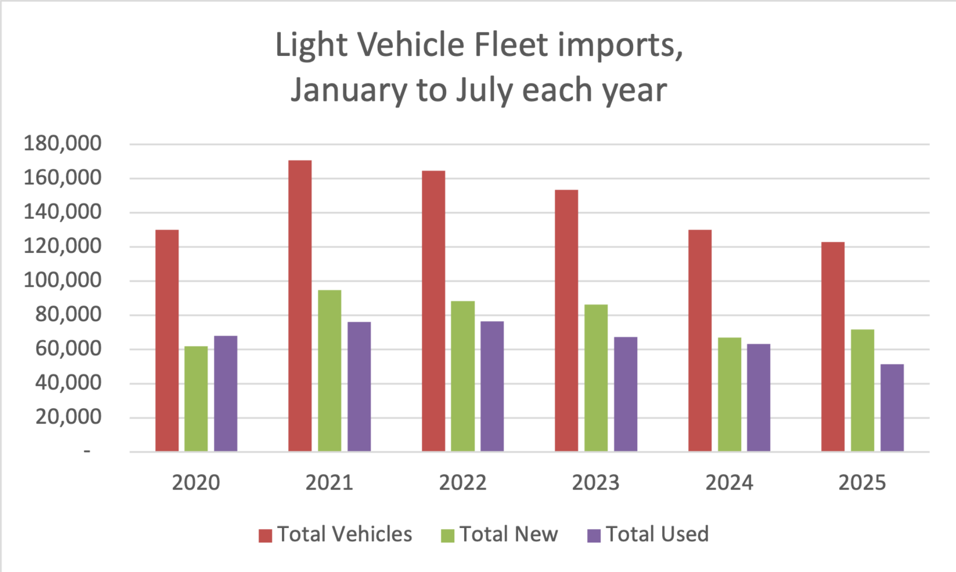

Figure 11: Year to date vehicle imports, Jan to July

Two things are evident for 2025 year-to-date: the CCS targets from January 2025 are not being met (see Figure 2, page 12), and on a year-to-date basis the number of vehicles being imported reflect a declining trend over recent years (Figure 11). Both of these seem to be consistent with the comments made by the motor vehicle dealers, and were subsequently validated by the Minister of Transport, (Beehive, 2025b). It is difficult to be certain that the problems are caused the way the dealers have said (difficulty with supply), but some corroborating evidence comes from used vehicle export data from Japan[35], that suggests increased competition from other nations and reduced success for New Zealand in terms of securing used Japanese imports. See Figure 12. This shows declining Japanese exports to New Zealand as a share of Japanese exports from 2017 onwards. This could be caused in part by declining New Zealand interest in higher-emitting used vehicles since the introduction of the Clean Car Discount and Clean Car Standard. It is difficult to be certain about causation.

[35] The data was provided by a motor vehicle dealer who had received it from a vehicle exporting partner in Japan.

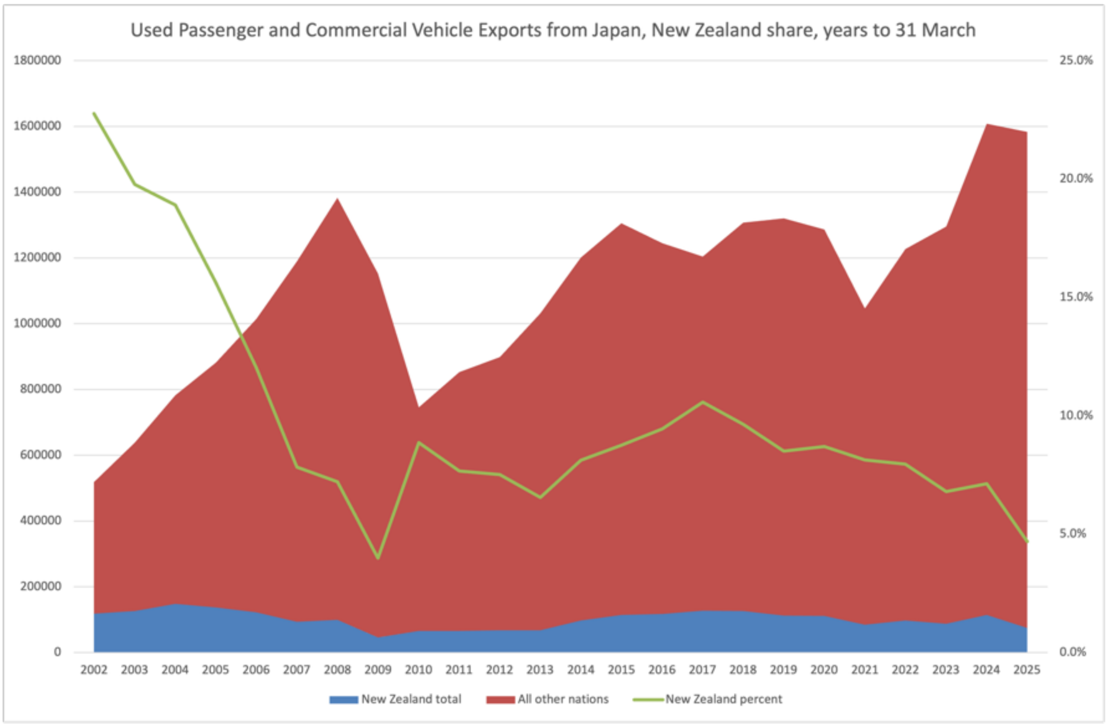

Figure 12: Used light vehicle exports from Japan to New Zealand[35]

Scrappage of fossil-fuelled vehicles: An important claim made by the motor vehicle dealers is that the scrappage rates of fossil-fuelled vehicles is being reduced. No corroborating evidence was immediately available regarding scrappage rates to date. This could be investigated from fleet statistics, and this is suggested as a further research opportunity. But the logic of the idea seems sound, at least for some categories of vehicles. To the extent that the CCS pushes up the price of newly imported high-emitting vehicles, so it raises the value of previously imported similar vehicles. In making an economic decision about repairing or scrapping a damaged or broken high-emitting vehicle, the 'value once repaired' would be compared to the 'cost to repair', and if the former exceeds the latter, repair might be a more likely outcome. The 'value once repaired' could be higher if the CCS has driven up the value of previously imported high-emitting vehicles, making the decision to repair occur more often, and to scrap less often.

The likelihood of reduced scrappage should become lower over time if models of electric vehicles become more available to fill niches of the transport market that EVs have not so far filled.

7. Modeling the light-vehicle fleet to 2050

There were about 4.4 million petrol and diesel vehicles in the light-vehicle fleet at the end of August 2025. At an annual replacement rate of 210,000 vehicles, about 4.7% of the fleet changes each year. Year to date for 2025 the zero emissions additions to the fleet were just 4.4%, so over 95% of fleet additions have some fossil-fuel reliance, and average emissions in the order of 168 g/km.

To understand the impact on emissions over time, the period from 2025 to 2050 has been modelled, looking at the EV (zero-emissions) fleet and the fossil-fuelled fleet separately with a realistic set of assumptions about various important trajectories drawing on methodology from Minett (2020)[36]. Table 10 shows the key assumptions. If needed, a brief discussion of each assumption can be found in *Appendix 2: Explanations of key assumptions used to model the light-vehicle fleet to 2050.*

Table 10: Key assumptions for the fleet analysis. Abbreviation: FF = fossil fuelled.

Key assumptions		
Year of all zero emissions vehicles	2035	
Annual Additions Rate Previous Year	210,000	
Starting % EV*	5%	of additions
Additions Growth Rate	1%	per year
Starting g/km FF fleet	188	gm/km
Starting avg g/km FF fleet additions	168	gm/km
FF fleet additions g/km trajectory	-2	gm/km
Accident scrappage rate	2%	per year
FF Worn-out (w/o) scrappage rate	2.00%	per year
FF Starting avg g/km of w/o scrappage	200	gm/km
Annual change to g/km ff w/o scrappage	2	gm/km
EV worn-out scrappage rate	0.25%	per year
Annual change to EV worn-out scrappage rate	0.030%	per year
*EV growth is non-linear reflecting growing market share each year		

Table 11 shows the results of the modelling, using the assumptions set out in Table 10 as a base case. In the base case, the imports of EVs are seen to grow, while the imports of fossil-fuelled vehicles fall each year. Fossil-fuelled vehicle additions are zero from 2035 onwards. The average emissions ratings of the fossil-fuelled vehicle additions fall gradually over this period. The size of the fossil-fuelled vehicle fleet hits maximum at 4.423 million in 2028 and then begins to fall. In the year 2050 there are still 2.1 million vehicles in the fossil-fuelled fleet, and their average emissions are 153 g/km. The EV fleet has grown dramatically and by 2050 is 3.75 million vehicles. The total fleet is therefore just over 5.9 million vehicles by 2050, up by almost 1.5 million from today. In the absence of a mechanism to encourage changed usage focused on reducing overall emissions, the model assumes that the weighted average emissions per km will be at the (unweighted) average emissions rate of the whole fossil-fuelled fleet.

[36] The modelling follows a more simplified approach to that of Minett (2020) in that it does not consider the size of each age cohort of fossil-fuelled vehicles. Due to imports of 'elderly' used vehicles, there are some substantial distortions between the sizes of different model-years, especially regarding model years 2004-2008. Model-year-specific modelling could be carried out to achieve more robust estimates.

Table 11: Forecasting Fleet Composition 2026 to 2050

New Zealand Light-Vehicle Fleet Estimates of Fleet Average Emissions to year ending 31 August

	Fossil fuel fleet								Zero emissions fleet				Combined Fleet Statistics					
	Additions	g/km	Acc-ident Scrap-page	g/km	Worn out Scrap-page	g/km	Fleet	g/km	Additions	Acc-ident Scrap-page	Worn Out Scrap-page	Fleet	Vehicles	Growth	%FF	%EV	Additi ons gm/km	Full Fleet gm/km
2025		168				200	4,377,500	188				85,000	4,462,500					
2026	197,831	166	87,550	188	87,550	202	4,400,231	187	14,269	1,700	238	97,331	4,497,562	0.8%	97.8%	2.2%	155	183
2027	192,409	164	88,005	187	88,005	204	4,416,630	185	21,812	1,947	302	116,894	4,533,524	0.8%	97.4%	2.6%	147	181
2028	183,122	162	88,333	185	88,333	206	4,423,086	184	33,241	2,338	397	147,400	4,570,486	0.8%	96.8%	3.2%	137	178
2029	169,855	160	88,462	184	88,462	208	4,416,017	183	48,672	2,948	545	192,579	4,608,596	0.8%	95.8%	4.2%	124	175
2030	152,492	158	88,320	183	88,320	210	4,391,869	181	68,220	3,852	770	256,177	4,648,046	0.9%	94.5%	5.5%	109	171
2031	130,914	156	87,837	181	87,837	212	4,347,109	180	92,005	5,124	1,102	341,956	4,689,065	0.9%	92.7%	7.3%	92	167
2032	105,001	154	86,942	180	86,942	214	4,278,226	178	120,147	6,839	1,573	453,691	4,731,917	0.9%	90.4%	9.6%	72	161
2033	74,628	152	85,565	178	85,565	216	4,181,724	177	152,771	9,074	2,223	595,165	4,776,889	1.0%	87.5%	12.5%	50	155
2034	39,671	150	83,634	177	83,634	218	4,054,127	176	190,002	11,903	3,095	770,169	4,824,296	1.0%	84.0%	16.0%	26	148
2035	0	0	81,083	176	81,083	220	3,891,961	175	231,970	15,403	4,236	982,500	4,874,461	1.0%	79.8%	20.2%	0	140
2036	0	0	77,839	175	77,839	222	3,736,283	174	234,290	19,650	5,699	1,191,441	4,927,724	1.1%	75.8%	24.2%	0	132
2037	0	0	74,726	174	74,726	224	3,586,831	173	236,633	23,829	7,268	1,396,977	4,983,808	1.1%	72.0%	28.0%	0	125
2038	0	0	71,737	173	71,737	226	3,443,357	172	238,999	27,940	8,941	1,599,095	5,042,452	1.2%	68.3%	31.7%	0	118
2039	0	0	68,867	172	68,867	228	3,305,623	171	241,389	31,982	10,714	1,797,788	5,103,411	1.2%	64.8%	35.2%	0	111
2040	0	0	66,112	171	66,112	230	3,173,399	170	243,803	35,956	12,585	1,993,050	5,166,449	1.2%	61.4%	38.6%	0	104
2041	0	0	63,468	170	63,468	232	3,046,463	168	246,241	39,861	14,549	2,184,881	5,231,344	1.3%	58.2%	41.8%	0	98
2042	0	0	60,929	168	60,929	234	2,924,605	167	248,703	43,698	16,605	2,373,281	5,297,886	1.3%	55.2%	44.8%	0	92
2043	0	0	58,492	167	58,492	236	2,807,621	166	251,190	47,466	18,749	2,558,256	5,365,877	1.3%	52.3%	47.7%	0	87
2044	0	0	56,152	166	56,152	238	2,695,317	164	253,702	51,165	20,978	2,739,815	5,435,132	1.3%	49.6%	50.4%	0	81
2045	0	0	53,906	164	53,906	240	2,587,505	163	256,239	54,796	23,288	2,917,970	5,505,475	1.3%	47.0%	53.0%	0	76
2046	0	0	51,750	163	51,750	242	2,484,005	161	258,801	58,359	25,678	3,092,734	5,576,739	1.3%	44.5%	55.5%	0	72
2047	0	0	49,680	161	49,680	244	2,384,645	159	261,389	61,855	28,144	3,264,124	5,648,769	1.3%	42.2%	57.8%	0	67
2048	0	0	47,693	159	47,693	246	2,289,259	157	264,003	65,282	30,683	3,432,162	5,721,421	1.3%	40.0%	60.0%	0	63
2049	0	0	45,785	157	45,785	248	2,197,689	155	266,643	68,643	33,292	3,596,870	5,794,559	1.3%	37.9%	62.1%	0	59
2050	0	0	43,954	155	43,954	250	2,109,781	153	269,309	71,937	35,969	3,758,273	5,868,054	1.3%	36.0%	64.0%	0	55
Total	1,245,923		1,756,821		1,756,821				4,744,443	763,547	307,623							

Further, the Ministry of Transport's estimated VKT-growth (New Zealand Government, 2024) is incorporated to extrapolate total emissions for each year based on the fleet composition and weighted average usage by vehicles with different energy sources. Figure 13 is from the Government Policy Statement on land transport 2024-2034 (page 7) reflecting the expectation that VKT will grow while fuel consumption reduces[37], (New Zealand Government, 2024), creating a VKT index in which 2025 is 100, and the VKT from Figure 13 for each subsequent year is converted to an index value. In Table 12 the VKT index is applied to the emissions profile from Table 11 to produce an estimate of total emissions by year. Under the base case assumptions, emissions from the light-vehicle fleet would peak in 2028 at 9.586 megatonnes and then reduce over time to 3.7 megatonnes by 2050 (Table 12).

[37] While the axis labels in Figure 13 say they represent 'petrol' VKT and litres, the context and cross-checking other sources suggest these are all fuel combined (petrol plus diesel VKT and litres). There is possibly a discrepancy that has not been resolved.

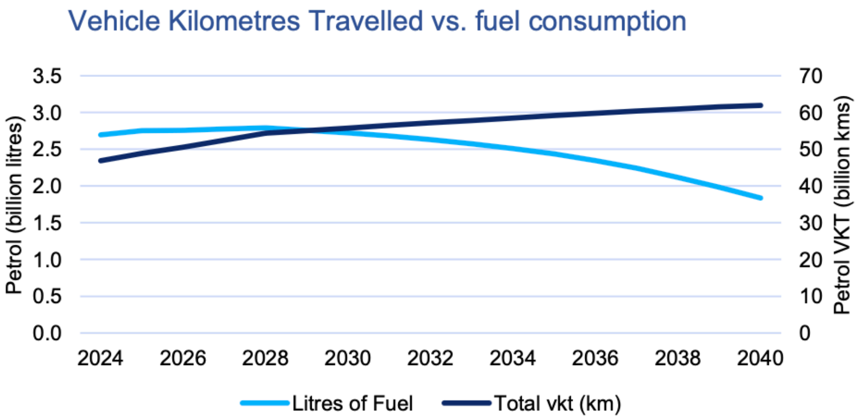

Figure 13: New Zealand Government estimated VKT and fuel consumption to 2040, (New Zealand Government 2024).

Table 12: Emissions impact of modelling incorporating VKT index based on Figure 13.

	Emissions Impact			
	VKT index	Emis-sions, mega-tonnes	% change	Emissions index
2025	100	8.9		100
2026	103.1	9.125	2.5%	103
2027	106.2	9.296	1.9%	104
2028	111.3	9.586	3.1%	108
2029	112.6	9.529	-0.6%	107
2030	113.8	9.414	-1.2%	106
2031	115.1	9.294	-1.3%	104
2032	116.3	9.056	-2.6%	102
2033	117.5	8.811	-2.7%	99
2034	118.8	8.502	-3.5%	96
2035	120.0	8.126	-4.4%	91
2036	121.2	7.741	-4.7%	87
2037	122.5	7.405	-4.3%	83
2038	123.7	7.061	-4.6%	79
2039	124.9	6.709	-5.0%	75
2040	126.2	6.348	-5.4%	71
2041	127.4	6.04	-4.9%	68
2042	128.7	5.725	-5.2%	64
2043	129.9	5.466	-4.5%	61
2044	131.1	5.138	-6.0%	58
2045	132.4	4.866	-5.3%	55
2046	133.6	4.653	-4.4%	52
2047	134.8	4.37	-6.1%	49
2048	136.1	4.147	-5.1%	47
2049	137.3	3.919	-5.5%	44
2050	138.6	3.686	-5.9%	41

Sensitivity analysis

The base case was adjusted to test the impact of different policy settings or assumptions. The most significant policy option for emissions reduction from the light-vehicle fleet is the year from which no further fossil-fuelled vehicles are imported into New Zealand. The results of different policy settings for this factor are charted in Figure 14. The settings tested in addition to the base case (2035) include 2028, 2032, 2040, 2050, and ‘never’. The TMERS (see Section 8) trajectory is also included in Figure 14 for ease of comparison.

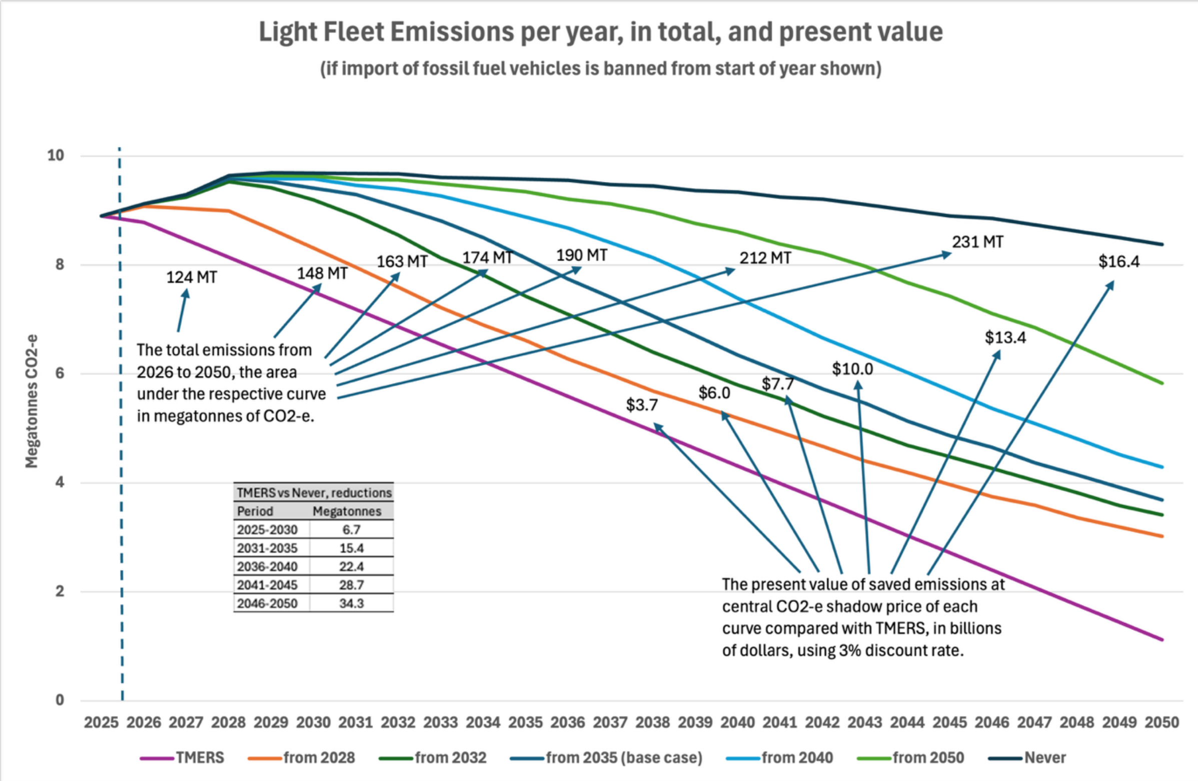

Figure 14: Emissions reduction impacts of policy alternatives for ending fossil-fuelled vehicle imports

Figure 14 shows that if fossil-fuelled vehicle imports are never banned, (which feels at the moment to be the likely trajectory) holding all other assumptions constant, including EV imports at 5% of all light-vehicle imports, light-vehicle fleet emissions would rise to about 9.7 megatonnes for the years 2029 to 2032 and then drop gradually (as EVs gradually become a larger part of the fleet) to 8.4 megatonnes by 2050. The chart inserts show the total emissions over 25 years under each curve ranging from 124 megatonnes for TMERS to 231 megatonnes for a policy of never banning fossil-fuelled vehicle imports. The embedded table shows the impact on total emissions across each five-year Paris Agreement budget period.

The earliest year of ban, 2028, would deliver the greatest reduction by 2050, to 3 megatonnes.

The TMERS 2050 result would be equal to whatever target was agreed for the implementation of TMERS (in this example a reduction to 1 megatonne) and would be less likely to require a ban because TMERS would encourage people and organisations to change their trip-making and their vehicle technology.

Building on this analysis, the present value of the saved emissions costs of each policy setting (compared with TMERS) is also shown in Figure 14, the lower group of inserted figures. The present value is estimated using the central shadow price for carbon each year, discounted at 3%. Compared with never having a ban, the present value of TMERS is in the order of $16.4 billion. Sensitivity analysis using the low and high shadow price paths creates a present value range from $11 billion to $22 billion respectively. The savings in offshore payments under the Paris Agreements could be substantially more, given the uncertainty of the prices of internationally transferable mitigation outcomes at the time, and the prevailing foreign exchange rates.

8. Downstream tradable emissions rights system (TMERS)

Literature review

There is extensive literature on the topic of personal tradable rights, especially related to transport externalities that would not otherwise be controlled, dating back to 1968 and beyond. Early transport-related work considered the topic more broadly, including emissions reduction, while later work has focused more on the use of the tool for reducing congestion or vehicle kilometres travelled. There is substantial academic enthusiasm for the concept. The following five paragraphs are a general description of tradable rights and how they work, not specific to transportation.

As described by Dales (1968), the essence is that a societal target quantity (a cap) of an activity (say discharging harmful process-waste into a waterway) is established and divided up into notional bite-sized quantities. Dales (1968) calls each bite-sized quantity a Right because it is of the nature of real property, and rights would be sold to operators (people or entities) who might undertake the activity, and operators could trade surplus rights. The objective is to control the total quantity of the activity on a periodic basis (daily, weekly, monthly, quarterly, annually, biannually, sliding average, etc.) in line with what society considers to be acceptable. The objective is that the total for any one period or group of periods is tightly controlled, (Dales, 1968).

There is an assumption in establishing such a system that were the rights system not in place, the operators would collectively undertake the activity at a greater rate than desired by society. There follows an expectation that to continue their operations (and perhaps grow) without exceeding their rights, an operator (and or their fellow operators) would innovate to reduce their rate of the activity per unit of their product output. If an operator successfully innovated and reduced the rate of the activity, that operator might no longer need their full allowance for the periods going forward. Enabling the operator to sell unused periodic allowances to other operators creates a virtuous system that encourages further innovation, (Dales 1968).

The revenue an operator receives from selling unused rights can be seen as profit from investing in the innovation. The revenue per right would reflect the price other operators are prepared to pay to increase their own level of the activity. Both parties to such a trade are seen to gain: the seller who receives a return on investment, and the buyer who can now do more of the activity. Assuming a transparent market the successful buyer will be the one who perceives the greatest value in increasing their level of the activity (so offers the highest price), and the seller receives the best available price. Other operators taking the opportunity to also innovate will increase the supply of rights available to trade, and those who can innovate at the lowest possible cost will make the greatest profit from selling their surplus rights. In this way the trading activity encourages operators to seek innovation (reduction) at the lowest possible cost, (Dales, 1968) (Tietenberg, 2003).

Thus, a tradable rights system can be expected to achieve two important objectives – firstly controlling the quantity of the activity that occurs each period according to the societal limit (a cap), possibly maintaining the original total or forcing it down (called a 'sinking cap'); and secondly bringing about the lowest cost reductions possible.

According to Tietenberg (2003) research has shown that tradable rights have the same impact of finding the lowest 'cost of removal' regardless of the initial allocation method, therefore allowing the rights allocation method to be cognizant of equity issues between operators without impacting the societal effectiveness of the tradable allowances system. It is the tradability that makes such solutions effective, (Tietenberg, 2003).

For over 50 years (since Dales, 1968) the use of tradable rights (by one name or another) for reducing externalities from transport has found very strong interest among the academic community. There are nuanced differences between rights, credits, and permits, but these and other terms are used somewhat interchangeably.

Verhoef et al (1997) contrasts the difference between tradable permits (rights) and optimal Pigouvian taxes[38], in the situation where new emitters come along. Tradable permits, even if some of the total allocations were issued to the new emitters, would maintain the targeted level of emissions because the total permits allocated would remain the same. If instead of tradable permits the governing authority was charging Pigouvian pollution taxes the new emitters would pay the taxes and the total emissions would rise. Verhoef et al (1997) say that it is important to define a policy target, set out the geographic domain, and the method for the distribution of permits. They suggest that distributing permits with a zero price "*creates the possibility for the regulator to have a budget-neutral, and hence socially more acceptable, economic regulatory instrument*". Verhoef et al (1997) find 'tradable fuel permits' to be the most promising application related to emissions reduction "*so long as gasoline stations are allowed to sell fuel only to purchasers handing in a sufficient number of permits"* and considers them to be most efficient. They go on to explore the potential for mitigating social opposition by making equity adjustments to the quantities of free rights issued, identifying people not owning cars, and the disabled, as potential recipients of greater than average allocations (Verhoef et al, 1997).

Wadud (2007) "*investigates the equity effects of a personal tradable carbon permit policy for household's fuel consumption*." Equal distribution is not equitable distribution. Gaining acceptance for a policy might require equitable rather than equal distribution. The paper discusses reasons that price elasticities vary between households and the implication of this. Price elasticity of gasoline decreases with higher household income but increases if more than one vehicle is owned, attributed to the ease with which such households can own and use more energy efficient vehicles. Multiple wage earner households have higher price elasticity. Households in rural areas have lower price elasticity. Wadud (2007) draws all this analysis together to consider the impact of different permit allocation policies on the social acceptability of a tradable permit scheme and finds that an allocation policy based on household needs is most progressive[39]. He further finds that estimated permit prices will be higher than estimates of the price of equivalent carbon emissions under upstream emissions trading schemes[40]. He estimates that the proportion of households benefiting exceeds 50% when allocation is most progressive, giving highest probability of societal and political support, (Wadud, 2007).

[38] Optimal Pigouvian taxes, after Pigou 1929, an alternative approach that would tax an activity with the full cost of the externalities caused by the activity.

[39] Progressive policies put least burden on those who can least take the burden. Regressive policies put more burden on those who can least take the burden.

[40] Note that this work was in 2007 prior to the EV era.

Wadud (2011) finds the biggest disadvantage of a downstream tradable emissions permits policy to be the initial set up costs; and biggest advantages to be the policy's ability to stabilise petrol prices felt by consumers faced by fluctuations in underlying petrol prices, and being progressive. He compares 1) a tax policy that fixes the price of emissions and lets the market decide the quantity emitted with 2) tradable permits that fix the quantity emitted and lets the price of emissions be decided by the market. He posits that personal allocations of tradable permits create a direct incentive to reduce emissions and "*share the burden of emission reduction*". He notes there is a "*natural resistance"* against policies that raise tax revenue, which is avoided if tradable permits are allocated freely. He anticipates permits being held electronically and surrendered when purchasing fuel, based on the carbon content of the fuel, and that transactions of buying, selling, and using credits could be carried out on a government or other central agency-provided platform(s). He observes that this was previously perhaps thought impossible to administer due to the large number of participants, but that the internet age makes consideration of such a solution more realistic. He anticipates the need for market makers to lower transaction costs and reduce uncertainty about pricing, (Wadud, 2011).

Geng et al (2023) report a 2-week congestion-reduction experiment to establish if a tradable travel permit scheme in which one permit was required to be surrendered for travel outside peak, and two permits for inside peak would have the expected impact of reduced peak travel and trading by participants. The experiment, which appears robust and includes control groups, involved students who could choose to eat breakfast during peak, or off peak. Peak breakfast demand was reduced by about 20% over the course of the experiment. The conclusion of the project is that people easily understand the concept and act within the solution in a way that reflects that they understand it[41], (Geng et al, 2023).

There have been only two 'real' pilot projects carried out to test or prove that tradable allowances could work for reducing GHG from transport: one in Norfolk Island and the other in the Finnish city of Lahti. There are mentions of pilot projects in the UK, and concrete information is difficult to find.

A difficult-to-find report by Prescott (2008) reported UK research including a pilot, into needed design attributes for voluntary personal carbon trading at a community level that include: transparently fair allocations that consider equality including children and extra needs-based support; excess permit disposal options; banking options; minimal transactions; prevention of hoarding; credible institutional management; and market-set pricing. The report goes on to describe a pilot project that involved customers of BP (a fuel retailer) with a loyalty card called Nectar that successfully used existing infrastructure to capture data about fuel purchases that could be used in a broader scheme. The point was that the cost of establishing such a system could be much lower than the 2-billion pounds (sterling) costs being suggested in Government reports at the time (because the government was interested in the possibility of tradable carbon rights, see next item). The Nectar project had several different waves of participants and tradable rights with minimal incentive value

[41] It is noted that experiments involving university students are sometimes criticized for not reflecting how people would act in the real world, both due to participants' level of understanding, and that the structure of the experiment does not reflect a 'real' situation. In the work of Geng et al (2023) the situation was real because the students did eat breakfast and changed their eating times during the experiment.

and achieved emissions reductions with each wave, (Prescott, 2008), however the pilot was very small and involved motivated people who were keen to experiment with the idea.

UK House of Commons Environmental Audit Committee (2008) reported proceedings from a review of personal carbon trading for the UK carried out in 2007-2008. The report is critical of the Government for its decision at that time to keep an eye on academic developments in the field but to not take any further action. The Committee makes a very strong call for continued development of the ideas on the basis that meeting the Government's 2050 emissions targets needs the rigour of reduced emissions that personal carbon trading could guarantee, (UK House of Commons Environmental Audit Committee, 2008).

Webb (2018) reported on the Norfolk Island[42] project that ran from 2011 to 2013, designed to "*measure the effectiveness of Personal Carbon Goals (PCG), an interim version of PCT, in reducing carbon emissions and body weight in an isolated island environment.*" 27% of island households participated using a PCG carbon card system that recorded household (not personal) consumption of gas, electricity and fuel. Participating households were given a 10% emission reduction target that was tailored to the number of people in each household. The expectation was that the pilot would drive reduced emissions in part through active transport with a co-benefit of reduced body weight and improved health. No rights were assigned, and no trading occurred, but there was an incentive: namely a 4 cents per litre discount on the price of fuel purchased during the project. An average 18% reduction was achieved in total household carbon emissions, including a 25% reduction in transport fuel usage. There were no statistically significant changes in active transport or body weight, (Webb, 2018).

Uusitalo et al, (2022) reported on a project in the Finnish city of Lahti[43], intended to make and test a user-friendly personal carbon trading application for smart phones that would automatically measure distance and mode of travel, calculate emissions, and enable buying and selling to balance permits to needs. 212 citizens contributed to baseline data collection over six months from October 2018 to March 2019. The pilot ran from May to December 2020 (note the COVID 19 overlap). There were difficulties getting some groups such as elder people to participate. The project had a target of a 25% emissions reduction. Public perceptions of fairness for allowance allocations were obtained through a survey. Distribution that is sensitive to needs and capabilities was considered to be most fair, so individual baseline mobility data was used as the basis for emission cap estimation and emission allowance allocation. Because direct trading would be technically more difficult to implement, automatic trading was established with a 'bank', and allowance prices were adjusted weekly. Trading prices were in 'virtual' euros and were held in a 'virtual' wallet: and these 'virtual' funds could be spent on real rewards from bus tickets to swimming passes to cycling equipment and discounts provided by local businesses. Active users per week ranged between 100 and 350 over the six-month trial. COVID 19 got in the way, but still 36% of users reported shifting their mobility choices in a more sustainable direction due to receiving

[42] Norfolk Island is in the South Pacific Ocean, 1,600 km from the east coast of New South Wales, Australia. The island had a population at the time of about 1,800 people in about 800 households.

[43] Lahti is in southern Finland and is a typical mid-sized Finnish city with 120,000 inhabitants. The dominant mode of transport is personal vehicles despite 80% of citizens living within 300 m of public transport, and 75% of the population living within 5 km from the city center. Lahti is renowned for its long-term commitment to sustainable development and was awarded European Green Capital of 2021.

information about their emissions; being willing to make changes; and having incentives available for doing so, (Uusitalo, 2022).

Hamm et al, (2025) provides a useful and up-to-date framework for thinking about the design of tradable credits/rights/permits schemes. There are several key considerations regardless of the field involved: the definition of what the rights enable; who the rights apply to; the basis for allocating the rights; how long the rights are valid for; and if the rights can be transferred (to other users or other periods). The report then digs deeper, through a survey carried out in Munich, Germany, into the basis for allocations related to transport, and which attributes should be considered when setting the allocation received by each person. Their sample size was 1,352 and survey design is available through a linked paper. The study observed that most participants (almost 70%) support non-uniform initial credit allocation, and deem family-, health-related, and socioeconomic factors more important for allocation than mobility-related factors such as trip distance or frequency. Respondents would allocate an equity adjustment of additional credits/rights to the base level, ranging from 36-54% depending on the factor under consideration, (Hamm et al, 2025).

Developing a Strawman TMERS specification

To enable discussions about the validity of a potential downstream tradable mobile emissions rights system (TMERS) approach in a symposium setting involving subject-matter experts, a well-developed system-description would be needed that could be reviewed critically, in advance, by the experts. The objective of the strawman specification was to describe a TMERS that could be a complement to the NZ ETS in case the NZ ETS needed help achieving gross emissions reduction in New Zealand. Following the literature, there were several key objectives that were chosen for the TMERS to achieve, as follows:

- Set a cap on light-fleet emissions and a pathway for orderly emissions reduction (sinking lid) from the light-fleet over time by issuing periodic rights that would be required to be surrendered in association with making emissions from the light-fleet.
- Encourage innovation in the use of the light-fleet and removal of the 'lowest cost to remove' emissions from the light-fleet by making the rights tradable.
- Maximise the potential acceptability of the system for the general population by
    - Maximising the benefit for as many people as possible so that there would be strong public support
    - Reducing transport inequity to the greatest extent possible
    - Proposing a system that people would have no difficulty understanding or operating

The draft strawman was also influenced by a submission to the second emissions reduction plan consultation by Minett et al, (2024).

Holding the symposium

The draft Strawman was widely circulated with information about the symposium. Four subject-matter experts, Erik Verhoef, Kexin Geng, Dr. Zia Wadud, and Meng Xu, agreed to prepare and present keynote addresses and to participate in the discussions during the symposium. The symposium was hosted by the international Ridesharing Institute in July 2025. 34 people joined the call. Participation was noted from the following countries: USA (13), New Zealand (7), Germany (5), Brittain (2), Serbia (1), Canada (1), China (3), Netherlands (1), and Austria (1).

Full details of the symposium are attached in Appendix 2, see page 69.

Strawman TMERS specification post-symposium

After the symposium the specification was adjusted to reflect the advice received. The following is an attempt to state the TMERS solution as simply as possible.

For a person who does not engage with the details of the system, the following box contains a description of the simple operation of TMERS that applies to every person 16+ yrs of age:

1. One off: Load TMERS app on phone, and register for a TMERS account, OR: Go online and register for a TMERS account; OR: Go to an NZTA agency and register in person for a TMERS account. If not owning a smart phone, receive a TMERS card in the post.
2. One off: Complete profile information to qualify for any equity adjustment entitlements.
3. Observe the free quarterly deposits of rights into the TMERS account.
4. If owning/operating a fossil-fuelled vehicle, when buying fuel, use the quantity of rights automatically advised by retailer: either by swipe on phone, or swipe with TMERS card. Observe the rights being deducted from the TMERS account.
5. If needing additional rights, buy them at the market price by the most convenient method (on phone, online, in person at fuel station, or in person at NZTA agency).
6. If having surplus rights (due to no fossil-fuelled vehicle or making no or few fuel purchases) save, gift, or sell surplus rights, privately or through the market, by the most convenient method (on phone, online, in person at fuel station, or in person at NZTA agency).

Whilst simple in operation, there would be many details to be worked out. Important ones are listed below. Questions arise when reading this list, hopefully answered in the subsection that follow this one*: Questions and answers*.

1. The proposed solution is tradable rights to make emissions using the light-vehicle fleet. The light-vehicle fleet is a discrete generator of GHG emissions that can be measured and therefore managed. The system would not be a carbon tax because the NZ ETS already taxes carbon emissions upstream. The rights would determine 'who' could make the emissions (that have been taxed via the NZ ETS and are included in the price of the fuel). TMERS would find low-cost-to-remove emissions opportunities that are hidden from the NZ ETS because the marginal cost of even low-cost-to-remove trips in fossil-fuelled vehicles is considered to be trivial.
2. Surrender of rights would be required based on the emissions content of the fuel. One right would allow buying fuel that when used in a light vehicle would release 1kg of CO_2-e.
3. The requirement to surrender rights would apply to all owners/operators of light-vehicles, including individuals and organisations, with no exceptions or exemptions. Similarly, petrol and diesel retailers would be required to account for all sales of fuel to the light-vehicle fleet.
4. There would be free (no payment required) quarterly allocations of rights to all adult people (16 yrs+) with some small exceptions. There would be no allocations to organisations.

5. The quantity of rights allocated for the first quarter would be equivalent to the nation-wide emissions from the light-vehicle fleet for the previous quarter divided between all adults on an equitable (not equal) basis.
6. An Equity Adjustment Factor methodology and an Equity Backstop provision will be established to ensure allocations are sufficiently equitable and there is a backstop for people who end up without rights and no way to obtain them.
7. Because the gross quantity of rights to be issued would include the previous quarter's emissions from light-fleet vehicles owned by organisations, at the average individuals would receive more rights than they would need for the coming period.
8. One or more market-makers would buy excess rights from individuals and sell required rights to organisations and individuals who needed more than their allocation. Market-makers would advertise buy and sell prices for rights and be required to hold stocks of rights so that orders could be filled. Their buy and sell prices would give them a margin that would cover the costs of operating the system and reward them for the risks they take as market-makers.
9. Every individual would establish a rights account that their quarterly allocation would be placed into, while organisations would establish a rights account that their purchases would be placed into. Technology would ensure it was easy to carry out rights transactions including surrendering the rights when buying fuel. The accounts could be operated through the National Ticketing System currently being implemented for public transport.
10. Organisations would immediately need to purchase rights, either privately or through the market-maker, which the market-maker would buy from individuals. Individuals can trade privately, gift rights to other people or organisations, or buy or sell with the market-maker.
11. The requirement for organisations to buy rights will ensure there is market activity. Many people (such as EV owners) would not need their full allocations and would provide the supply for the market.
12. Rights allocations would reduce every quarter in line with a sinking cap that would achieve an agreed national reduction target for light-vehicle fleet emissions by an agreed date.
13. Rights would not expire and could be saved up. To protect any substantial early emissions-reduction success, if total banked rights (across all holders, summed together) at the end of a quarter exceed a threshold (to be determined, but perhaps 1.5 times the current year's total allocations) the following quarter's allocations must be reduced accordingly, by the 'excess stock holding', being the amount that total banked rights exceed the threshold.
14. The price that the rights will trade at is unknown. It is possible people will choose to hold on to their surplus rights which could cause prices to rise. A rising price would be offset by the extent to which people avoid using up their rights by changing their mode or quantity of travel or switching to EVs.

Questions and answers

1. Why give rights to all adults, and what might the exceptions be?

As a general observation, almost all adults 'could' obtain a drivers' license and buy a fossil-fuelled vehicle and so start to make emissions from the light-vehicle fleet. If drivers' license and vehicle ownership were required, there could then be an uptick of people obtaining these for the purpose of getting an allocation of rights. By not owning and driving a fossil-fuelled vehicle, such people can be seen as part of the solution. Issuing rights to them rewards them for this. However, there are adults who could not obtain a drivers' license, or who could not use one if they had it – examples include immobile elderly in care homes, elderly who have lost their license but continue to live at home, and incarcerated prisoners. There could be other examples.

2. What is the logic of giving no allocation to organisations?

Mostly it is because organisations do not vote – and the objective was to create a system that would be chosen by the public in a referendum. But there are additional reasons and benefits. Firstly, by making it necessary for organisations to buy all the rights they need ensures that there is a 'demand side' for the market for the tradable rights from day 1. Secondly, larger organisations are likely well placed to take actions to reduce emissions from their light vehicle fleets. Having to purchase rights will encourage greater levels of electrification of organisational fleets because EVs will require no rights surrender to allow their operation. Thirdly, if TMERS is introduced along with the FED to RUC switch, organisations with higher-emitting vehicles will experience a reduction in costs, so the pain for them purchasing rights will not be as great. Note that the majority of high-emitting vehicles that were added to the light fleet in 2023-2025 were imported for commercial purposes. See Figure 15. Fourth, organisations already receive a benefit under the CCS with a different maximum mass allowance compared with non-commercial usage. Finally, if TMERS introduction were to cause an overall increase in organisational costs, commercial entities have margins that can absorb cost increases, and in time these can be recovered through adjustments to prices or by finding other offsetting efficiencies.

A follow-on question about organisations relates to the self-employed: people who use their vehicle for home and work. The intention is to NOT make an allocation based on vehicle ownership, but rather 'adult-ship'. The self-employed person would qualify to receive an equitable allocation. They could dispose of that allocation in any way they see fit. Assuming they have just one vehicle, used for work and home, they would likely sell all of the allocation to their business activity, and quite possibly need to buy additional rights to meet their total needs. Their accountant would help them find the best way to handle the transaction, ensuring that the price the rights are transferred at is fair, and the business-related share of the costs is properly reflected in their taxation accounts.

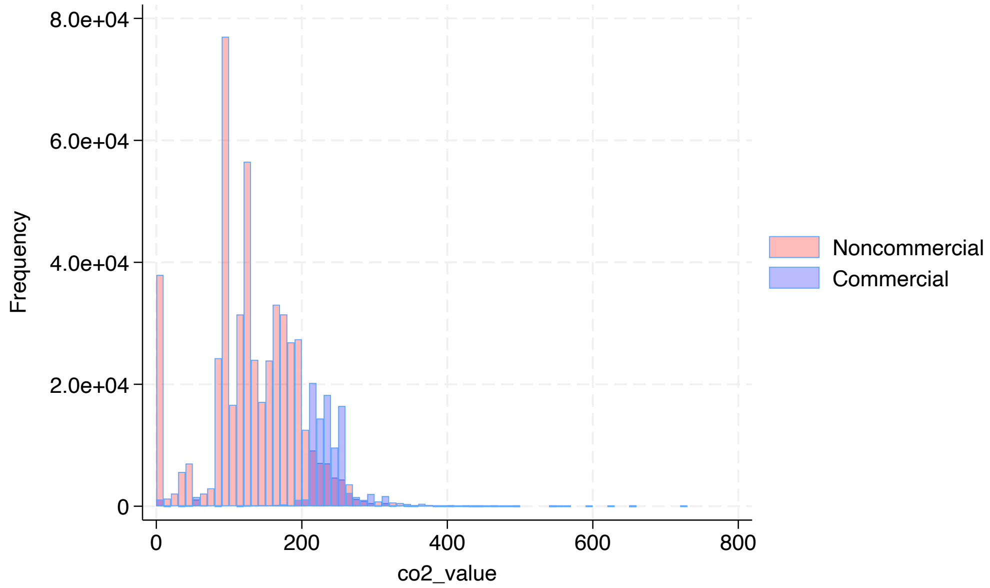

Figure 15: Import emissions ratings by usage, 2023 to 2025. Source: CCS Import Dataset[44]

3. What is the likely price that the rights will trade at?

Pricing is not known but could be predicted. This should be part of the further work of developing the solution. Such further work should take the following into consideration:

To begin with, the first quarter's total allocation will equal the previous quarter's emissions, so barring significant seasonality in emissions, there should be sufficient rights to go around. Each qualified adult will receive a base allocation, and many will receive an equity adjustment. Everyone's allocation will exceed the average person's needs because the total allocation includes all the emissions from organisations in the previous quarter. So, while organisations will have demand for rights there should be an equivalent amount of supply available from individuals, that individuals are not going to use. Organisations and individuals will each form their own opinion of the value, given their understanding: a) that the total allocation will be lower and continue to decline in all following quarters; b) that overall demand from organisations will likely drop as they move quite quickly to electrify their fleets to avoid the cost of buying rights; c) that there will be an ongoing reduction in demand as people actively seek ways to reduce their use of the rights to maximise their personal economic benefit; and d) other relevant factors.

The market maker will be required to hold stocks of rights and publish buy and sell prices, plus detail of the prices that rights have changed hands for in the market (much like happens for the share market). At any time, any person or organisation can consider the offered price and decide to buy or sell rights, based on their opinion about the value. Organisations such as the Citizens Advice Bureau will be able to help people who feel unsure about what to do, whether to sell their surplus, for example, or hold on till a later time.

[44] This chart was derived from a spreadsheet received from NZTA under the Official Information Act, Request #19619, being a listing of all vehicles imported under the Clean Car Standard, including their make, model, class, fuel type, year of manufacture, new or used, emissions rating, emissions target, etc. from inception of CCS to September 2025.

As time goes on, each quarter there will be growing tension between continued use of fossil-fuelled vehicles and seeking out options to change. If emissions reduction is slow, there will be greater demand for rights than the new quarter's supply, and the price will rise. There will be a place for government to encourage innovation to help keep emissions falling. Innovation could be in the implementation of more extensive public transport systems or finding better ways to encourage individuals to be more embracing of the switch to electric.

Recognising that the cap will continue to sink every quarter, people will feel more confident making investments in such solutions as residential charging for EVs, knowing that if they electrify, their reducing allocation of rights will provide a stream of revenue to offset the costs of doing so.

4. What is the reason for the 'excess stock holding' provision?

The objective of the whole system is to support reduction in emissions by finding and removing low-cost-to-remove emissions. Making a given change sooner is more valuable than making the same change later because emissions reduction benefits are summed through the years. It is conceivable that there would be some dramatic adjustment to emissions early in the existence of the system, perhaps as organisations rapidly electrify at a substantial level, which would impact on demand so much that the rights would have only minimal tradable value. The nature of the system-design will be that there is a total agreed and known quantity of emissions allowed over the life of the system, equal to the sum of all the quarterly allowed emissions from start to end. If early demand fell away, it could have the effect of 'banking' higher levels of emissions to be made in the future, which would be detrimental to the objective of the system. The 'excess stock holding' provision is a mechanism for ensuring that early gains are held on to. Once deducted, the excess stock holding adjustment is permanent.

5. Why make an allocation to people who do not have a car, or who have an EV so don't need to buy fossil fuel? And would any people be excluded?

While carless or EV owning people might not need to buy fossil fuel at the moment, they could get a car that uses fossil fuel at any time. The fact that they do not means that they are part of the solution, and it is fair to recognise them for this. The stated objective in design of the system is to make it as acceptable as possible to as many voters as possible.

A logical exclusion would be people who are not likely under any circumstances to get a car, such as immobile residents of nursing homes, or incarcerated prisoners.

6. How would this fit with the proposed 'time of use' or 'congestion' charging scheme that the Government is developing?

If TMERS were implemented before time of use charging, it could be that TMERS would reduce the amount of traffic at peak times, reducing the need for time of use charging, though this is not a certain outcome. If time of use charging were introduced before TMERS, it is possible that the value of a TMERS right would be slightly lower than otherwise would be the case, but overall the two policies could complement each other, making it more valuable to (for example) reduce trips by pooling: participants might share the cost of the toll, while passengers would also benefit from avoiding use of their TMERS rights by reducing their own fossil-fuelled-vehicle trips.

7. What is the likely number of rights that would be allocated each quarter, if the system was put in place during 2026?

A key development step will be the setting of the target and the quarterly reductions. This will involve deciding what quantity of light-fleet emissions should be allowed within the emissions total anticipated in 2050 in the 'net-zero' calculation. Given that 2024 emissions from the light fleet appear to have been about 8.9 megatonnes, and there are 100 quarters between the start of 2026 and the end of 2050, the simple calculation would be:

[Starting quarterly average less ending quarterly average] divided by 99 quarters

For example, if the end 2050 annual target for light-fleet emissions were to be 1.0 megatonne[45], the final 2050 quarter's emissions would need to be 0.25 megatonnes.

The starting average quarterly emissions are (8.9 megatonnes/4 quarters) = 2.225 megatonnes

The ending average quarterly emissions need to be (1 megatonne/4 quarters) = 0.250 megatonnes

The total amount the quarterly emissions allowances need to reduce = 1.975 megatonnes

There are 99 quarters in which the quarterly reduction must occur so 1.975 is divided by 99, and the quarterly reduction is 0.01994949 megatonnes (19,949.5 tonnes).

Quarterly reductions would need to be 19,949.5 tonnes per quarter to reduce from 8.9 megatonnes per year to 1.0 megatonnes per year over 99 quarters. In this example, in the first quarter 2,225,000,000 rights would be allocated (being the same quantity as the final pre-TMERS quarter, 8.9 megatonnes divided by 4, expressed as kilogrammes). In the second quarter 2,205,050,500 rights would be allocated, (being 2,225,000,000 less 19,949,500). In the third quarter 2,185,101,000 rights would be allocated. And so on, with reductions of 19,949,500 rights each quarter.

8. What about visitors to New Zealand? Do they become entitled to receive rights?

Visitors would be able to purchase rights but would not have an entitlement unless they stayed for a qualifying period: a detail to be worked out. More likely in the case of visitors using rental cars is that the rental car company would purchase rights and include access to those rights as part of the rental agreement.

9. What would be considered in the Equity Adjustment Factor calculation? How would it work?

It is recommended that the answer to this be the result of broad consultation and community engagement. An initial list based on the literature would suggest including for consideration: a transparent formula that increments the basic allocation based on household composition (numbers of children per adult), income, disability, access to low-emission alternatives such as public transport, rural vs urban residence, distance to employment, etc. EAF would be denoted as a percentage increment to an individual's basic allocation. To determine the unadjusted allocation the following formulae would be used:

[45] Note that the Climate Change Commission has recommended updating the 'net zero' target to a 'net -20Mt' target, (Climate Change Commission, 2024). With the original 'net zero' target the Ministry of Transport estimated that transport would need to be almost fully decarbonized by 2050, (New Zealand Ministry of Transport, 2022b). It has been difficult to find a statement of the expected gross emissions and the expected removals in 2050 that would lead to a 'net zero' or a 'net -20Mt'. It is perhaps more likely that this target would be zero, but 1.0 megatonne is used to make the example calculations more explicatory.

(Total rights available to allocate for the quarter) – (rights needed to establish or replenish the Equity Backstop to the agreed level) – (any number of rights required to adjust for excess stock holdings) = Rights to be Allocated

(Sum of the qualifying 16+ population) + (Sum of all the percentage EAFs) = Equity-Adjusted allocation population

(Rights to be Allocated) / (Equity-Adjusted allocation population) = rate of allocation to individuals with no EAF.

The rate of allocation to people with EAFs would be:

(The rate of allocation to individuals with no EAF) X (100% plus the individual's EAF percentage) = Allocation to a person with an EAF

Continuing with the example numbers from above, the average personal allocation in the first quarter would be 2,225,000,000 divided by all people 16+ years of age. Assuming that there are 4.3 million people who qualify, the average personal allocation for the first quarter would be in the order of 517 rights, (2,225,000,000 divided by 4,300,000), before the application of the Equity Adjustment Factor. Simplistically, if 20% of people received a 15% equity adjustment factor (EAF), and all others received the average, the first quarter allocation would be an average of 502 for people who received no EAF, and 577 for those who received the 15% uplift. The following workings are relevant:

4,300,000 x 20% = 860,000 people who receive EAF (and 3,440,000 people who do not)

860,000 x 15% = 129,000 EAF increment

4,300,000 people plus 129,000 EAF increment = 4,429,000 Equity adjusted allocation population.

2,225,000,000 divided by 4,429,000 = 502 rights allocation to people with no equity adjustment factor

502 X 1.15 = 577 rights allocation to people with a 15% EAF.

In this simple example, 3,440,000 people receive 502 rights each, and 860,000 people receive 577 rights each, for a total of 2,223,100,000 rights allocated. There is a difference due to rounding. The rounding difference could be written off or carried forward to the next period's allocation.

The allocation would reduce each quarter by just over 1% of the original allocation (because the period covered is 100 quarters). Average individual allocations would also adjust due to population changes. 500 rights would enable purchase of just over 200 litres of petrol. Across a year with reductions included that would allow about 800 litres of petrol. A substantial proportion of people use far less petrol than this each year.

10. How is it intended that the Equity Backstop works?

The Equity Backstop is a pool of rights retained from the quarterly allocation that can be used in emergency situations as an additional free allocation to people with transportation poverty: such rights could only be used; they could not be on sold. The rules around the Equity Backstop would require careful consideration because as time goes on and the sinking cap reduces the number of rights available, people in transportation poverty might be required to make some adjustments to their trip-making, or society might need to provide alternative services that reduce the incidence of transportation poverty.

11. What happens after 2050?

When the 2050 target has been met, unless it is for zero emissions, there will still be quarterly emissions from the light vehicle fleet. The solution would be expected to continue operation, but without further reductions to the quarterly allocations.

Personas

Scenarios by persona

Following is a description of the experience of people in different situations and the impact TMERS has on their lives and their travel-mode plans, one year into TMERS.

There are seven different personas:

1. A person with no car
2. A person with an electric car
3. A couple with a plug-in hybrid petrol car
4. A couple with a diesel-fuelled car and a petrol sedan
5. A person with low income and a petrol-fuelled car, living in the exurbs (beyond the suburbs)
6. A couple with high income and a petrol-fuelled car, living in the close-in suburbs
7. An accountant working in a medium-sized business.

A person with no car

George lives alone and has no car. He uses public transport to get around or takes an occasional Uber or other similar taxi service. He lives a short distance from most places he needs to visit. George will be quite happy with the arrival of TMERS because he will be able to sell TMERs and receive cash to supplement his income.

After a year of TMERS operation, four periods in, George has found that the best way to sell his TMERs is through one of the market-makers. There is not much fluctuation in the price of TMERs. George sells his TMERs automatically as soon as they are allocated into his account. He has noticed that the quantity of TMERs he receives has been reducing slightly each period, and that the price per TMER has dropped slightly since the first allocation. From discussions with his friends at the tennis club, he thinks this is because people have gotten used to having them, and the level of saving up of TMERS has dropped off.

A person with an electric car

Mike lives alone and has an EV. It makes no emissions, he does not buy petrol, so he does not need to use the TMERs. When he receives his TMER allocation each quarter he donates half of the TMERs to an organisation that drives people to medical appointments. He sells the other half privately to work colleagues who need more than their allocation. The colleagues pay him in cash the price they would have to pay the market-maker, so Mike earns a little more than he would if he sold to the market. He easily transfers the TMERs to both the organisation and his colleagues using the app on his phone. It is as easy as doing internet banking.

A couple with a plug-in hybrid petrol car

Maysie lives with her partner Ali and has a plug-in hybrid car. She must surrender some TMERS when she buys fuel. Ali mostly cycles to work, though in bad weather Maysie drops him off. Maysie's allocation of TMERs has been more than sufficient for her needs because of the low emissions rating of the vehicle. Maysie initially kept her surplus TMERs, but after four quarters she can see that she does not need to keep such a large buffer. She now sells most of her surplus to the market-maker. She carries out this transaction on the app on her phone, and the money is paid into her bank account. Ali gives some of his allocation to Maysie and sells the balance to the market-maker.

A couple with a diesel-fuelled car and a petrol sedan

Tom drives a diesel and has done for years. His wife Dora drives an energy efficient petrol sedan. They have two teenage boys whom they drive to several different sports activities each week. They often drive one of the cars to their beach house on weekends. Tom surrenders TMERs when he buys diesel, it happens automatically when he swipes his TMERs card. He is grateful that the allocation has been sufficient with a small surplus. There was no change in the price of diesel when TMERS began. Tom and Dora find that they usually have just enough TMERs between them for all their travel. Dora surrenders her TMERs when she buys petrol, it is calculated automatically, and the surrender occurs when she swipes the TMERS across on the app on her phone. One quarter Dora did more driving than usual, and Tom easily transferred some of his surplus TMERs to her. They have been noticing that the quantity of TMERs they receive is reducing after a year of the system being in operation. They are starting to think about how to reduce their need for TMERs and have been looking at EVs.

A person with low income and a petrol-fuelled car, living in the exurbs (beyond the suburbs)

Gerry is a single mother with three daughters. She drives a petrol-fuelled car and covers a lot of distance because the girls have sports and dance and lots of other extra-curricular activities, and she hates to disappoint them. She is on a relatively low income and feels lucky that she receives a 15% equity increment in her TMERs due to her income, number of children, and the distance she lives from work.

Gerry's TMERs allocation is deposited into her account at the start of each quarter. Gerry surrenders TMERs when she buys petrol. The quantity needed is automatically calculated and she uses the TMERs app on her phone to make the surrender. She can easily check the balance she has remaining, via the app.

After the first quarter of TMERs Gerry found she had a decent surplus, and she easily sold them to the market-maker and received a little extra cash. The transaction was also carried out on the app, and the money was deposited in her bank account. Gerry has noticed that the TMERs surplus is reducing each quarter because the allocations are getting smaller. She knows that after another year she will have to change her trip-making or start buying instead of selling TMERs. She has been talking to neighbours about carpooling three days a week and likes the idea but has not yet committed. She also thinks about getting a job closer to home.

A couple with high income and a petrol-fuelled car, living in the close-in suburbs

Anne and Chris are semi-retired and live in an apartment in a suburb close to the city. They own a new luxury petrol-fuelled car that they drive on an irregular basis. For many of their needs they can (and do) walk. They mainly use their car to drive to the beach. They receive two allocations of TMERs, one each, and so far, have only used about a third of their total quarterly allocation. They automatically surrender their TMERs when they buy petrol. The surrender is achieved using the TMERs app on their phones, that treats them as a household so both their allocations and usage is merged in one account that they can separately access. They have two married adult children who live in rural areas who have found that their allocations are insufficient, so Anne and Chris gift their surplus TMERs to their children.

An accountant working in a medium-sized business.

Sunita is an accountant for a landscaping business. The firm has several petrol-fuelled light vans, a company car each for the CEO and Operations Manager, and a diesel truck that does topsoil deliveries. Sunita has always had to buy RUC for the truck because it is a heavy vehicle and has a hubometer. She is used to the process of RUC, but now she also needs TMERs for the vans. Having no allocation of TMERs for the business, Sunita has tried a few different ways of getting enough of them. The CEO and Operations Manager agreed with her argument that they should transfer their personal allocations to the company. For the vans she has found the easiest way to get TMERs is through the market-maker. In the first quarter it was quite expensive while people gained an understanding of how the system worked. Many people were reluctant to sell their surplus TMERs, and this pushed the market price up. This made it more attractive for people to sell some of their allocations and that was how it all balanced out. Over time people have gotten used to the small amount of extra cash, so sell their surplus even though the price has fallen. Sunita has heard that the unused quantity from the most recent quarter is about 50% lower than the unused quantity from the first quarter.

Sunita is careful to ensure that each van has sufficient RUC always prepaid. The TMERs she has acquired are accumulated in a company TMERs account and surrendered from there. The TMERS are automatically surrendered when the van drivers fill up the vans. Sunita makes sure that each van has a TMERs card on board so that the driver can swipe it when buying petrol.

Buying TMERs is an extra cost for the business. Seeing the extra cost, the CEO has recently asked Sunita to investigate buying electric vans, which would not need TMERs.

9. Key findings, discussion, limitations, conclusions, recommendations

Key findings

1. There will be no blowout in emissions with the FED to RUC switch. In fact, emissions from petrol vehicles will possibly reduce by as much as 1.6%, if the RUC rate implemented is the same as the current RUC for diesel and electric vehicles. There will be increases in emissions by users of less energy-efficient petrol vehicles, but these will be more than offset by decreases in emissions by users of more energy-efficient petrol vehicles.

Charging petrol vehicles for RUC at the existing rate will generate in the order of $129 million additional annual revenue for the Government, which might be the real reason for the proposed change. The Government has lost substantial annual revenue from the FED due to the improvement in petrol-fleet fuel efficiency over recent years. The $129 million is the net of increases of $235 million from owners of more energy-efficient vehicles and reductions of $106 million from owners of less energy-efficient vehicles.

Average petrol-fleet fuel-efficiency of 9.5 litres per 100 km was used to set the current RUC for non-petrol light-vehicles, and it dates to 2012 (New Zealand Ministry of Transport, 2022a). The actual average petrol-fleet fuel-efficiency is now much lower. By bringing all vehicles up to a RUC charge that is based on a much higher fuel-efficiency than average, the FED to RUC change will have an impact on a very large proportion of petrol-vehicle owners.

It is estimated that owners of as many as 2.9 million petrol vehicles, 85% of the petrol light-vehicle fleet, will experience an increase in total costs of motoring. This is because their current petrol costs include FED, and the amount of RUC they will pay when the FED is removed will be higher than the FED amount that they currently pay. This is because the RUC they will pay will be based on an historical energy efficiency of 9.5 litres/100 km times the FED rate per litre, while their current petrol cost includes FED at a more efficient litres/100 km times the FED rate. They have been receiving a de facto ‘energy efficiency discount’ on their contribution to the costs of the transport system, and this discount is being removed with the switch to RUC.

2. The NZ ETS is broken, but even if it was functioning well it would have little impact on the price of petrol even as the NZU price rises over time, assuming it follows Government-agreed shadow prices for CO_2-e through to 2070.

   The central shadow price for CO_2-e would increase petrol prices to about $3.35 per litre by 2050 (from $2.60 per litre now and excluding the FED to RUC switch, so still including FED). There is little confidence that the NZ ETS will successfully raise unit prices from the recent level of $55 (and lower) to the current central shadow price of $120.

3. Given the inelasticity of fuel purchases in response to changes in the price of petrol, (-0.20 in the short run and -0.5 in the long run) the price rises caused by the NZ ETS will have little impact on petrol consumption or emissions.

   The central shadow price for CO_2-e will drive only a small decrease in emissions from petrol from the current annual level of 6.0 million tonnes to 5.33 million tonnes by mid-century.

4. There is international evidence that petrol prices have an impact on the average emissions ratings of additions to the light vehicle fleet, but the impact is very small. Efforts in this research to replicate the international evidence using New Zealand data were not successful because there is substantial noise in the data that were accessed.

   Assuming the overseas elasticity estimates can be applied in New Zealand and ignoring the impact of the Clean Car Standard on the mix of fleet additions, the price of petrol will have no meaningful impact on the emissions profile of fleet additions.

The current average level of fleet additions of 158 g/km would reduce to 154 g/km by mid-century.

5. It is proving difficult for the motor industry to source sufficient low emissions vehicles to meet the fleet additions average emissions targets covered by the Clean Car Standard; and the Government is moving to ease the rules.

   It is also possible that scrappage rates of some fossil-fuelled vehicle types will be reduced through the working of the CCS, causing older, less safe, higher-emitting vehicles to be retained in the fleet for longer, reducing the overall benefit of adding more low-emitting vehicles.

6. Analysis of the light-vehicle fleet, and how it might evolve over time under different policy settings including bans on fossil-fuelled vehicle imports from various starting dates, found that the fossil-fuel fleet will still be numerous by 2050 under all scenarios. When compared with the various different potential ban commencement dates, substantial present values were found in favour of TMERS.

   A scenario of never having such a ban, with EV imports at a constant rate of 5% of vehicle additions, was compared with the TMERS option with a target of 1 megatonne of emissions per year remaining by the end of 2050 and a constant emissions reduction rate from 2026 to 2050. The difference between the two scenarios achieves a present value of $16.4 billion (based on the central shadow value of emissions avoided, discounted at 3%). Policy settings with ban-commencement dates are more valuable than never having a ban, and earlier ban dates give more impact. Ironically, it is possible that with TMERS a ban would not be necessary because people would adjust in response to the declining availability of rights over time and the resulting market prices under TMERS.

7. A symposium of experts, considering a TMERS strawman expressed concern that this could be seen as a duplication of the NZ ETS, and were not sure why TMERS would be needed since NZ ETS exists.

   Expecting this concern could be addressed, the experts were supportive, and their main concerns were for getting TMERS accepted politically. Their recommendation was that TMERS should strongly address inequity through the process of rights allocation, and that this would increase acceptability. There was general agreement that TMERS could achieve emissions reduction because it would have a cap and a sinking lid. Proposed design features seemed generally acceptable.

8. The TMERS strawman has been updated based on the results of the symposium and other inputs.

Discussion

Would a credible (well-functioning) NZ ETS still need help?

The most significant discussion item is the question about the need for TMERS when New Zealand has an upstream emissions trading scheme. Economists (including the symposium experts) expect that a well-functioning ETS would achieve the task of removing ‘low-cost-to-remove’ emissions from operation of the light vehicle fleet. The government intends to return the NZ ETS to credibility by 2030, (Beehive 2024). If the NZ ETS were returned to credibility, would it achieve the task of removing 'low-cost-to-remove' emissions from operation of the light vehicle fleet? Would a TMERS be needed?

Some jurisdictions make substantial effort and investment to manage transportation demand[46], encouraging people to use alternative modes such as public transport, carpooling, cycling, and walking. In decarbonisation planning in 2022 the New Zealand Ministry of Transport described over 40 initiatives aimed at early emissions reduction, (New Zealand Ministry of Transport, 2022b). Subsequently these strategies were seen as not being necessary because emissions from transport are covered by the NZ ETS, which "*limits the degree to which enabling transport policies directly reduce net emissions in the long run*", (New Zealand Ministry for the Environment, 2024a, page 61).

For a petrol-light-vehicle with average emissions[47], the NZ ETS currently adds a trivial 1.26 cents per km to the cost of driving (with the NZU priced at $55). If 'returned to credibility' means the pricing of NZUs tracks the central shadow price, the 'credible' price in 2025 would be $120 per NZU. At this level, the NZ ETS would impose an additional 1.49 cents per km, for the average emissions vehicle, for a total of 2.75 cents per km, which is still considered to be trivial. Returning the NZ ETS to credibility by the end of 2025 would increase the price of petrol by about 0.6%, and with a long run elasticity of -0.5 have no noticeable impact (-0.28%) on petrol consumption. As shown in Figure 7 (page 23) petrol prices that include the central shadow price of carbon to mid-century and beyond have minimal impact on total emissions from petrol.

Eventually a well-functioning NZ ETS would cause the price of petrol to rise to a high-enough level that consumption and emissions from the light-fleet would fall. But it appears that is not likely to occur by 2050, unless the actual price pathway of carbon is substantially different to the agreed shadow prices.

This matters because there is a time value of early emissions reduction. New Zealand's international obligations are stated in quantities of emissions over the 2021 to 2030 budget period, followed by 5-year budget periods *ad infinitum*. The first period of reckoning will be during the early 2030s when emissions for the 2021-2030 period will be accounted for. At that time, and after each budget period following, if there have been excess emissions the Crown will have to purchase international transferable mitigation outcomes (ITMOs) equal to the excess.

Further, if there are excess emissions, the ITMOs will have to be purchased at their prevailing price and will be an international payment by the crown to overseas interests that are generating the ITMOs at the time of settling the excess, and foreign exchange rates at the time. An unintentional budget-period excess could easily become a multi-billion-dollar liability. As an alternative, investing domestically to reduce or avoid the excess would support the domestic economy: creating jobs, improving resilience, and improving productivity.

If there were a strategy for emissions reduction that could be applied in year 1 or year 5 of a budget period with a similar expectation of impact on annual emissions, it makes most sense

[46] Generally, under the heading of 'transportation demand management' (TDM) or 'mobility management' (MM) programmes.
[47] Assumes 8.1 litres of petrol per 100 km, and 199 gm of emissions per km.

to apply it in year 1 because the benefit would be felt for the whole 5 years. Similarly, a successful emissions reduction strategy in 2026 would have 25 years of benefit out to 2050.

It is not difficult to compile a list of potentially low-cost-to-reduce opportunities in emissions from the operation of the light-vehicle fleet. People make short trips by car that could be walked or cycled. People drive alone when they could share transport, such as by carpooling or vanpooling or catching public transport. People make multiple trips that could be chained together. People with choices between higher and lower emissions vehicles choose the higher emissions vehicle.

These are all examples where making a change would involve minimal effort and minimal economic outlay for the individuals involved and would reduce emissions, **if people could just be motivated to make the changes**. Of course, each person would have a different view of the economic and psychological/cultural costs and effort of making these emissions reductions, and it would be difficult to develop a reliable estimate of the quantum of such low-cost-to-reduce opportunities, especially because they probably represent only one part of each vehicle's usage pattern. However, the International Energy Agency, (2022), for example, shows that strategies involving shared transport have the largest payoff in reduced fuel consumption and therefore emissions.

Here it might be useful to think more deeply about the use of light fleet vehicles, especially at a household level. As suggested in the previous paragraph, low-cost-to-reduce opportunities may represent only one part of each vehicle's usage pattern. If we imagine that there are three levels of 'cost-to-remove': low, medium, and high; we could survey users, and we might find examples such as those shown in Figure 16 (note that the examples shown are hypothetical).

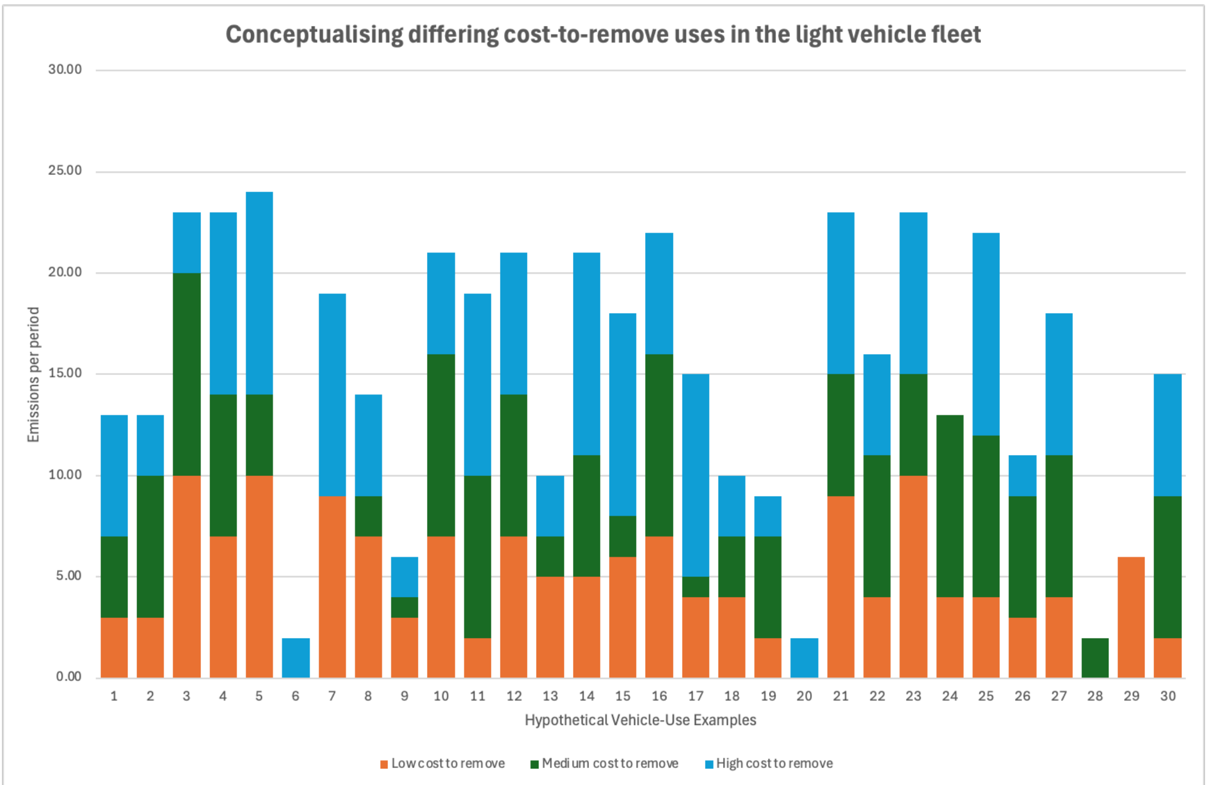

Figure 16: Conceptualising different cost-to-remove uses in the operation of the light vehicle fleet

Needing their vehicle for 'high- and medium- cost-to-remove' uses (for example, long journeys in rural areas), the vehicle owner/operator might mentally apply the full fixed-cost of vehicle ownership to those uses and think of only the marginal cost (possibly only the fuel consumed and then not necessarily with great precision) in relation to the low-cost-to-remove uses. As discussed on page 15, at a current petrol price of $2.60 per litre, including NZU priced at $55 plus 15% GST, for an average energy-efficiency vehicle, the cost of fuel is 21 cents per km including an NZ ETS component of 1.26 cents per km. The important question is, what NZ ETS-driven fuel price change would it take to motivate the owner/operator to change these trips which are neither expensive nor difficult to change? It is a difficult question to answer.

However, the reason the question is difficult to answer compared with emissions reduction in other sectors could be the fragmentation of ownership of the light-vehicle fleet. The vast majority of light vehicles are owned in ones or twos, with a relatively small number of larger fleets. There is no benefit of scale for innovation in the operation of fleets of one or two vehicles. Lacking the benefit of scale and facing trivial cost and no motivation to make change, the interaction of the NZ ETS with the operation of the light vehicle fleet is futile within the 2026 – 2050 timeframe. Something more is needed if light-fleet emissions are to be reduced.

Comparing the CCS and TMERS

The second-most consequential discussion item is the Clean Car Standard, and whether it can be modified to better help the NZ ETS, or if TMERS is a potentially valid alternative. To help think this through, the same set of hypothetical vehicle-use examples is used. See Figure 17.

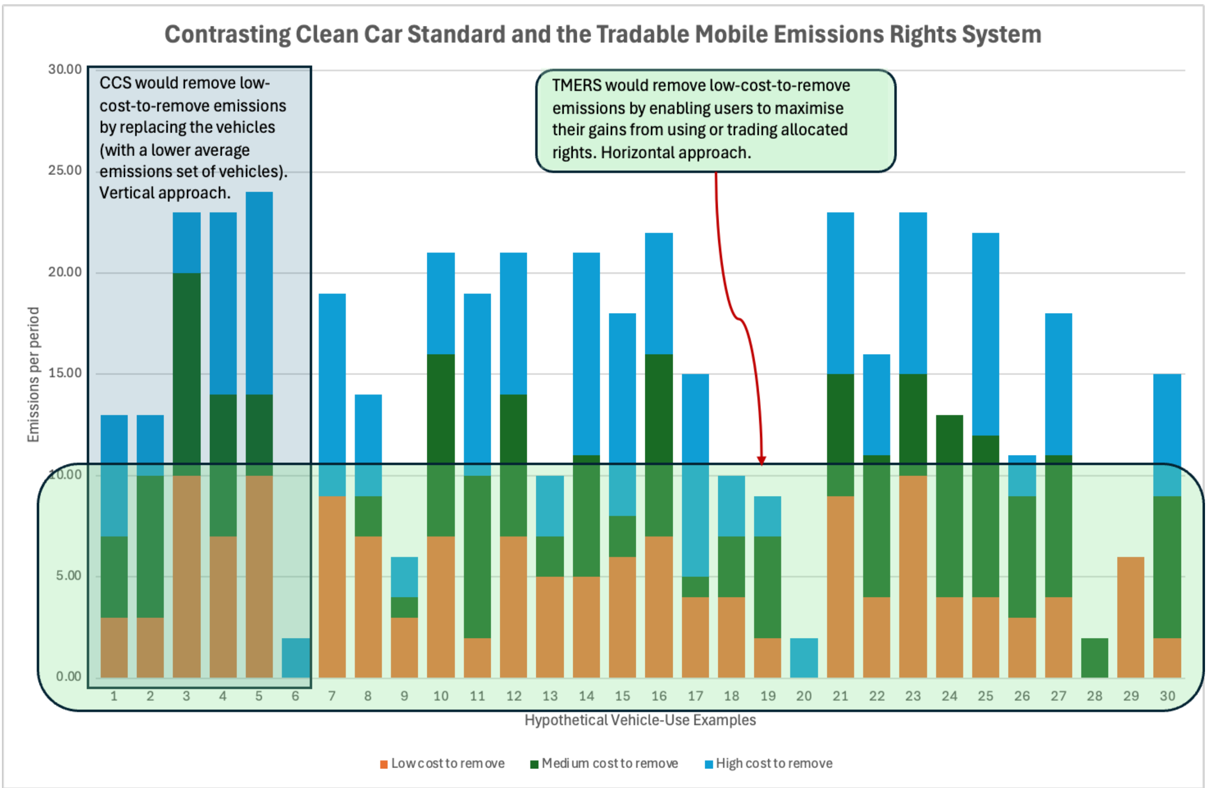

Figure 17: Comparing the CCS with TMERS

Figure 17 shows the method by which each strategy delivers a result.

The CCS can be characterised as a vertical strategy: it reduces the full range of cost-to-remove emissions vehicle by vehicle, replacing a higher-emitting vehicle with a lower-emitting one, but not necessarily fully removing the emissions (unless the replacement vehicle is an EV). The impact of the CCS is felt very gradually as the CCS modifies the fleet.

On the other hand, TMERS can be characterised as a horizontal strategy because it makes all vehicle users consider their options on a regular basis and enables them to maximise their gains from either using their rights or selling them. The size of the impact will depend on the price at which TMERS trade: at 1 cent each they would have little impact. At $1.00 each their impact could be dramatic. At $1.00 each the cost to purchase rights would have the same impact as the price of an NZU being $1,000.

An important question is whether the CCS and TMERS should co-exist, or if TMERS should replace the CCS. Under the CCS, as the targets are lowered over time, the number of credits importers earn from importing an EV will fall, and the number of penalty credits required to import a higher emitting vehicle will rise. There is already evidence of fallout from the impact this has on the price of higher-emitting vehicles as the government has moved to slash the prices of penalty credits (in other words, reducing the penalty price for importing a higher emitting vehicle). This means that the vertical strategy potentially has less impact than it was hoped it would have. The price of a TMERS right, and the certainty that the sinking lid will reduce the number of rights available each quarter, will send a clear message to people about the importance of reducing use of fossil-fuelled vehicles, and replacing fossil-fuelled vehicles with EVs. The TMERS market will encourage buyers of vehicles to make choices that maximise their returns from their rights. There is quite a different psychological proposition between the two strategies. In fact, it seems that people could be prepared to pay a premium for an electric vehicle as they anticipate receiving TMERs that they can then sell, instead of needing to use them to fuel a fossil-fuelled vehicle.

On balance, it feels as if TMERS would make the CCS redundant. They could co-exist, but it seems that the overheads of running the CCS could be avoided without loss of effectiveness.

Potential issues and uncertainties with TMERS

The solution is not without potential issues and uncertainties.

The biggest issue is the need to go 'all in' on the solution. It is not a solution that can be half implemented. This could be offset by having a time-limited pilot period of (say) five years, following which the whole solution would be re-evaluated. Dales (1968) proposed precisely this arrangement as a way to trial his proposed solution for managing waterway pollution. New Zealand does have some history of going 'all in' on large important decisions: MMP, ACC, and the Auckland Super City come to mind as examples.

The biggest uncertainty may be how supportive the general public of New Zealand will be to the solution. In two survey series of New Zealanders' attitudes towards emissions reduction and climate change, it is clear that climate change is a personal issue for a majority of New Zealanders, and people are looking for genuine government and business leadership on reducing emissions and the impacts of climate change, (Kantar, 2025), (IAG, 2021) and (IAG, 2025). Based on Kantar (2025), it would appear that getting business brands onside could be a valuable strategy.

Other potential issues and uncertainties include:

- Taxation: should revenue from sale of rights be taxable income?

- Avoiding fraud: The need to think through how fraud could come about and making sure the solution is robust enough to prevent it or detect and remove it if it happens.
- Tracking light-fleet diesel sales: Currently diesel sales can be made to heavy and light vehicles from the same pump, while petrol sales are not common for heavy vehicles.
- Petrol sales that are not for the light fleet: such as lawnmowers, and marine uses
- What happens if capture and sequestration of greenhouse gases starts to happen at a substantial level: Perhaps this triggers a review of the system.
- What happens if a shortage of rights for sale makes the price of rights extremely high for organisations: how to avoid the government issuing additional free rights and destroying the effectiveness of the solution. Consider enabling borrowing and lending of rights, and payment of interest in rights.
- Whether TMERS is a crypto currency: and whether its use should be managed and tracked on the blockchain.
- Whether there are viable alternatives to TMERS: assuming it is agreed the NZ ETS needs help, has TMERS been compared to other alternatives?
- If the pain TMERS will bring could be avoided: or if the pain is just there anyway and TMERS makes the most of a difficult situation.

Limitations of the research

FED to RUC Switch analysis: As noted in footnote 21, it is challenging to validate any given estimate of 'in use' energy efficiency of vehicles in the light-fleet. It is possible the results of the analysis of the FED to RUC switch would be different if a break-down of distance weightings was available by emissions category by fuel type. Further, as noted in the sensitivity analysis at the end of Section 3, where the objective is to have reliable petrol-fleet-only distances by engine size or emissions category, and also to have reliable knowledge of the average rate of emissions by each category. See further research in the recommendations section below.

New Zealand-specific elasticities for additions emissions: As noted in Section 5, this research was unable to replicate international estimates of elasticities for the energy-efficiency of fleet additions to changes in the price of petrol, and the modelling therefore used international findings instead. The modelling showed that the impact of forecast petrol-price changes would have negligible impact on the energy-efficiency of fleet additions. It is possible that New Zealand-specific elasticity estimates could drive a different conclusion.

Light fleet modelling to 2050: As noted in Section 7, footnote 36, the modelling of the light vehicle fleet to 2050 does not consider the size of each age cohort of fossil-fuelled vehicles and it is suggested the modelling is not as robust as it could be. This limits the accuracy of the estimates of emissions under different sets of assumptions, and the estimate of the present value of TMERS compared with the current trajectory of emissions reduction.

Further tradable credits implementations: As mentioned in Section 8 there are mentions of tradable credits pilot projects in the UK, but concrete information is difficult to find (and could not be found for this research). The possibility is not discounted that there might have been pilot projects that would have been useful to mention in this research.

Conclusions

1. The NZ ETS needs help with reducing emissions from the operation of the light vehicle fleet in the timeframe required for achieving net zero by 2050, and the benefits of early reduction are cumulative.
2. TMERS can provide help without duplicating the NZ ETS.
3. NZ ETS should continue to operate as it has done, with a single price for all emissions reductions across the economy.
4. The CCS is not fit for purpose and should be replaced by TMERS.
5. TMERS should be further developed through a process of organisational and community engagement, leading to a referendum on its acceptability.

Recommendations

Further develop TMERS

It is recommended that TMERS be further investigated. Public engagement should help determine the acceptability of the solution, especially by involving the public in the development of the equity adjustment factor and mechanism. The target date for TMERS implementation should be aligned with the intended date of the FED to RUC switch.

Further research

Following are suggestions for further research:

1. To further refine the estimates of the impact of the FED to RUC switch: Break-down of distance weightings by emissions category by fuel type, or by engine size by fuel type, and average emissions by emissions category. An alternative to the latter would be to have an emissions rating by vehicle, enabling analysis that did not need to conform to arbitrary emissions categories.
2. To provide valuable input for policymaking: Regarding estimating the elasticity of the energy efficiency of fleet additions to changes in fuel prices in New Zealand: further work should be carried out to refine the data used, and extend it over a greater number of years, and with more reliable emissions data for each vehicle in the fleet additions database.
3. To determine the veracity of comments by motor vehicle dealers about vehicle scrappage rates and the possibility that they have reduced due to the CCS: investigate scrappage rates based on fleet statistics to find out if older vehicles are being retained in the fleet for longer. This would best be done by emissions category. It may also be practical to survey mechanics shops to find out if they perceive the situation suggested. The value of knowing this is for developing more reliable models of fleet emissions into the future.
4. To improve the robustness of the estimates of the fleet mix to 2050, and the resulting estimates of alternative emissions reduction pathways and the present value of TMERS compared with the current emissions trajectory, the estimates could be refined by carrying out model-year-specific modelling following the method in Minett (2020).
5. To validate the assumption that there are low-cost-to-remove emissions available from the operation of the light vehicle fleet, case studies could be prepared and comprehensive surveying carried out to establish an estimate; and taken further to compare the costs of removing such emissions to the costs of removing emissions in other sectors.

6. To improve knowledge about the operation of downstream tradable permit, right, or credit solutions:
    a. Perform a fuller search of pilot projects that have been carried out, especially with reference to the UK, but also in China and other countries. While the pilots completed might have had a slightly different focus (for example, congestion reduction; household emissions, etc.), the value of these pilot projects is in how people respond to them, how well they understand the solution, and if they act in a way that is consistent with understanding.
7. To develop additional TMERS-specific knowledge, the pathway forward should be treated as a research project in itself: how to engage, how to gather reliable community input, how to build support, and so on. For example, the survey used by Hamm et al, (2025) could be used to gather information about which attributes should be considered in setting the equity allocation factor; or a broad deliberative democracy initiative could be used; or both could be tried in different regions and the findings compared: both the learnings from the consultation process, and the relative levels of support for TMERS in any subsequent referendum. In addition, there are several matters that will require further research:
    a. The regulatory framework that TMERS would sit within, and whether current legislation needs to be altered to allow such a system to be implemented.
    b. A study into the likely price pathways that TMERS rights might trade at over time. This would consider the potential for initial reluctance to sell surplus rights, the size of initial organisational demand for rights, possibly a survey of individuals and organisations to get a sense of their expectations for prices (once they are aware of the system). It would also consider the likely progression over time as the quantity of rights allocated each quarter is reduced by a predictable amount, including calculating the required rates of EV, pooling, and active transport transition by year to maintain a stable price.
    c. Development of the Equity Adjustment Factor, as mentioned above.
    d. Factual data about the current split between organisational emissions and personal emissions via the light fleet, to support the pricing study.
    e. A study into the likely costs of establishing and operating the TMERS solution, considering the possibility of the Motu Move platform being used, considering the potential for user fees to be charged per transaction, considering not charging user fees at all but absorbing and covering such costs from NZ ETS revenues, making recommendations.
    f. Identification of the need (or not) for, and purpose of, experimentation, pilots, or demonstration projects to enhance the probability of a successful implementation if confirmed.
    g. Carrying out such experimentation, pilots, or demonstration projects as are deemed necessary.

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Appendix 1: Calculation details, FED to RUC emissions impact

Composition of the petrol light-vehicle fleet.

The composition of the New Zealand petrol light-vehicle fleet by technology and emissions categories at the end of August 2025 is shown in Table 13.

The FED to RUC switch applies only to the petrol light-vehicle fleet, which by the end of August 2025 comprised 3.4 million vehicles (see Table 13, including pure petrol, petrol hybrid, and plug-in petrol hybrid vehicles.

Table 13: Petrol light-vehicle fleet composition by technology and emissions category on 31 August 2025[48]

			Vehicle emissions categories in grams of CO2-e per km of travel							
		Grand Total	Zero (0g/km)	Very low (1-49g/km)	Low (50-99g/km)	Moderate (100-149g/km)	High (150-199g/km)	Very high (200-249g/km)	Extremely high (over 250g/km)	Unknown
Petrol										
	Petrol	3,012,324	2	16	1,061	251,421	1,132,380	664,303	413,374	549,767
	Hybrid Petrol	356,531	12	1	164,296	167,980	21,335	2,072	303	532
	PHEV Petrol	39,472	36	27,431	10,634	115	126	3	11	1,116
	Total Petrol	3,408,327	50	27,448	175,991	419,516	1,153,841	666,378	413,688	551,415

Revenue towards the transport system budget from the light-vehicle fleet

Table 14 shows the current rates of revenue towards the transport system budget from the vehicles in the light fleet, together with the situation that will prevail once the switch from FED to RUC has been completed. The light-vehicle fleet (vehicles with a mass of less than 3,500kg) is thought to cause no wear-and-tear damage to the roads, so wear-and-tear costs are recovered only from heavy vehicles, via heavy-vehicle RUC at rates that are higher than for the light-vehicle fleet, (New Zealand Ministry of Transport, 2022a). The government has announced its intention to raise the FED rate (and the RUC rate proportionately) by 12 cents per litre from 1 January 2027 and a further 6 cents from 1 January 2028, (New Zealand Government, 2024)[49].

Table 14: Current and future light fleet recovery of transport system costs

Source of funds for light vehicle fleet share of transport system operations and management costs							
	Current				Future		
Technology	Fuel Excise Duty (FED)	Rate	Road User Charge (RUC)	Rate	Fuel Excise Duty (FED)	Road User Charge (RUC)	Rate**
Petrol (inc petrol hybrid)	✓	$0.80/litre	✖		✖	✓	$TBA/km
Plug-in petrol hybrid	✓	$0.80/litre	✓	$38/1,000 km*	✖	✓	$TBA/km
Diesel	✖		✓	$76/1,000 km	✖	✓	$TBA/km
Electric	✖		✓	$76/1,000 km*	✖	✓	$TBA/km
*Since 1 April 2024. Previously these vehicles paid no RUC.							
**the future rate of RUC is expected to be the same for all technologies.							

[48] Source: https://www.transport.govt.nz/statistics-and-insights/fleet-statistics/monthly-mv-fleet/, current fleet summary table tab, reconfigured by the author.

[49] The announced FED increases in 2027 and 2028 have not been factored into the analysis in this report.

The petrol light-vehicle fleet consumed about 2.4 billion litres of petrol in calendar year 2024[50]. At the rate of $0.80 per litre for FED (inclusive of ACC and GST), the Government will have received revenue of approximately $1.9 billion. See Table 15.

Current emissions, efficiency, and costs for the petrol light-vehicle fleet

The following brief explanations are relevant for Table 15, which sets out current data for the petrol fleet.

- Calculations based on this data require estimates of the average emissions rating of each category of vehicle in the whole petrol light-vehicle fleet. This would ideally be calculated based on the actual emissions rating of each vehicle in each category for the whole fleet. This information is not immediately available. As a next best option, the average emissions rating of additions to the fleet from 2020 to 2025 are used in Column 1, in which 98.1% of all vehicles have been matched with emissions ratings, on a category-by-category basis.
- In Column 2 the average emissions per category are converted to energy efficiency ratings in litres per 100 km by dividing the average emissions rating by the emissions per litre of 91 Octane petrol in New Zealand: 2.46 kg of CO_2-e per litre.

Table 15: Current emissions, efficiency, and costs for the petrol light-vehicle fleet

Emissions Category	1. Average Emissions in g/km by category based on 2020 - 2025 petrol fleet additions	2. Average energy efficiency in litres/ 100km at category average	3. Current proportion of Distance Travelled per 1,000 km of fleet travel	4. Current emissions in g/km per weighted km of fleet travel	5. Current marginal cost per km @ $2.60 / litre and zero RUC	6. Current FED revenue by Category $million
Very low (1-49g/km)	38	1.5	5.2	0.20	$ 0.040	1.8
Low (50-99g/km)	90	3.7	33.6	3.03	$ 0.095	27.5
Moderate (100-149g/km)	123	5.0	95.9	11.79	$ 0.130	107.3
High (150-199g/km)	176	7.2	236.8	41.67	$ 0.186	379.1
Very high (200-249g/km)	218	8.9	365.6	79.71	$ 0.231	725.1
Extremely high (over 250g/km)	284	11.6	262.9	74.65	$ 0.301	679.1
Total/Average (as applicable)	211	8.6	1000.00	211.05	$ 0.224	1,920.0

- Using Ministry of Transport data, the contribution to each average 1,000 kilometres of fleet travel by vehicles from each emissions category is derived (see below) and input in Column 3. 1,000 km of average fleet travel is estimated to include (for example) 365.6 km of travel by vehicles in the 'Very high (200-249g/km)' emissions category.
    - Data was obtained from the MOT website showing the distance travelled by the light-vehicle fleet, broken down into engine size categories, for the 2023 year. A caveat is that this data is for all light-fleet vehicles including petrol and diesel, and diesel light-vehicles made up 28.6% of the light-fleet at that time: it is possible that data excluding diesel vehicles would give a different result. A further caveat is that the categories in the MOT website are different to the categories of emissions ratings. The distance travelled by each engine size category is converted to distances travelled by emissions category based on

[50] Per the New Zealand Ministry of Business, Innovation and Employment, https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/oil-statistics.

an estimate of the relative proportions of emissions by vehicles within engine size categories, shown in Table 16 and Table 17.

- *Table 16: Allocation of engine sizes into emissions categories*

Engine size	Typical CO_2 range (g/km)	Likely 50 g bands	Allocation rule (approx. share of VKT)
≤1.3 L	100–140	100–149	100% into 100–149
1.4–1.6 L	130–170	100–149, 150–199	40% into 100–149; 60% into 150–199
1.7–2.0 L	150–190	150–199	100% into 150–199
2.1–2.4 L	170–210	150–199, 200–249	50% into 150–199; 50% into 200–249
2.5–3.4 L	200–250	200–249, 250–299	60% into 200–249; 40% into 250–299
≥3.5 L	250–350+	250–299, 300–349	70% into 250–299; 30% into 300–349

- *Table 17: Allocating distances travelled by engine size to emissions categories*

Light fleet VKT (million VKT)(per NZVehicleFleet_2023) by engine size. Note includes diesels.									
	Light < 1350	Light < 1600	Light < 2000	Light < 3000	Light 3000+			Bands	
Per MOT	3129.25879	7232.31091	12490.3107	16829.9163	5017.69107			1-49	0.005197
Emissions Categories							Weighting	50-99	0.033635
100-149	3129	2893				6022	0.13472337	100-149	0.095891
150-199		4339	6245			10584	0.23678382	150-199	0.23678382
200-249			6245	10098		16343	0.36562339	200-249	0.36562339
250-299				6732	3512	10244	0.22917739	250+	0.26286942
300-349					1506	1506	0.03369203		
Total	3129	7232	12490	16830	5018	44699	1		

- The final column in Table 17 is multiplied by 1,000 for easier explanation, and input into Colum 3.

- In Column 4 the weighted average in-use emissions of the whole petrol fleet are calculated. They sum to 211 g/km, which is then converted to 8.6 litres of petrol per 100 km at the bottom of Column 2. This compares favourably with factors used to estimate petrol vehicle operating costs in 2022, (New Zealand Ministry of Transport 2023).
- The existing marginal cost of motoring (petrol plus RUC) on a per km basis is calculated in Column 5 by multiplying the Column 2 value by the current price of petrol plus zero RUC for each category. The weighted average marginal cost per km is calculated by multiplying Column 2 times $2.60, divided by 100. (Note that there are hidden decimal places in the numbers displayed in Column 2).
- Finally, the current estimated FED revenue is calculated in Column 6. This uses the recent annual petrol consumption statistic of 2.4 billion litres, converting it to kilometres at the fleet in-use average litres per 100 km at the bottom of Column 2, (deriving 27.9 billion km). Each category's weighted proportion of this from Column 3 is multiplied by 27.9 billion km to derive the distance travelled by each category of vehicle. The distance travelled is multiplied by the energy efficiency of each category to derive total litres of fuel consumed by each category. The fuel consumed is multiplied by the FED rate per litre of $0.80 to derive the FED revenue received by the government from each category.

Future costs after the change from FED to RUC

In Table 18 the future costs of petrol (excluding FED) and RUC are calculated for each category, and in Column 10 the future marginal cost per km is compared with the current marginal cost per km from Column 5 in Table 15. All emissions categories experience an increase in marginal costs per kilometre except the 'Extremely high' category, that experiences a 6% decrease in marginal costs. The reason only the Extremely high category experiences a decrease in marginal costs is that the existing RUC rate is based on average energy efficiency of 9.5 litres/100 km, and the average energy efficiency of all other categories is lower than this level. The switch from FED to RUC will increase marginal costs for all emissions categories except 'Extremely high'.

Table 18: Future costs and percentage change by category

Emissions Category	2. Average energy efficiency in litres/ 100km at category average	7.Future petrol cost per km @ $1.80 / litre	8. Future RUC cost per km @ $76 per 1,000 km	9. Future marginal cost per km of petrol plus RUC	10. Percent change in motoring costs per km
Very low (1-49g/km)	1.5	$ 0.028	$ 0.076	$ 0.104	158%
Low (50-99g/km)	3.7	$ 0.066	$ 0.076	$ 0.142	49%
Moderate (100-149g/km)	5.0	$ 0.090	$ 0.076	$ 0.166	28%
High (150-199g/km)	7.2	$ 0.129	$ 0.076	$ 0.205	10%
Very high (200-249g/km)	8.9	$ 0.160	$ 0.076	$ 0.236	2%
Extremely high (over 250g/km)	11.6	$ 0.208	$ 0.076	$ 0.284	-6%
Total/Average (as applicable)	8.6			$ 0.231	
				3.2323%	

Impact of change in terms of distance travelled, emissions, and government revenue

Table 19 shows the calculation of the impact of the change from FED to RUC, on a category-by-category basis. The most important factor in this calculation is the estimated long run elasticity of petrol consumption to changes in the marginal cost of motoring, and the way this is applied to calculate the impact, by recognising that there will be a proportional reduction in the distance travelled (Column 13).

Table 19: Impact of change

Emissions Category	10. Percent change in motoring costs per km	11. Long Run Elasticity Estimate of marginal consumption (to marginal cost of motoring in petrol plus RUC)	12. Estimated Percent Change in distance travelled	13. Future Distance Travelled by category per 1,000 km of of current fleet travel	14. Future emissions by category in g/km per weighted km of fleet travel	15. Future RUC revenue by Category $million	16. Change in contribution to government revenue $million
Very low (1-49g/km)	158%	-0.5	-79%	1.1	0.04	2.3	0.51
Low (50-99g/km)	49%	-0.5	-24%	25.4	2.29	53.9	26.35
Moderate (100-149g/km)	28%	-0.5	-14%	82.7	10.17	175.4	68.10
High (150-199g/km)	10%	-0.5	-5%	224.9	39.59	477.3	98.14
Very high (200-249g/km)	2%	-0.5	-1%	361.7	78.85	767.4	42.31
Extremely high (over 250g/km)	-6%	-0.5	3%	270.1	76.71	573.1	(106.08)
Total/Average (as applicable)		-0.50		965.9	207.64	2,049.3	129.33
				-3.41%	-1.6162%	6.74%	

- Firstly, the long run elasticity estimate for petrol consumption is taken from the literature review in Section 2 (page 13). There are no elasticity estimates by vehicle emissions category, so the same long run elasticity estimate is used for each category. The long run elasticity is used, and in the following calculations it is treated as if it would occur in one short run impact. In reality, it is likely to occur over time as people firstly anticipate the change (and some people make changes in advance), secondly experience the change (and begin making changes), and thirdly make their changes over the following years. The literature expects it to take up to three years for the impact of a petrol price change to have fully occurred.
- While the elasticity estimate relates to the change in petrol consumption given a change in petrol price, two important considerations are implied in arriving at the result shown in Column 12.

- Firstly, 'petrol price' in the elasticity literature is reinterpreted to mean 'marginal cost of motoring' so that the impact of RUC can be included. It is reasonable to expect that people will respond to the combined cost rather than just the new price of petrol, at least as the change from FED to RUC is occurring.
  - Secondly, while the elasticity estimate is for the change in petrol consumption, the change in petrol consumption is implicitly converted for each category to a change in distance travelled, since there is a direct relationship between VKT and petrol consumption for each category.
- In Column 12 it is notable that distances travelled are reduced for all vehicle categories except the 'extremely high' emissions category, which increases by 3%.
- In Column 13, the distance travelled by category in Column 3 of Table 15 is adjusted by the distance impact in Column 12. Note that for every 1,000 km of current travel, the impact of the change in costs will drive a reduction to about 967 km, a reduction in total distance travelled by the fleet of 3.4%.
- In Column 14, the future distance travelled is converted to a future emissions per km for each category and summed to a new overall average. In total, future emissions are estimated to fall by 1.6% compared with the current situation.
- In Column 15 the future annual RUC revenue is calculated for each category based on the new distances travelled times the RUC rate. Compared with Column 6 of Table 15, the total of Column 15 shows a 6.7% increase in government revenues.
- In Column 16 the change in government revenue from each emissions category of vehicle is calculated (Column 15 minus Column 6 of Table 15). In total the calculations show an increase of $129 million in government revenue, that is the net of an increase of $235 million from all emissions categories except the Extremely High category, which shows a reduction of $106 million.
- Reference back to Table 13 shows that as many as 2.9 million petrol vehicles will be subject to increases, being all the vehicles in all the categories except the Extremely high category. 85% of the petrol fleet will have increased costs.

Overall impact

Table 20 shows the existing and future VKT and emissions by category and in total. Total distance travelled declines by just over 900 million VKT, 3.41%, while total emissions from the petrol fleet reduce by about 0.09 megatonnes, 1.6%.

Table 20: Current and Future totals for VKT and Emissions

Emissions Category	17. Current Km travelled (millions)	18. Future km travelled (millions)	19. Current emissions (mega-tonnes)	20. Future emissions (mega-tonnes)
Very low (1-49g/km)	145	30	0.01	0.001
Low (50-99g/km)	939	709	0.08	0.064
Moderate (100-149g/km)	2,677	2,308	0.33	0.284
High (150-199g/km)	6,610	6,280	1.16	1.105
Very high (200-249g/km)	10,207	10,097	2.23	2.201
Extremely high (over 250g/km)	7,339	7,540	2.08	2.141
Total/Average (as applicable)	27,917	26,965	5.89	5.797
		-3.41%		-1.62%

Sensitivity analysis

Several assumptions have been tested to see if there would be a substantial variation from the above estimates if key values were changed. Changes to the elasticity estimates make little difference. Changes to the proportion of distance travelled by each category per 1,000 km of fleet travel appear to have some impact on the totals. Petrol-fleet-only annual distances of travel by engine size or by emissions category have been found to be unavailable. The data used combines petrol and diesel vehicle distances of travel by engine size. There is no reliable basis for guesstimating what an alternative set of proportions would be. Changes to the average emissions by category, which drives an average in-use energy efficiency of 8.6 L/100km in Column2 of Table 15, would drive modest adjustments to the overall results but is not thought likely to change the conclusions. Adjustments here should be based on reliable knowledge of the actual average rate of emissions by each category.

Appendix 2: Explanations of key assumptions used to model the light-vehicle fleet to 2050

Key assumptions		
Year of all zero emissions vehicles	2035	
Annual Additions Rate Previous Year	210,000	
Starting % EV*	5%	of additions
Additions Growth Rate	1%	per year
Starting g/km FF fleet	188	gm/km
Starting avg g/km FF fleet additions	168	gm/km
FF fleet additions g/km trajectory	-2	gm/km
Accident scrappage rate	2%	per year
FF Worn-out (w/o) scrappage rate	2.00%	per year
FF Starting avg g/km of w/o scrappage	200	gm/km
Annual change to g/km ff w/o scrappage	2	gm/km
EV worn-out scrappage rate	0.25%	per year
Annual change to EV worn-out scrappage rate	0.030%	per year
*EV growth is non-linear reflecting growing market share each year		

Year of all zero-emissions vehicles: this is an arbitrary but important policy setting. Sensitivity analysis will show the impact of changing this setting. It provides the required import rate of pure electric vehicles in the intervening years.

Annual additions rate previous year: The number of additions in future years will be increases or decreases compared with the previous year (for modelling simplicity).

Starting %EV: The proportion of the previous year's imports that were pure EV. The model will calculate the number of EVs needing to be imported each year to bring the EV imports to 100% by the target year in the first assumption.

Additions growth rate: This is the change in total (fossil-fuelled vehicle + EV) additions each year and is modelled as a constant percentage. More complex modelling could vary this based on other policy settings.

Starting g/km FF fleet: This is the estimated starting average emissions rating of the fossil-fuelled fleet and includes all vehicles that rely on fossil fuels (petrol, diesel) to any extent.

Starting average g/km FF fleet additions: Treating the EV fleet as separate, the CCS-reported average emissions for all additions is adjusted to reveal this factor.

FF fleet additions g/km trajectory: The CCS targets are based on lowering average fleet additions year over year into the future. As EVs become an ever-larger proportion of annual additions the average will fall without changes to the FF fleet additions average emissions. However, it is expected that there will be continued improvements in technology, and a growing proportion of lower-emissions (but not zero) vehicles. This factor allows for an assumption to be made about how the fossil-fuelled fleet itself will be changing.

Accident scrappage rate: Minett (2020) modelled additions and scrappage of EVs and the fossil-fuelled New Zealand fleet and found that scrappage is caused by two different factors: accidents where the vehicles are written off (not repaired) for economic reasons; and end-of-life where vehicles are no longer kept running, also for economic reasons. These two causes need to be treated separately because on average each one will involve vehicles with different emissions ratings. The accident scrappage rate is expected to be the same for both the FF fleet and the EV fleet as both are exposed to similar risks. The modelling assumes the emissions profile of accident scrappage is the same as the average emissions of the relevant fleet (fossil-fuelled vehicle or EV) at the beginning of the year of scrappage.

FF worn-out-scrappage rate: The end-of-life scrappage rate is expected to be different between the fossil-fuelled vehicle and EV fleets. This is primarily because relatively few EVs have yet reached their 'end-of-life', while each year many thousand fossil-fuelled vehicles reach the end of life. The FF worn-out scrappage rate is treated as a constant in the modelling and for simplicity is modelled as a percentage of the opening fleet for the year.

FF starting average g/km of worn-out FF scrappage: This factor could be a constant, or through the next assumption it could vary in one direction or the other over time. The assumption used is that the average g/km of scrapped vehicles will be greater than the average g/km of the fleet. This assumption is based on the expectation that rising fuel prices and pressure to reduce emissions will have some impact on what gets scrapped, and that the CCS has brought a larger proportion of low-emitting FF vehicles into the fleet in recent years.

Annual change to g/km of fossil-fuelled vehicle worn-out-scrappage: The factor allows sensitivity analysis and assumptions regarding the choices of which vehicles get scrapped, and whether this changes over time in a predictable way. In the base model it is assumed to increase over time.

EV worn-out-scrappage rate: As mentioned above, few EVs have reached end-of-life, so there is no track record of the rates at which this occurs. Over time it is reasonable to expect it will increase. The starting assumption is an educated guess.

Annual change to EV worn-out-scrappage rate: This factor allows for a reasonable assumption of an increase in the EV worn-out-scrappage rate over time.

EV growth rate is non-linear: The structure of the model assumes that additions to the EV fleet will grow year-on-year as markets develop and barriers are progressively lowered. The percentage of total additions that is EV is calculated for each year as follows: Years to 100% are numbered from one. The formula used is (starting EV share %) + ((year number) / (summation of year numbers to 100%)). As total additions increase, the resulting share is applied to derive EV additions. EV additions are deducted from total additions to derive FF additions.

Appendix 3: Details of the strawman development and the symposium of experts

Developing a Strawman TMERS specification

To enable discussions about the validity of a potential downstream tradable mobile emissions rights system (TMERS) approach in a symposium setting involving subject-matter experts, a well-developed system-description would be needed that could be reviewed critically, in advance, by the experts. The objective of the strawman specification was to describe a TMERS that could be a complement to the NZ ETS in case the NZ ETS needed help achieving gross emissions reduction in New Zealand. Following the literature, there were several key objectives that were chosen for the TMERS to achieve, as follows:

- Set a cap on light-fleet emissions and a pathway for orderly emissions reduction (sinking lid) from the light-fleet over time by issuing periodic rights that would be required to be surrendered in association with making emissions from the light-fleet.
- Encourage innovation in the use of the light-fleet and removal of the 'lowest cost to remove' emissions from the light-fleet by making the rights tradable.
- Maximise the potential acceptability of the system for the general population by
    - Maximising the benefit for as many people as possible so that there would be strong public support
    - Reducing transport inequity to the greatest extent possible
    - Proposing a system that people would have no difficulty understanding or operating

The draft strawman was also influenced by a submission to the second emissions reduction plan consultation by Minett et al, (2024).

Key content of the draft strawman

Description

The draft strawman was developed and circulated in advance of the symposium. The communication that accompanied distribution of the draft regarding the purpose of the solution was heavily influenced by an expected blow-out in emissions with the change from FED to RUC and that TMERS would reverse the increased emissions impact of that change[51], and could be implemented contemporaneously with that change.

1. The proposed solution was described as personal, tradable rights to make emissions using the light-vehicle fleet. The system would not be a carbon tax because the NZ ETS already taxes carbon emissions upstream. The rights would determine 'who' could make the emissions that had been taxed via the NZ ETS and included in the price of the fuel. The NZ ETS is not providing a sufficiently strong signal for transport decision-makers (individuals and organisations) about the need to make mode and fuel-source changes.
2. Surrender of rights would be required either when buying RUC, or when buying fuel, based on either the emissions rating of the vehicle (if surrendering with RUC purchase) or the emissions content of the fuel (if surrendering with fuel purchase).

[51] This reflected the expectation at the time leading up to the Symposium that there would be a blow-out in emissions due to the FED to RUC switch, which has since been found not to be the case, see Section 6.

3. The requirement to surrender rights would apply to all owners of light-vehicles, including individuals and organisations.
4. There would be free (no payment required) periodic allocations of rights to all adult people (16 yrs+). There would be no allocations to organisations.
5. The quantity of rights allocated should be divided between all adults on an equitable (not equal) basis.
6. One or more market-makers would buy excess rights from individuals and sell required rights to organisations and individuals who needed more than their allocation.
7. Every individual would establish a rights account that their allocation would be placed into, while organisations would establish a rights account that their purchases would be placed into. Technology would ensure it was easy to carry out rights transactions including surrendering the rights when buying RUC or fuel. The accounts could be operated through the National Ticketing System currently being implemented for public transport.
8. Organisations would immediately need to purchase rights, through the market-maker, which the market-maker would buy from individuals.
9. Rights allocations would reduce every period in line with a sinking cap that would achieve an agreed national reduction target for light-vehicle fleet emissions by an agreed date.
10. Rights would not expire.
11. The price that the rights will trade at is unknown. It could relate back to the change in costs experienced with the FED to RUC switch. It is possible people will choose to hold on to their surplus rights which could cause prices to rise. This would be offset by the extent to which people avoided using up their rights by changing their mode of travel or switching to EVs.

The draft strawman was developed and, together with some background information, distributed to experts for consideration in preparation for the symposium.

The Symposium

Invitations and attendance

The symposium was held on 24 July 2025. It was hosted by the Ridesharing Institute, an international non-profit organisation dedicated to transportation innovation. The symposium was held online in two parts to enable participation by interested people from around the world: the first part started at 7 am New Zealand time; the second part started at 7 pm New Zealand time. Participation was free. Invitations were distributed to several relevant email lists and to the members of the Transportation Group of Engineering New Zealand. 34 people joined the call. Participation was noted from the following countries: USA (13), New Zealand (7), Germany (5), Brittain (2), Serbia (1), Canada (1), China (3), Netherlands (1), and Austria (1).

Four very well qualified experts agreed to make keynote presentations. Their noted papers and bios:

Keynote speakers

Part 1

Erik Verhoef, co-author of Tradeable permits: Their potential in the regulation of road transport externalities, 1997. Erik has been a member of the Dutch Council for the Environment and Infrastructure since 2020. He holds a full-time professorship in spatial economics at VU University Amsterdam. He holds unpaid ancillary positions as a member of the Advisory Council on Traffic and Transport Models of the Directorate-General for Public Works and Water Management [Rijkswaterstaat], a fellow of the Knowledge Institute for Mobility Policy; a member of the Supervisory Board of the Foundation for Scientific Research on Road Safety; a figurehead of the Dutch Research Agenda's Logistics and Transport Route; and an Adjunct Professor at Beijing Jiaotong University.

Kexin Geng, author of Tradable permits and travel behavior, 2025. Kexin is a Research Fellow at the School of Earth and Environment, University of Leeds. She recently received a joint PhD in Economics from Beijing Jiaotong University and Vrije Universiteit Amsterdam. Her doctoral research focused on the effectiveness of tradable mobility permits in managing rush-hour congestion and travelers' decision-making processes regarding travel time uncertainties, using a combination of surveys, field experiments, and economic modelling. She has published in leading journals such as Transportation Research Part A, Part B, Part D, and Transport Policy. Her current works include the acceptance of tradable mobility permits, and the potential of tradable permit schemes in residential electricity consumption.

Part 2

Dr Zia Wadud, author of Personal tradable carbon permits for road transport - why, why not and who wins, 2011. Zia is a Professor of Mobility and Energy Futures at the Institute for Transport Studies and School of Chemical and Process Engineering at the University of Leeds. Zia's research sits at the juncture of transport, energy and the environment in a multidisciplinary setting, with special interest on the impacts of new mobility technologies (e.g. autonomous vehicles), transition to low carbon mobility, personal carbon trading, and transport and energy data analysis. He has published over 70 articles in leading journals and is among the top 2% cited authors in the world. His agenda-setting research on autonomous vehicles, ride sourcing services, and long-distance travel have attracted international media attention from prestigious outlets such as the Guardian, the New York Times, the New Scientist etc. Zia has substantial experience in developing and emerging economies such as Bangladesh, India, Uganda, and Nigeria. He has served as the Secretary of the Universities Transport Studies Group in the UK, and member of various TRB committees on energy, climate change and aviation. Zia has a PhD from Imperial College London and has previously worked at the University of Cambridge and Massachusetts Institute of Technology. He is currently the Head of Faculty Graduate School, responsible for PhD research matters.

Meng XU, co-author of The Role of Tradable Credit Schemes in Road Traffic Congestion Management, 2014. Meng is currently a Professor at Beijing Jiaotong University (BJTU), and Institute Director of the Comprehensive Transportation Systems Science. The major portion of his research focuses on innovative urban mobility management, sustainable transportation systems, smart city management, transport policy analysis, green transport demand management policies, modelling and analysis of transportation systems, network equilibrium models and solution algorithm development, and large-scale traffic data sets analysis. He is the author or co-author of over 200 articles in refereed journals, book chapters and proceedings, and owns over 20 patents involving emerging mobility technologies. He serves as the Associate Editor of "International journal of urban sciences (IJUS)", "Frontiers in Future Transportation", IEEE Intelligent Transportation Systems Society Conference (IEEE ITSC) and IEEE Intelligent Vehicles Symposium (IEEE IV). His academic opinions and comments have been disseminated in many different media.

Recordings

The highlights of Part 1 can be viewed on YouTube at the following link: https://youtu.be/wNDlSj7WZ5Q.

The whole recording of Part 1 can be viewed at the following link: https://youtu.be/4UAaWuTeajg.

Unfortunately, the recording function failed during Part 2. The video for Part 2 is being reconstructed and will be uploaded to YouTube in due course.

Overview of presentations

Verhoef: Tradable Permits in Road Transport

- The issue is 'unpriced negative effects agents impose on others'
- We observe 'market failure' resulting in overconsumption (i.e. of emissions)
- There have been many economic instruments since 1920 (Pigou) to internalise external costs
- Corrective pricing (i.e. tolls) causes generalised price increase, everyone is worse off except the regulator
- Tradable permits are more natural, transparent, fair, and efficient than corrective pricing
- His own work explored the concept in 1997, now there is a substantial body of work on the topic including other authors
- Overarching conclusions from experimental studies of tradable permits:
  - Participants understand and use the system as intended
  - They do this in a 'rational' way consistent with understanding
  - Carrying out trading transactions increases engagement
  - Acceptability is higher than for pricing, and grows through using the system

Geng: Trading trips: combatting traffic congestion through tradable permits

- Described a randomised field trial of 'tradable rush-hour permits scheme' for Beijing
- The objective was to reduce traffic congestion and emissions
- The method was free allocation of permits to each driver based on historical trip-making; permits would be used up by driving in congested periods and road sections, 1 for shoulder peak, 2 for peak; whilst free, the stated value of a permit was 10 yuan (currently (November 2025) about $2.51 NZD).
- An alternative budget was provided with equivalence to the allocations based on the stated value
- Permits could be traded among car drivers; the market price was dynamic
- The trial was carried out with users of an installed OBD box and related app, a 30,000 population
- 358 users joined the trial; they were trackable based on the technology; transactions were 'digital'; there were two treatment groups and a control group; the treatment groups were 1) drive in peak, use permits 2) drive in peak, pay a toll from the budget

- The result was a decrease in the number of rush-hour trips, and a greater variation of departure times
- The impact was greatest among those who traded more actively
- In an exit survey most users preferred the tradable permits over the alternative congestion charge

Wadud: Carbon trading at personal/household level

- Comparison of tradable permits with taxes for driving:

Tradable carbon permits	Carbon taxes
Quantity abated fixed, price variable	Quantity abated variable, price fixed
Effective when price response unclear, or less responsive – driving has a low price elasticity	Effective when price response known
Can act as buffer for volatile fuel prices +	No such buffering -
Transaction costs larger -	Transaction costs lower +
Do not raise revenue, unless initial permits are auctioned – highly unlikely -	Revenue raising +
Can be seen as fair and acceptable ++	People do not like taxes! --

- The equity/fairness of the allocation method is important for public acceptability of a policy
- Work from several years ago considered the welfare effects of tradable emissions permits with different allocation methods: impacts vary so important to consider
- Equal ≠ Fair
- Other work on personal carbon trading looked at all household use rather than just transport, so in-house plus transport emissions. For example, a study explored:
    - A free allowance of 4 tonnes CO_2-e per year; survey to determine respondent choice between options to reduce emissions; can sell unused permits if emitting <4t, must buy if >4t
    - 75% of participants reduced 'some' emissions; more difficult for those emitting <4t; those emitting >4t reduced more because having to buy permits motivated doing more to reduce
    - Reduced from both transport and in-home emissions sources; 25% found it difficult to reduce transport emissions; 17% found it difficult to reduce in-home emissions

Xu: Issues in developing tradable credits scheme for mobility/emission management

- Main challenges: allocation method, what credit covers, if traders of credits face transaction costs
    - Differentiated allocation is more effective than equal allocation
        - Houses with different income levels, car ownership status, and urban vs rural affected differently
    - Credit distance-based or trip-based
        - Distance more closely related to emissions, easier technology situation, easier fee collection with prepaid RUC system, but
        - Weak incentive for green or off-peak travel; risk of per km charge being too low

        - Trip-based more suitable for managing peak-hour travel; is complex, ambiguous, and has privacy risk
    - Charging transaction costs makes people more hesitant to buy or sell credits
- Reported work on Netherlands/UK and Beijing experiment giving a tradable kilometre budget to everyone: drive more buy additional; drive less sell unused kilometres
    - Established Netherlands/UK baseline for each respondent then sought response to surplus or shortage of 15% or 30% in kilometre allowance
    - Established Beijing baseline including number of trips as well as distance then sought response to surplus or shortage of 25 or 50 km, with options including changing: # of km, # of trips, route, destination, mode of transport
- Results indicated
    - Higher education and higher car use intensity participants were more willing to change, while higher income participants were less willing to change but found the solution more acceptable
    - Conclusion is that acceptability ≠ action
- Therefore, suggests prioritising high education and heavy car users for pilot programs
- Also reported work on a tradable credit scheme associated with financing new road construction costs
- Reported work on combining tradable credits with operation of high occupancy vehicle lanes

Symposium critique of the strawman

Overall, the symposium was supportive of the intent of TMERS but had some concerns about how it fit with the existence of the NZ ETS. There were concerns that TMERS would be seen as double taxation for the carbon emissions from the light-vehicle fleet, and that such a structure was not logical or perhaps even needed given that the NZ ETS exists. Eric Verhoef asked a 'mirror image question': why not broaden the (TMERS) instrument to all consumption?

A further question asked: 'since there is RUC already, why not simply weight the RUC by emissions?'

However, assuming that the NZ ETS does in fact need help reducing emissions from transport, the symposium's strong opinion was that the allocation system for the rights should be broad based and equitable, adjusting to make it fairer than would be the case if all rights were divided equally. There was no critical pushback on providing no allocation to organisations.

Transport emissions are very difficult to reduce – so a cap gives a strong signal. Users get a direct benefit from reducing their use of the rights, so acceptability is possibly higher than it would otherwise be. And EVs are more available now so people have more options, and it should be less difficult than previously to reduce emissions (these last comments relate back to earlier years before EVs became as common as they are today).

With regard to the alternative methods for surrendering rights (when purchasing RUC, or when purchasing fuel) the symposium was strongly of the view that the more often people needed to engage with the tradable rights, the more likely it would be that the tradable rights system would be relevant and successful. All else being equal the symposium experts would prefer to see rights surrendered as part of the fuel purchase process. This was further supported on the basis that if surrendered based on the emissions rating of the fuel being purchased, the amounts required to be surrendered would reflect the nature of the driving that was being done, and a stronger signal would be in place to encourage green or off-peak travel.

With regard to designing an experiment to pilot or test or demonstrate the TMERS in New Zealand, it was not seen as being difficult to do or needing to be overly expensive. It was suggested that the best people to engage in a pilot would be those with higher education or higher car use, and that while people with higher incomes might appear to be more accepting of the solution, they were also less likely to make a change while participating in a pilot.

Finally, in a discussion about the challenge of bringing a solution such as TMERS into being, the symposium experts agreed that there has been little success beyond limited experimentation. There was a common feeling that the socialisation of the concept is really important, along with making sure the largest number of people or households feel they would be better off if the solution were implemented. There were no strong recommendations for how to go about this beyond holding a successful demonstration. It was not clear what such a demonstration would be expected to demonstrate.

Response to experts' critique

In the order they are highlighted in the discussion above, here are the relevant responses:

1. How does the TMERS fit with the NZ ETS? The answer is that it complements the NZ ETS, which is not able to send a strong enough signal through the price of fossil fuels to encourage low-cost-to-make changes. NZ ETS makes sure that the carbon price is included in fossil fuel. TMERS make sure the lowest cost reductions are found within the light vehicle fleet.
2. Why not extend the TMERS concept to all consumption? The intransigent emissions source that no-one is succeeding in beating back is emissions from the light-vehicle fleet. It is also the dominant source of household emissions. Light-vehicle fleet emissions are easily measurable. Extending the concept to all consumption would make it more complicated and would lose the power of focus on one aspect of emissions.
3. Why not weight the RUC by emissions? This would be a simple solution, capturing an 'emissions tax' to complement the RUC. It would be subject to the same criticism as surrendering TMERS with RUC payment, that it does not capture the variability of driving conditions that make the average g/km rating a less reliable measure of actual emissions. Notionally, the RUC would be a flat rate per km to cover the cost of the transport system, and the additional 'emissions charge' would be used in some way to encourage emissions reduction. The key problems with this alternative are that it would certainly be seen as a tax, it would not have any ability to limit emissions as long as people were prepared to pay the price, and the objective of changing from FED to RUC was to level the playing field on a cost per km basis. Weighting the RUC by emissions would make the playing field uneven again.

Revised strawman

Based on the discussions at the symposium, there were small changes to make to the strawman, to clarify items where the intent was not clear, and to reflect responses to the key critique items. In the following list additions to the original description are in bold, and deletions are shown as ~~crossed out~~.

1. The proposed solution is personal, tradable rights to make emissions using the light-vehicle fleet. The light-vehicle fleet is a discrete generator of GHG emissions that can be measured and therefor managed. The system would not be a carbon tax because the NZ ETS already taxes carbon emissions upstream. The rights would determine 'who' could make the emissions (that have been taxed via the NZ ETS and are included in the price of the fuel). ~~The NZ ETS is not providing a sufficiently strong signal for transport decision-makers (individuals and organisations) about the need to make mode and fuel-source changes.~~ **TMERS would find low-cost-to-remove emissions opportunities that are hidden from the NZ ETS because the marginal cost of trip in fossil-fuelled vehicles is incredibly low.**
2. Surrender of rights would be required ~~either when buying RUC, or~~ when buying fuel, based on ~~either the emissions rating of the vehicle (if surrendering with RUC purchase) or~~ the emissions content of the fuel ~~(if surrendering with fuel purchase)~~. **One right would allow buying fuel that when used in a light vehicle would release 1kg of CO_2-e.**
3. The requirement to surrender rights would apply to all owners of light-vehicles, including individuals and organisations.
4. There would be free (no payment required) **quarterly** allocations of rights to all adult people (16 yrs+). There would be no allocations to organisations.
5. **The quantity of rights allocated for the first quarter would be equivalent to the nation-wide emissions from the light-vehicle fleet for the previous quarter** divided between all adults on an equitable (not equal) basis.
6. **An Equity Adjustment Factor methodology and an Equity Backstop provision will be established to ensure allocations are sufficiently equitable and there is a backstop for people who end up without rights and no way to obtain them.**
7. **Because the gross quantity of rights to be issued would include the previous quarter's emissions from light-fleet vehicles owned by organisations, at the average individuals would receive more rights than they would need for the coming period.**
8. One or more market-makers would buy excess rights from individuals and sell required rights to organisations and individuals who needed more than their allocation. **Market-makers would advertise buy and sell prices for rights and be required to hold stocks of rights so that orders could be filled. Their buy and sell prices would give them a margin that would cover the costs of operating the system and reward them for the risks they take as market-makers.**
9. Every individual would establish a rights account that their **quarterly** allocation would be placed into, while organisations would establish a rights account that their purchases would be placed into. Technology would ensure it was easy to carry out rights transactions including surrendering the rights when buying fuel. The accounts could be operated through the National Ticketing System currently being implemented for public transport.
10. Organisations would immediately need to purchase rights, through the market-maker, which the market-maker would buy from individuals. **Individuals can**

trade privately, gift rights to other people or organisations, or buy or sell with the market-maker.

11. **The requirement for organisations to buy rights will ensure there is market activity. Many people (such as EV owners) would not need their full allocations and would provide the supply for the market.**
12. Rights allocations would reduce every quarter in line with a sinking cap that would achieve an agreed national reduction target for light-vehicle fleet emissions by an agreed date.
13. Rights would not expire **and could be saved up**. **To protect any substantial early emissions-reduction success, if total banked rights (across all holders, summed together) at the end of a quarter exceed a threshold (to be determined, but perhaps 1.5 times the current year's total allocations) the following quarter's allocations must be reduced accordingly, by the 'excess stock holding', being the amount that total banked rights exceed the threshold.**
14. The price that the rights will trade at is unknown. ~~It could relate back to the change in costs experienced with the FED to RUC switch.~~ It is possible people will choose to hold on to their surplus rights which could cause prices to rise. A rising price would be offset by the extent to which people avoided using up their rights by changing their mode or quantity of travel or switching to EVs.

Appendix 4: Whole of Government Agreed Carbon Shadow Prices

Table 11: shadow price of carbon (NZ$ 2024 per tonne of CO_2 equivalent)

Year	Low	Central	High
2025	80	120	161
2026	88	132	176
2027	96	143	191
2028	103	155	206
2029	111	166	222
2030	119	178	237
2031	122	183	244
2032	126	189	251
2033	130	194	259
2034	133	200	267
2035	137	206	275
2036	142	212	283
2037	146	219	292
2038	150	225	300
2039	155	232	309
2040	159	239	319
2041	164	246	328
2042	169	253	338
2043	174	261	348
2044	179	269	359
2045	185	277	369
2046	190	285	380
2047	196	294	392
2048	202	303	404
2049	208	312	416
2050	214	321	428
2051	216	331	450
2052	218	341	472
2053	221	351	496
2054	223	361	520
2055	225	372	546
2056	227	383	574
2057	230	395	602
2058	232	407	633
2059	234	419	664
2060	236	432	697
2061	239	444	732

Year	Low	Central	High
2062	241	458	769
2063	244	472	807
2064	246	486	848
2065	249	500	890
2066	251	515	935
2067	254	531	981
2068	256	547	1030
2069	259	563	1082
2070	261	580	1136

A shadow price places a value on future greenhouse gas emissions emitted or reduced, usually concerning international and/or national emissions goals.

Shadow prices are different from market traded prices in the Emissions Trading Scheme (ETS), which do not currently reflect the full marginal cost of achieving New Zealand's emission targets. An ETS is typically only one of the many policies that governments implement to meet their climate targets.

NZ Transport Agency Waka Kotahi, 2025b. Pages 65 & 66.

Appendix 5: Lift-out TMERS specification including personas

Downstream tradable mobile emissions rights system specification

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Brief description

This lift-out describes a downstream personal tradable mobile emissions rights system (TMERS) with a sinking cap that is recommended for consideration in New Zealand. In the proposed system all adults aged 16+ (but not organisations) would receive free quarterly equitable allocations of rights that in total would represent the budget of emissions from the light-vehicle fleet for that quarter. Each right would represent permission to purchase fuel that when used would emit 1 kg of CO_2-e emissions. Purchasing fuel for light-vehicle use would require the surrender of rights. The system would be fully digital, and it would be easy for people and organisations to buy any additional rights they need or sell any that they have that are surplus to their needs. Fuel retailers would have to account for all the rights they receive from sales of fuel. It is thought that the nationwide public transport ticketing system, Motu Move, could be adapted to provide account structures for management of the system at minimal cost. Transactions could be completed using ubiquitous smart phones, though facilities for card-based or manual transactions could also be established.

Benefits

There would be substantial benefits. Such a system can be expected to:

1. Provide an economic driver for individuals to make emissions-reducing changes to their trip-making choices at a low cost to society and without new taxes.
2. Give certainty to the reduction of emissions from the light-vehicle fleet over time.
3. Through certainty, give organisations and individuals the confidence to innovate by investing in emissions-reducing solutions.
4. Through certainty, encourage demand for land-use changes and new public transport services as ways to reduce the need to use up rights.
5. Encourage the use of new public transport services as they come on stream.
6. By allocating rights to all people, provide a valuable incentive for EV uptake that has been missing since the cancellation of the Clean Car Discount. EV owners would receive rights that they do not need to use, so could sell.
7. Encourage greater uptake of EVs by organisations as they will be able to avoid the need to purchase rights and so lower their operational costs.
8. Reduce traffic congestion in major urban areas as people make greater use of available public and shared transport opportunities.
9. Provide some stability to the marginal cost of fossil-fuelled motoring in the face of volatile fuel prices caused by international events, as changes to the price of fuel and

the value of rights can be expected to offset each other to some extent, (Wadud, 2011).

10. If introduced in conjunction with the switch from FED to RUC, reduce the savings achieved by owners of extremely high-emitting petrol vehicles, and offset the added costs incurred by owners of low-emitting petrol vehicles that will result from the switch.
11. Compared with observed current settings, create a stream of emissions reductions, that when valued at the central shadow price for CO_2-e emissions over the coming 25 years, discounted at 3%, has a present value in the order of $16.4 +/- $5 billion. This only includes the emissions reduction value and does not include valuation of the other benefits outlined above, nor health benefits valued at 1.1 billion per year from 2030.
12. Benefit both sides in every trade of emissions rights. Those who sell the rights view the cash as more valuable than the rights given up. Those who buy the rights value their use more than the cash they give up.

Specification

For a person who does not engage with the details of the system, the following box contains a description of the simple operation of TMERS that applies to every person 16+ yrs of age:

1. One off:
- Load TMERS app on phone, and register for a TMERS account, OR: Go online and register for a TMERS account; OR: Go to an NZTA agency and register in person for a TMERS account. If not owning a smart phone, receive a TMERS card in the post.
- Complete profile information to qualify for any equity adjustment entitlements.
2. Ongoing:
- Observe the free quarterly deposits of rights into the TMERS account.
- If owning/operating a fossil-fuelled vehicle, when buying fuel, use the quantity of rights automatically advised by retailer: either by swipe on phone, or swipe with TMERS card. Observe the rights being deducted from the TMERS account.
- If needing additional rights, buy them at the market price by the most convenient method (on phone, online, in person at fuel station, or in person at NZTA agency).
- If having surplus rights (due to no fossil-fuelled vehicle or making no or few fuel purchases) save, gift, or sell surplus rights, privately or through the market, by the most convenient method (on phone, online, in person at fuel station, or in person at NZTA agency).

Whilst simple in operation, there would be many details to be worked out. Important ones are listed below.

1. The proposed solution is tradable rights to make emissions using the light-vehicle fleet. The light-vehicle fleet is a discrete generator of GHG emissions that can be measured and therefore managed. The system would not be a carbon tax because the NZ ETS already taxes carbon emissions upstream. The rights would determine ‘who’ could make the emissions (that have been taxed via the NZ ETS and are included in the price of the fuel. TMERS would find low-cost-to-remove emissions opportunities that are hidden from the NZ ETS because the marginal cost of even low-cost-to-remove trips in fossil-fuelled vehicles is considered to be trivial.

2. Surrender of rights would be required based on the emissions content of the fuel. One right would allow buying fuel that when used in a light vehicle would release 1kg of CO_2-e.
3. The requirement to surrender rights would apply to all owners/operators of light-vehicles, including individuals and organisations, with no exceptions or exemptions. Similarly, petrol and diesel retailers would be required to account for all sales of fuel to the light-vehicle fleet.
4. There would be free (no payment required) quarterly allocations of rights to all adult people (16 yrs+) with some small exceptions. There would be no allocations to organisations.
5. The quantity of rights allocated for the first quarter would be equivalent to the nation-wide emissions from the light-vehicle fleet for the previous quarter divided between all adults on an equitable (not equal) basis.
6. An Equity Adjustment Factor methodology and an Equity Backstop provision will be established to ensure allocations are sufficiently equitable and there is a backstop for people who end up without rights and no way to obtain them.
7. Because the gross quantity of rights to be issued would include the previous quarter's emissions from light-fleet vehicles owned by organisations, at the average individuals would receive more rights than they would need for the coming period.
8. One or more market-makers would buy excess rights from individuals and sell required rights to organisations and individuals who needed more than their allocation. Market-makers would advertise buy and sell prices for rights and be required to hold stocks of rights so that orders could be filled. Their buy and sell prices would give them a margin that would cover the costs of operating the system and reward them for the risks they take as market-makers.
9. Every individual would establish a rights account that their quarterly allocation would be placed into, while organisations would establish a rights account that their purchases would be placed into. Technology would ensure it was easy to carry out rights transactions including surrendering the rights when buying fuel. The accounts could be operated through the National Ticketing System currently being implemented for public transport.
10. Organisations would immediately need to purchase rights, either privately or through the market-maker, which the market-maker would buy from individuals. Individuals can trade privately, gift rights to other people or organisations, or buy or sell with the market-maker.
11. The requirement for organisations to buy rights will ensure there is market activity. Many people (such as EV owners) would not need their full allocations and would provide the supply for the market.
12. Rights allocations would reduce every quarter in line with a sinking cap that would achieve an agreed national reduction target for light-vehicle fleet emissions by an agreed date.
13. Rights would not expire and could be saved up. To protect any substantial early emissions-reduction success, if total banked rights (across all holders, summed together) at the end of a quarter exceed a threshold (to be determined, but perhaps 1.5 times the current year's total allocations) the following quarter's allocations must be reduced accordingly, by the 'excess stock holding', being the amount that total banked rights exceed the threshold.

14. The price that the rights will trade at is unknown. It is possible people will choose to hold on to their surplus rights which could cause prices to rise. A rising price would be offset by the extent to which people avoid using up their rights by changing their mode or quantity of travel or switching to EVs.

Implementation notes

The following is a compilation of thoughts related to bringing TMERS into being. Further matters will inevitably arise and need to be added to this list.

Developing community support

Ideally the TMERS concept will be socialised with a number of community organisations as a starting point, and a deliberative democracy process undertaken around the country so that ordinary citizens have a real opportunity to engage and contribute to the final design. Initial outreach should occur to organisations such as the Sustainable Business Network, iwi, ITS New Zealand, the Sustainable Business Council, the Helen Clarke Foundation, the Citizens Advice Bureau, the Climate Change Commission, philanthropies, EECA, and others in a snowballing process that ensures inclusive socialisation and the potential for a leadership team to emerge. Some funding would then be needed to support substantial citizen engagement. A strategy would be developed for citizen engagement to help define and agree such matters as the 2050 goal, the equity adjustment factor, the equity backstop quantity and rules and others. At some point it would become clear whether an operational pilot or experimentation is needed, and what such a pilot would need to demonstrate or resolve, and for whom.

Issues and uncertainties

The solution is not without potential issues and uncertainties.

The biggest issue is the need to go 'all in' on the solution. It is not a solution that can be half implemented. This could be offset by having a time-limited pilot period of (say) five years, following which the whole solution would be re-evaluated. Dales (1968) proposed precisely this arrangement as a way to trial his proposed solution for managing waterway pollution. New Zealand does have some history of going 'all in' on large important decisions: MMP, ACC, and the Auckland Super City come to mind as examples.

The biggest uncertainty may be how supportive the general public of New Zealand will be to the solution. In two survey series of New Zealanders' attitudes towards emissions reduction and climate change, it is clear that climate change is a personal issue for a majority of New Zealanders, and people are looking for genuine government and business leadership on reducing emissions and the impacts of climate change. Kantar (2025), IAG (2021) and IAG (2025). Based on Kantar (2025), it would appear that getting business brands onside could be a valuable strategy.

Other issues and uncertainties include:

1. Taxation: should the revenue from selling TMERS be taxable? (Suggestion is no, unless they have been purchased for resale). Should the cost of TMERS be a tax deductable expense for organisations? (Suggestion is yes, as they are purchased to support revenue-making activities).
2. Potential for fraud: Need to consider if there are obvious places in the system that could be exploited by fraudsters, and how to ensure sufficient system security.

3. Tracking light-fleet diesel sales: Diesel is sold to both heavy fleet vehicles and light fleet vehicles, through the same pumps. What mechanisms will need to be developed to give certainty that a) rights are surrendered for purchase of diesel for the light fleet, and b) fuel companies account for all the rights.
4. Petrol sales that are not for the light fleet: One option is to make ALL petrol sales subject to TMERS even if not for light-fleet vehicles. This could include fuel for lawn mowers, boats, and other off-road vehicles. Sales of petrol in bulk will also be an issue to be dealt with.
5. What if capture and sequestration of carbon get going in a big way and emissions-reduction ceases to be an issue? The logical response is that the TMERS solution would be stopped. There might need to be some clear rules around the extent of capture and sequestration, or a target lowering of the amount of CO_2 in the atmosphere, that would trigger such a change.
6. How would experimentation work when to prove TMERS works requires society-changing implementation of the solution? It is a solution that cannot be ‘half’ implemented. (Possible responses: a series of simulations to test out all the possible variables and make sure all issues have been considered; a time-limited implementation across the whole country (say for 5 years) with a review and confirmation that the solution should continue after that time has passed).
7. What if the price of rights becomes extremely high at the start as people hold on to their rights, regardless of the prices on offer (in other words, a serious shortage of supply of rights available for organisations): how would government intervention be avoided, for example avoiding government just issuing a lot of additional rights to ease the pain (and therefore causing the system to fail)? (Possible answers: enable borrowing of rights from the future (only by people who would qualify for future allocations); or enable people who wish to save their rights to deposit them with a ‘rights bank’ that can ‘lend’ rights out at an interest rate and so pay an interest rate to the owners. Such arrangements would require substantial development to ensure effectiveness and enable security of repayment so that the loan does not become a de facto increase of rights).
8. Is TMERS an opportunity for crypto currency development? Are the rights themselves a form of crypto currency? Would a crypto implementation be less costly and more effective than using Motu Move for all the record keeping and transactions needed for TMERS?
9. What about alternatives to TMERS. If it is agreed that the NZ ETS needs help reducing emissions from operation of the light vehicle fleet, are there other viable strategies that should be under consideration? (Possible answer: there probably are. Perhaps they could be developed, and a referendum held that provides a choice between two or more different strategies.
10. Won’t TMERS create pain for people that could be avoided? (Possible answers: There is no doubt that emissions-reduction from operation of the light fleet will inflict some economic pain on people and organisations – regardless of the solution implemented. TMERS has an advantage in that it establishes definite reductions that people can anticipate and respond to. The current course setting would not drive early reductions and will lead to greater costs of adjustment (pain) later on. Further, the gradual adjustment under TMERS has the possibility of increasing New Zealand’s

resilience and productivity – as the country would start becoming less reliant on imported fossil fuels without a drop in output.

Personas

Scenarios by persona

Following is a description of the experience of people in different situations and the impact TMERS has on their lives.

There are seven different personas:

1. A person with no car
2. A person with an electric car
3. A couple with a plug-in hybrid petrol car
4. A couple with a diesel-fuelled car and a petrol sedan
5. A person with low income and a petrol-fuelled car, living in the exurbs (beyond the suburbs)
6. A couple with high income and a petrol-fuelled car, living in the close-in suburbs
7. An accountant working in a medium-sized business.

A person with no car

George lives alone and has no car. He uses public transport to get around or takes an occasional Uber or other similar taxi service. He lives a short distance from most places he needs to visit. George will be quite happy with the arrival of TMERS because he will be able to sell TMERs and receive cash to supplement his income.

After a year of TMERS operation, four periods in, George has found that the best way to sell his TMERs is through one of the market-makers. There is not much fluctuation in the price of TMERs. George sells his TMERs automatically as soon as they are allocated into his account. He has noticed that the quantity of TMERs he receives has been reducing slightly each period, and that the price per TMER has dropped slightly since the first allocation. From discussions with his friends at the tennis club, he thinks this is because people have gotten used to having them, and the level of saving up of TMERS has dropped off.

A person with an electric car

Mike lives alone and has an EV. It makes no emissions, he does not buy petrol, so he does not need to use the TMERs. When he receives his TMER allocation each quarter he donates half of the TMERs to an organisation that drives people to medical appointments. He sells the other half privately to work colleagues who need more than their allocation. The colleagues pay him in cash the price they would have to pay the market-maker, so Mike earns a little more than he would if he sold to the market. He easily transfers the TMERs to both the organisation and his colleagues using the app on his phone. It is as easy as doing internet banking.

A couple with a plug-in hybrid petrol car

Maysie lives with her partner Ali and has a plug-in hybrid car. She must surrender some TMERS when she buys fuel. Ali mostly cycles to work, though in bad weather Maysie drops him off. Maysie's allocation of TMERs has been more than sufficient for her needs because of the low emissions rating of the vehicle. Maysie initially kept her surplus TMERs, but after four quarters she can see that she does not need to keep such a large buffer. She now sells most of her surplus to the market-maker. She carries out this transaction on the app on her phone, and the money is paid into her bank account. Ali gives some of his allocation to Maysie and sells the balance to the market-maker.

A couple with a diesel-fuelled car and a petrol sedan

Tom drives a diesel and has done for years. His wife Dora drives an energy efficient petrol sedan. They have two teenage boys whom they drive to several different sports activities each week. They often drive one of the cars to their beach house on weekends. Tom surrenders TMERs when he buys diesel, it happens automatically when he swipes his TMERs card. He is grateful that the allocation has been sufficient with a small surplus. There was no change in the price of diesel when TMERS began. Tom and Dora find that they usually have just enough TMERs between them for all their travel. Dora surrenders her TMERs when she buys petrol, it is calculated automatically, and the surrender occurs when she swipes the TMERS across on the app on her phone. One quarter Dora did more driving than usual, and Tom easily transferred some of his surplus TMERs to her. They have been noticing that the quantity of TMERs they receive is reducing after a year of the system being in operation. They are starting to think about how to reduce their need for TMERs and have been looking at EVs.

A person with low income and a petrol-fuelled car, living in the exurbs (beyond the suburbs)

Gerry is a single mother with three daughters. She drives a petrol-fuelled car and covers a lot of distance because the girls have sports and dance and lots of other extra-curricular activities, and she hates to disappoint them. She is on a relatively low income and feels lucky that she receives a 15% equity increment in her TMERs due to her income, number of children, and the distance she lives from work.

Gerry's TMERs allocation is deposited into her account at the start of each quarter. Gerry surrenders TMERs when she buys petrol. The quantity needed is automatically calculated and she uses the TMERs app on her phone to make the surrender. She can easily check the balance she has remaining, via the app on her phone.

After the first quarter of TMERs Gerry found she had a decent surplus, and she easily sold them to the market-maker and received a little extra cash. The transaction was also carried out on the app, and the money was deposited in her bank account. Gerry has noticed that the TMERs surplus is reducing each quarter because the allocations are getting smaller. She knows that after another year she will have to change her trip-making or start buying instead of selling TMERs. She has been talking to neighbours about carpooling three days a week and likes the idea but has not yet committed. She also thinks about getting a job closer to home.

A couple with high income and a petrol-fuelled car, living in the close-in suburbs

Anne and Chris are semi-retired and live in an apartment in a suburb close to the city. They own a new luxury petrol-fuelled car that they drive on an irregular basis. For many of their needs they can (and do) walk. They mainly use their car to drive to the beach. They receive two allocations of TMERs, one each, and so far, have only used about a third of their total quarterly allocation. They automatically surrender their TMERs when they buy petrol. The surrender is achieved using the TMERs app on their phones, that treats them as a household so both their allocations and usage is merged into one account that they can separately access. They have two married adult children who live in rural areas who have found that their allocations are insufficient, so Anne and Chris gift their surplus TMERs to their children.

An accountant working in a medium-sized business.

Sunita is an accountant for a landscaping business. The firm has several petrol-fuelled light vans, a company car each for the CEO and Operations Manager, and a diesel truck that does topsoil deliveries. Sunita has always had to buy RUC for the truck because it is a heavy vehicle and has a hubometer. She is used to the process of RUC, but now she also needs TMERs for the vans. Having no allocation of TMERs for the business, Sunita has tried a few different ways of getting enough of them. The CEO and Operations Manager agreed with her argument that they should transfer their personal allocations to the company. For the vans she has found the easiest way to get TMERs is through the market-maker. In the first quarter it was quite expensive while people gained an understanding of how the system worked. Many people were reluctant to sell their surplus TMERs, and this pushed the market price up. This made it more attractive for people to sell some of their allocations and that was how it all balanced out. Over time people have gotten used to the small amount of extra cash, so sell their surplus even though the price has fallen. Sunita has heard that the unused quantity from the most recent quarter is about 50% lower than the unused quantity from the first quarter.

Sunita is careful to ensure that each van has sufficient RUC always prepaid. The TMERs she has acquired are accumulated in a company TMERs account and surrendered from there. The TMERS are automatically surrendered when the van drivers fill up the vans. Sunita makes sure that each van has a TMERs card on board so that the driver can swipe it when buying petrol.

Buying TMERs is an extra cost for the business. Seeing the extra cost, the CEO has recently asked Sunita to investigate buying electric vans, which would not need TMERs.