The future of fuel demand

The direction of travel is clear. But how long will it take?

ENERGY

Introduction

Over the next two decades, the need to address global climate change will change the face of transport in New Zealand. Central to that shift is a substantial reduction in the use of the liquid fuels that currently power the national fleet.

As an energy company, Z has understood and accepted that reality for some time. The direction of travel is clear. But more than most businesses, we need to understand the road ahead: when and where fuel demand will decrease, and what the alternative energy options will be.

This document is Z's assessment of these trends and will inform its strategic decisions. It does not seek to set out New Zealand's optimum climate response, but instead outlines what we currently believe will take place.

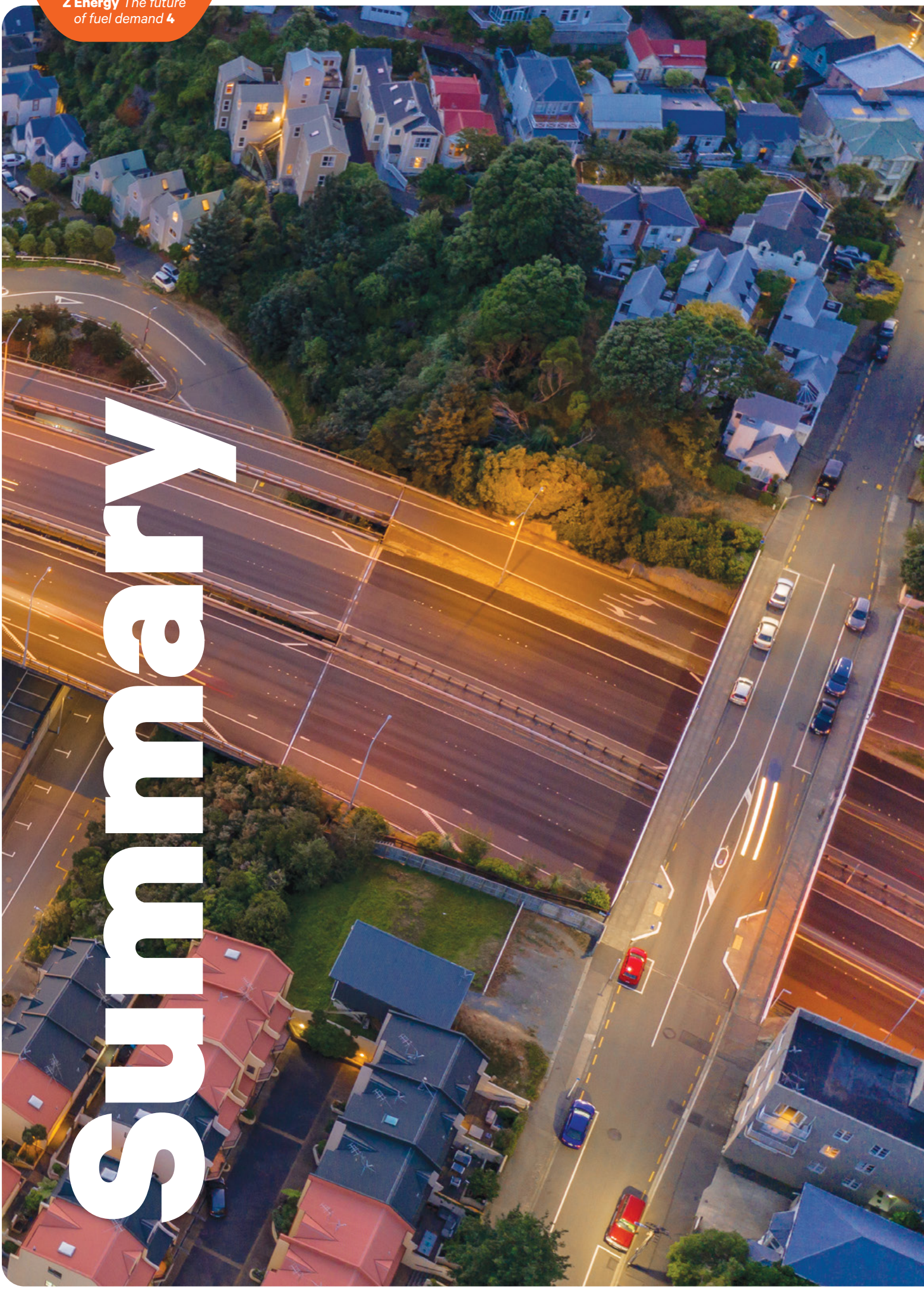
In forming our house view on the likely path ahead, we have consulted various agencies and drawn data from a range of sources for our own modelling. Our key benchmark is the final advice delivered to government this year by He Pou a Rangi Climate Change Commission (CCC), which calls for a near-halving of carbon emissions from transport from 2018 to 2035, consistent with the Climate Change Response (Zero Carbon) Amendment Act 2019.

This house view is highly contingent on expectations of government policy and will change if and when policy settings move or become clearer. The greater the clarity over policy, the better the decisions we are able to make as a business. We are committed both to making our assumptions clear and to reviewing them regularly as policy settings unfold.

For now, our assessment varies from the official 'best guess' — the CCC's 'demonstration path' scenario — in some important respects, while concurring on others. More narrowly focused than the CCC's broader scope, our angle on these issues offers a deep dive, informed by our knowledge of global networks and review of markets further along the substitution curve than New Zealand's.

While we may differ on some assumptions, we strongly agree with the CCC that the time to take action is now. This document is ultimately about how we at Z are best placed to do that.

Summary



Z Energy House View

Key points

1

Z is publishing these views not to try and sell product, but to communicate what we expect from current settings. Z is an energy company, but not necessarily a fossil fuel company. Our view is that the move away from fossil fuels will be slower than the CCC predicts. For the transition to take place more quickly, government policy will need to change.

2

Although liquid fuel demand will steadily reduce, fossil fuels are currently forecast to be part of the picture for decades to come.

3

Our view is that although annual growth in petrol and diesel demand will slow markedly from 2025 and turn negative from 2026 for petrol and 2028 for diesel, it will not reduce as quickly as the CCC predicts. We see demand for both fuels remaining substantially higher than the commission does out to 2040.

4

Although we predict that electric vehicles (EVs) will reach cost parity with internal combustion engine (ICE) vehicles more quickly than the CCC does, overall we believe EV uptake will be slightly slower than the commission does, principally because we do not expect a 'hard' ban on ICE imports. Our respective views on EV uptake are fairly close for the light fleet — but markedly different for the heavy fleet, which we believe will rely on liquid fuels for longer. Viewed through a technology diffusion framework, light EVs are considerably further along the typical uptake curve.

5

This could imply an important role for low-carbon liquid fuels (i.e. biofuel), but only if there is new policy to support biofuel production and use. The government is currently consulting on implementing a biofuels mandate, which would change the picture considerably.

6

We have sharply lower expectations for personal transport mode shift — from passenger vehicles to public transport and active modes — than the CCC does. This will have a substantial bearing on overall fuel demand. This is also an area sensitive to policy. If government policy changes in clear and substantial ways, our assessment could change markedly.

7

Overall, this is not a story of energy disruption, but one of energy substitution. New Zealand's population and economy will grow, even as carbon emissions are sharply reduced. More freight will be transported and more passenger kilometres will be travelled. What we want to know is how.

Process

The model and how we built it

Z commissioned Castalia, a global strategic advisory firm, to build a fuel demand model allowing Z to run results based on its view of assumptions and key drivers, undertake sensitivity analysis, and test scenarios.

We asked three key questions:

- **What is the total land transport task for New Zealand?** That is, how many vehicle kilometres travelled (VKTs) will be required?
- **How will the task be delivered?** That is, what mix of transport modes and vehicle types will fill the need?
- **What is the resulting fuel requirement?** That is, how much fuel will be required to complete the transport task?

We then identified 11 key drivers of demand for transport fuel and formed a view on each of them relative to the underlying assumptions in the CCC 'demonstration path' scenario.

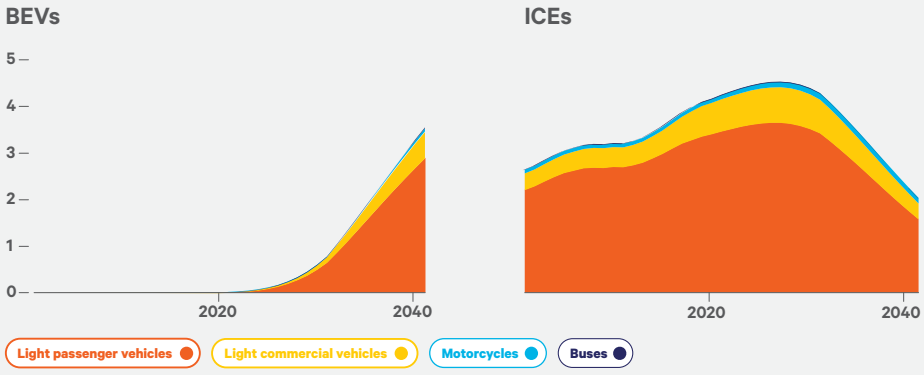
We agree with the CCC and other commentators on forecasts for New Zealand population and GDP growth. We also agree on the impact of better vehicle technology and fuel efficiency standards. So our view of these drivers would have fuel demand neither higher nor lower than the CCC's path.

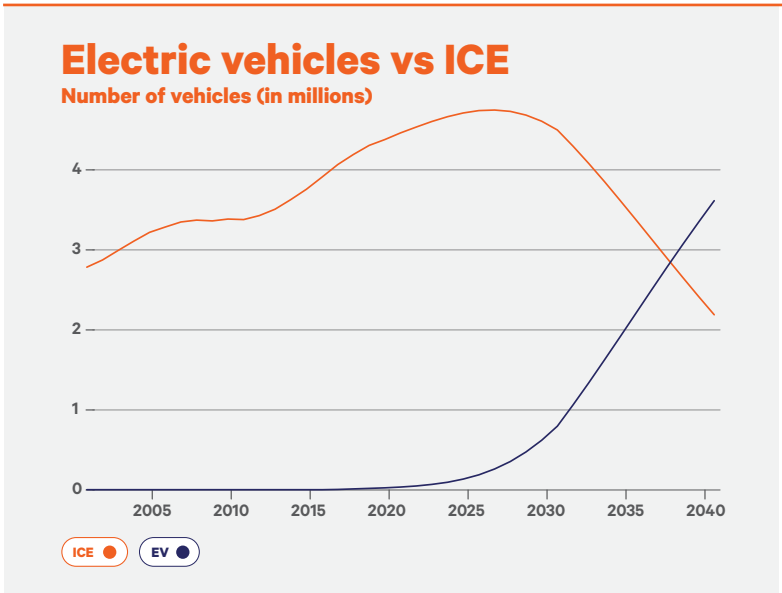
We believe EV adoption will be slower than the CCC suggests: we predict that by 2035, 36% of the national light passenger vehicle (LPV) fleet will be EVs (versus the CDC's prediction of 38%) and 2.4% of the truck fleet (versus 14.6%).

Our research predicts that EV uptake will be slightly slower than the CCC suggests.

Light vehicles, buses and motorbikes

Million vehicles





The variances in what our research has found and what the CCC predicts indicate higher fuel demand than expected.

Our expectation of the relative distances travelled — the 'transport task' — by EVs and ICEs also varies from that of the CCC. We expect vehicle kilometres travelled (VKTs) to be 30% higher for EVs than ICEs (versus the CCC's 46%). We expect the EV truck fleet to travel 9% further than ICE trucks by 2035 (versus up to 300% on the CCC path).

The driver here is the extent to which early EV adopters will also be those — from Uber drivers to trucking firms — who travel the most distance.

Our expectation of the overall 'freight task' differs significantly from the CCC path. We expect 3.5 billion VKTs for freight, while the CCC assumes only 2.9 billion.

All of these variances imply higher fuel demand than set out in the CCC advice.

On the other hand, we are more optimistic than the CCC on the EV/Battery price path — which encompasses the technological progress and investment decisions of manufacturers globally — and on EV pricing and availability in the New Zealand market. As a result, we expect light EV capital cost parity with ICE vehicles by 2029, compared to the CCC's forecast of 2031.

We also differ from the CCC on future fuel and electricity costs in real terms. Specifically, we see fuel costs being 5 cents per litre higher by 2026 and 10 cents higher by 2030. The CCC path expects no change in fuel prices from 2023.

These variances imply lower demand than set out in the CCC advice.

The final drivers relate to policy and for these our house view is a political assessment rather than being derived from our models.

Unlike the CCC, we do not foresee a 'hard' ban on ICE imports, only a 'soft' ban of 50% of residual sales from 2032 — and for reasons outlined below, we have cut by a third the CCC's expectation of mode shift and its consequent impact on fuel demand. Both of our policy calls here imply higher fuel demand than the CCC expects. But if we assume that the 'feebate' scheme for new EV purchases holds from 2022 to 2028, with declining rebates over time and rough fiscal neutrality over the life of the scheme, the effect would be to bring forward capital cost parity for LPVs.

In summary, Z's view is that five of the key drivers will not negatively impact liquid fuel demand, in contrast with CCC's prediction; two others will affect it to a similar extent as what the CCC outlines; and the remaining four drivers will reduce liquid fuel demand more than the CCC suggests.

Discussion

Z Energy House View

Z's house view concurs with the expectation of other commentators and the CCC on the growth of New Zealand's GDP and population up till 2035. Each of those metrics has a bearing on fuel demand. We differ from the CCC on the relationship between GDP growth and demand.

Freight

GDP growth is forecast to average 2.7% annually over the next decade, before reducing to around 1.7% thereafter. The question is what the relationship between GDP and the overall freight task will be. Our view differs significantly than that implied by the CCC's modelling results.

Historically, the national 'freight task' has had a strong positive relationship with GDP, albeit with a slow reduction in freight intensity over the last five years. We have forecast the relationship between the freight task and GDP to continue its slow reduction over the next five years, before remaining constant thereafter.

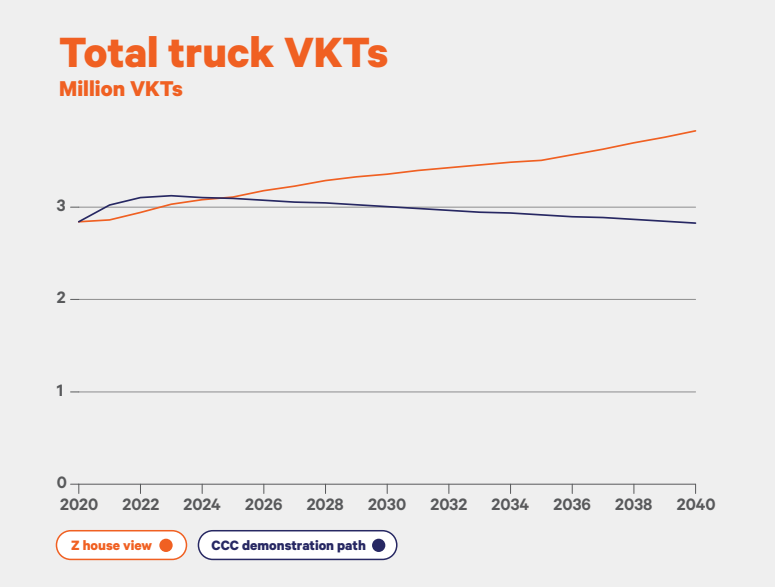
By contrast, the CCC results imply a much more aggressive decoupling of GDP growth and freight demand. As a result, its advice forecasts 2.9 billion VKTs for freight by 2035, while we expect 3.5 billion VKTs.

What that implies is the lower freight-weight sectors will account for more growth than the freight-intensive sectors — and perhaps also that the intensity across all sectors changes or reduces over time. We were unable to sustain this view.

We do remain relatively close to the CCC on other factors. The CCC's draft advice forecasts the proportion of land freight tasks delivered by rail to increase from 15% in 2021 to 22% by 2035. We have used the same assumption, with the freight share assumed to remain constant from 2035 at 78% road and 22% rail. The final advice shifted some of this rail growth into coastal shipping and slightly reduced trucking's share of the freight task. The assumption of a 78% share for roads remains materially consistent with the final CCC advice.

The upshot is that a modest modal shift towards rail and coastal shipping moderates the growth in the road freight task — but we

By 2035, we predict there will be significantly more VKTs for freight than CCC has forecasted.



still see the road freight task increasing by 31% between 2021 and 2040, from 2.9 billion VKTs to 3.8 billion VKTs.

Total vehicle kilometres travelled by non-freight vehicles are expected to increase in line with population growth — while per capita VKTs remain roughly stable. Two drivers — EV uptake and transport mode shift — therefore determine the overall trend in fuel demand and emissions.

EV Uptake

To model EV uptake, Castalia applied the Bass diffusion model, an established means of predicting the uptake of new technologies.

The Bass model divides consumers into two groups:

- **Innovators:** People who buy the product first and are influenced only by external communication, e.g. mass media or advertising.
- **Imitators:** Individuals who, in contrast, buy if others have already bought the product and are influenced by word of mouth or so-called 'internal communication'.

Castalia employed a modified Bass diffusion model, factoring in the relative costs of EVs and ICE vehicles. Although these costs are hard numbers, human nature has a role here too, as the government itself has recognised:

'People tend to focus on the upfront (short-term) costs of a product and often discount lower running (medium to long-term) costs. They give disproportionate weighting to upfront costs over the lifetime costs of vehicles.'

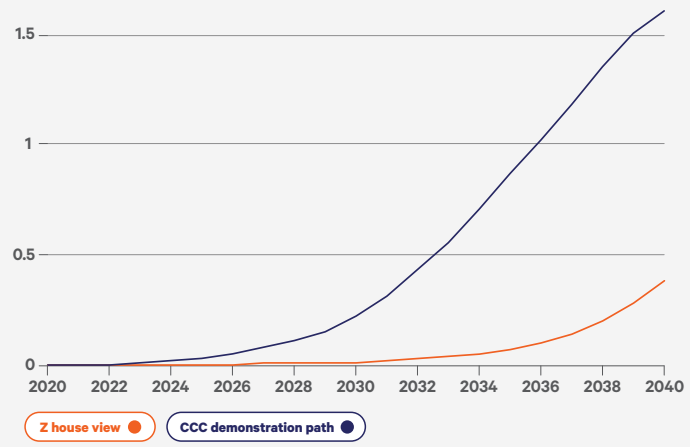
Ministry for the Environment Manatū Mō Te Taiao. 2018. Reducing barriers to Electric Vehicle uptake: Behavioural insights analysis and review.

The Ministry for the Environment analysis recommends various measures to address 'perceptual' and 'behavioural' barriers to EV uptake, focusing on ways to increase awareness of total cost of ownership advantages and the national EV charging network. Since then, the government has opted for a direct intervention on upfront EV prices, via the feebate scheme.

We have made assumptions about the lifespan of the feebate scheme, and from our model's perspective the scheme increases the proportion of the light passenger fleet that is electrified by four or five percentage points by 2035. We believe the scheme will pull forward some demand without changing the fundamental uptake dynamics.

EV truck VKTs

Million VKTs



Our research predicts a typical S-curve uptake of EV Truck VKTs that is significantly slower than CCC's estimations.

Our analysis would be improved by greater clarity on this policy — but for now, we believe EV uptake will follow the typical S-curve of new technology uptake, where adoption is initially slow, accelerates as barriers are removed and early adopters get on board, then flattens as it meets resistance to change.

This uptake curve is already manifesting in more advanced EV markets such as Norway, where EVs accounted for two thirds of new passenger vehicle sales in 2020, only seven years after passing 5%. While global EV sales defied a dramatic fall in global passenger vehicles sales overall, with Europe driving a 28% increase, New Zealand sales of pure EVs and plug-in hybrid EVs (PHEVs) both fell slightly in 2020. However, we expect growth to resume in 2021 due to increased model availability and the early impact of the clean car discount.

As noted above, we see EV uptake being somewhat slower than the CCC does — but our views diverge around the heavy fleet. The CCC is far more optimistic about growth in EV freight vehicles than we are.

In part, this is because the CCC has a different view on which parts of the freight sector will electrify first. The commission sees a level of adoption for long-haul freight that we believe will be constrained by the battery capacity and recharging times required for long-haul freight journeys. We believe more of the early uptake will be in lighter freight vehicles making shorter journeys, such as courier vans.

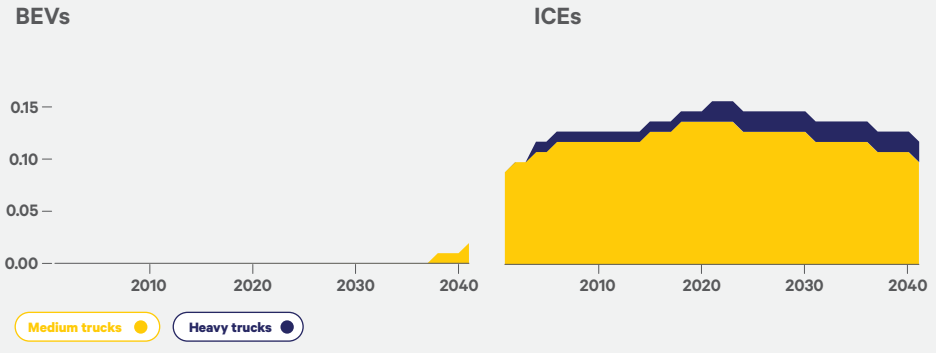
We also see heavy vehicles as being earlier in the uptake curve than the light fleet — roughly three years in comparison with 10 years. One driver of new technology uptake is choice, and New Zealand vehicle registration figures for 2020 tell quite a clear story on that. Across all classes of light EVs, there were 72 different models registered. For heavy EVs, there were five.

The realities of long-haul freight — particularly around the required battery size — may also point to a different technology being the eventual choice. We think that businesses are aware that a clear answer has not yet emerged, and that this awareness may see them delay decisions on migrating away from ICE fleets.

We see heavy vehicles being earlier in the EV uptake curve than light fleet — approximately three years compared to 10.

Trucks vehicle fleet

Million vehicles



Mode Shift

While EV uptake is influenced by a range of possible initiatives — from manufacturers, at the point of sale and from government — transport mode shift is far more determined by government policy actions.

Here, our house view diverges significantly from the CCC's advice. While our view allows for a material change, we believe that mode shift will not be as significant as the CCC forecasts. We see household person-kilometres travelled by car falling from 94% in 2021 to 86% by 2040, while the CCC has this reducing to 82%. Overall, we estimate that two thirds of the CCC's public transport mode shift will be realised.

Principally, this is because we believe local government and NZTA will struggle to invest sufficiently to re-engineer public transport, walking and cycling infrastructure in the time period.

We think this is evidenced by recent issues with the delivery of significant transport projects in a timely manner, such as Auckland Light Rail, Let's Get Wellington Moving and Auckland's Skypath. We have also paid attention to the view expressed in Auckland Transport's Regional Land Transport Plan (RLTP) that the CCC's draft forecast of 120% growth in public transport share of distance travelled is currently unachievable and that an 80% uplift is the most that is realistically achievable.

Auckland Transport believes that achieving the level of impact forecast by the CCC 'would require a substantial acceleration of investment in rapid transport projects across Auckland … [as well as] a significant increase in public transport services'.

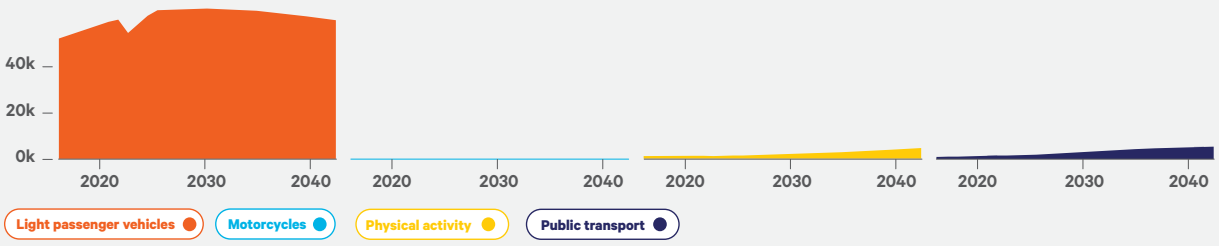
We also consulted the Ministry of Transport's recent green paper on transport decarbonisation — which explores multiple scenarios and, if anything, takes an even more aggressive position on mode shift than the CCC — but were unable to perceive a viable path to this degree of shift away from personal car use.

When our view was presented to a focus group of Wellington commuters, it was the subject of some debate and it was suggested to us that e-bike uptake could be influential. Sales and import data do show accelerating uptake of e-bikes, but we think that the lack of safe cycling infrastructure in New Zealand cities will place a constraint on their use. Substantial and rapid investment in safe cycle infrastructure would be required to change that picture.

In summary, we believe both the rationale and the need for greater mode shift are clear and some of the drivers are in place — but we remain unconvinced about the execution of the changes necessary for that to happen. We expect that the government's response to the CCC policy advice, due before the end of 2021, will provide additional clarity and we will update our model accordingly.

Household movement by mode

Million kilometers



We estimate that only two thirds of the CCC's projected household shift to using public transport will be realised due to insufficient government investment in public transport and infrastructure.

Hydrogen and fuel-cell EVs

Z has looked at the prospects for hydrogen as an energy carrier in a previous paper. We concluded that hydrogen is a real option to meet the needs of transport operators for certain use-cases, but it will take some time — and supportive government action — for cost-effective hydrogen fuelled vehicles to grow to material volume.

The model we used to inform this house view had the ability to select fuel-cell EVs (FCEVs) as a technology for trucking — and chose not to, based on cost curves.

Some of the drivers that could change that are out of New Zealand's control. It may be that offshore markets will drive an unforeseen improvement in the experience curves for the underlying technologies of FCEVs. That would generate a sustained change in cost.

On the other hand, government could influence FCEV purchasing decisions through a direct subsidy. More likely, government would have a key role in the provision of necessary infrastructure, including the large-scale electrolysers required to generate 'green' hydrogen (from renewable energy sources) or 'blue' hydrogen (from non-renewable sources with subsequent carbon capture).

There would also need to be a network of storage stations and dispensers. While some of the sites that are currently part of the liquid fuels system could be used, the liquid fuels infrastructure itself could not. It is hard to see such a network being built without the government either investing directly or underwriting a build by a commercial operator, ahead of demand.

There may be circumstances where buyers will look through upfront economics of total cost of ownership calculations because they perceive other benefits to FCEV adoption. It may be that a company in a position to build the necessary infrastructure at a demand nexus point will see FCEVs as an attractive option as vehicle costs come down. We note that Ports of Auckland Limited is exploring such a use-case.

One FCEV was registered in New Zealand last year, a Toyota Mirai. Toyota expects its saloon car to achieve price parity with plug-in hybrids within a decade, but we believe that if there is eventually a meaningful adoption of hydrogen technologies, it will be at the heavy- and high-utilisation end of the market.

Biofuel and low-carbon fuels

Biofuels and low-carbon renewable fuels can be used to substitute fossil fuel use while we transition the ICE fleet to zero-emission vehicles. In the very long term, uses for biofuel will disappear along with the ICE vehicles capable of using it, but until then, it could fill the decarbonisation gaps identified above — so long as there are policy initiatives in place to support its use.

The CCC recognises this potential in its advice and recommends a target and policies to ensure 140 million litres of low-carbon liquid fuels are sold annually by the end of 2035. The government has announced an 'in-principle' biofuels sales mandate, to be implemented in 2023, which would create a viable market for biofuels to start contributing to a reduction in transport emissions.

This is not a new idea: the New Zealand government established such a mandate in 2008, requiring 3.4% of liquid fuel sold to be biofuel by 2012. The mandate was repealed, but had it stayed in place, it would have reduced emissions from transport by more than 6 million tonnes a year by now.

That is recognised in a current discussion document published by the Ministry of Transport and MBIE, which also observes that under MoT projections, 'EVs and the future possibility of hydrogen will not transition transport fast enough to help meet our 2030 and 2050 emission targets'.

Biofuels themselves have made considerable progress in recent years with the arrival of advanced fuels manufactured not necessarily from plant crops but from other forms of biomass, such as forestry waste and municipal waste. A key characteristic of advanced fuels is that they are a 'drop-in' and can be used whole in vehicles, rather than as a percentage of a blend.

Our feedback from major customers is that they have been more concerned about the *relative* price of biofuel than the absolute price — in other words, they worried that adopting biofuel could put them at a disadvantage versus competitors who did not use it. But if all fuel companies were required to sell biofuel, the additional cost could be spread across all fuel product lines and a barrier to uptake would disappear.

We see the use-case for biofuels in a supportive policy environment as being primarily targeted to long-haul freight, which we believe faces significant practical challenges in moving to EVs.

We will continue to update our view as the process around the current biofuels mandate consultation document unfolds and likely policy directions become clearer. As noted more than once above, we are doing this work not to try and sell more products, but to understand how transport decarbonisation targets can be reached and how gaps on the way to those targets can be bridged.

The way we consume energy, particularly transport energy, needs to change. Z is committed to being a part of this change — and we want to enable our customers to make their own lower-carbon transport decisions. That's what this all comes down to.


WEST COAST
NEW ZEALAND
UNTAMED NATURAL WILDERNESS

Trapped assets on the road to change.

The oil and gas industry consists of far more than the final products the consumer sees.

It is a global system of assets stretching from resources in the ground to local distribution infrastructure. Both the disruption implied by climate change and measures taken to reduce and eliminate carbon emissions will have a bearing on the useful life and value of these assets in the years ahead.

Z believes it is important for investors to have a clear view of the business's climate-related risks and opportunities, and in 2020 we adopted the Task Force on Climate-related Financial Disclosures (TCFD) framework to provide transparency on the most material climate-related financial impacts.

(The government recently introduced an amendment to the Financial Markets Conduct Act 2013, which will require such reporting from around 200 large entities subject to the act by as early as 2023.)

A key concept in such reporting is that of 'stranded' or 'trapped' assets, which are defined by the independent think-tank Carbon Tracker thus:

'Trapped assets are now generally accepted to be those assets that at some time prior to the end of their economic life (as assumed at the investment decision point), are no longer able to earn an economic return (i.e. meet the company's internal rate of return), as a result of changes associated with the transition to a low-carbon economy (lower than anticipated demand / prices). Or, in simple terms, assets that turn out to be worth less than expected as a result of changes associated with the energy transition.'

Asset value — and more particularly a change in asset value — is of obvious interest to any investor, and clearly to Z itself. We believe that our long-term modelling can help with understanding the implications of movement in prices, policy and the climate itself.

Our view is that the trapped assets picture will vary across the oil and gas sector. Investors will come to a time when investing 'upstream' in exploration and production (E&P) oil companies is no longer viable because they are investing in assets that have a short and shortening useful life in which to generate a cash return — the definition of a stranded asset. Upstream companies face an inevitable decline in the cash flows once assumed from their in-ground reserves. Major institutional investors have already begun to define carbon in terms of risk.

'Investments with more carbon translate to higher risk, not just from potential carbon fees or pricing, but also from shifts in technology that can leave high carbon assets stranded.' Erik Solheim, former Head of UN Environment Programme

But the picture may be quite different for downstream companies like Z. Liquid fuels, including biofuel and other low-carbon fuels, will be required for some time yet as transport, logistics, aviation and agriculture progressively decarbonise. It may be 2060 or later before long-haul aviation finds a viable sustainable fuel base. Essentially, our tanks and terminals have a long economic life yet.

'Long' is of course not 'limitless', and the need for Z and other companies to work on biofuels and sustainable aviation fuel, for example, is no less compelling. We already anticipate using our existing sites to deliver EV charging, and upgrading truck stops to deliver hydrogen as that technology matures.

Although the imperatives of climate change are unprecedented, the accompanying economic process of 'creative destruction' is not. The gradual elimination of one economy is simultaneously the creation of a new, generally more vital, one. We've seen this cycle play out in multiple sectors over decades, even centuries. But this is the big one. At Z, we'll be here for it.

z.co.nz