



Centre for Sustainability  
University of Otago

---

# Interventions for a sustainable transport system for New Zealand: results from a Delphi study

Sam Spector, Janet Stephenson, and Debbie Hopkins  
A report from the Energy Cultures research programme

January 2017





Centre for Sustainability  
Kā Rakahau o Te Ao Tūroa



---

**This report should be cited as:**

Spector, S., Stephenson, J., & Hopkins, D. (2017). *Interventions for a sustainable transport system for New Zealand: results from a Delphi study*. Energy Cultures research programme, Centre for Sustainability, University of Otago, New Zealand.

ISBN: 978-0-9941371-3-5

© 2017 The Authors

**For further information please contact:**

Dr Sam Spector      samuel.spector@otago.ac.nz

Dr Janet Stephenson    janet.stephenson@otago.ac.nz

Dr Debbie Hopkins    debbie.hopkins@ouce.ox.ac.uk

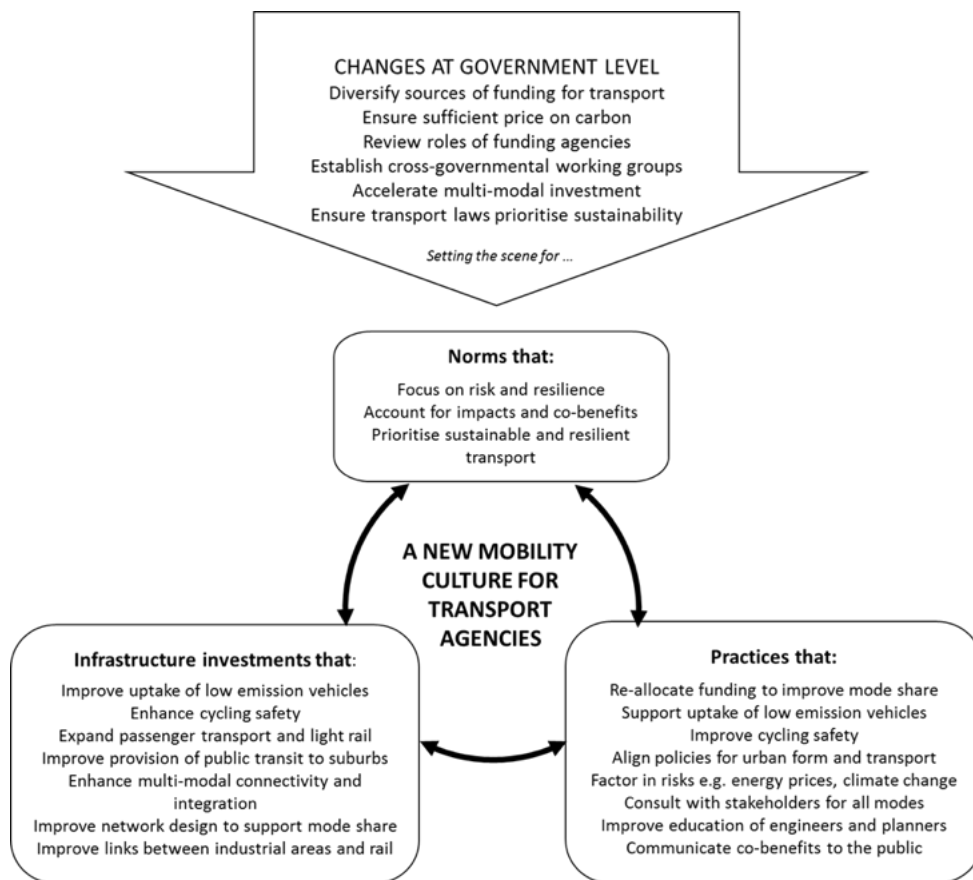
A workstream of the Energy Cultures research programme, funded by the Ministry of Business, Innovation and Employment. [energycultures.org](http://energycultures.org)

# Executive Summary

New Zealand transport experts consider that significant changes are required to develop a transport system that allows NZ to thrive economically, environmentally, and socially during this time of rapidly changing circumstances. New and upcoming constraints and opportunities include the need to decarbonise transport systems, the risks of plausible shocks such as oil price fluctuations, and the opportunities offered by new and emerging technologies. The experts considered that the following interventions are needed to future-proof New Zealand's transport system:

- ▶ A cultural and structural shift in transport agencies that supports consistent investment in sustainable transport.
- ▶ Change legislation and policies
  - to prioritise sustainable transport across all laws that affect transport including the Land Transport Management Act and the Resource Management Act.
  - to eliminate minimum parking requirements.
  - to ensure a sufficient carbon price to influence transport choices.
  - to prioritise the status of pedestrians and users of active transport in road networks.
- ▶ Alter the transport funding system to consistently reflect costs, benefits, and a long-term perspective. Consider options for revenue generation including congestion charging, carbon taxes, regional fuel taxes, road pricing (more for low occupancy vehicles), and the health budget (for active travel).
- ▶ Change allocation priorities for transport funds to
  - incorporate the impacts and co-benefits of transport when making funding allocations.
  - cancel or curtail many of the roads of national significance.
  - maintain existing roads and invest all additional funds in active/public transport.
  - increase the percentage of transport investment in public and active transport.
  - fund projects based on greenhouse gas emissions per kilometre.
  - link councils' transport funding to achieving mode-share.
  - designate R&D funding to make townships more walkable and accessible.
- ▶ Design or retrofit urban areas to support use of walking, cycling, and public transport.
- ▶ Increase investment in public and active transport infrastructure.
- ▶ Undertake network design changes, including reducing the road space given to cars, segregated cycle lanes, priority parking for carpoolers, and best practices guidelines for public transport (e.g. to optimise interchange design, segregation, and priority rights).
- ▶ Improve connectivity and integration across transport modes, such as via a 'one ticket system', scheduling apps, linking public buildings with public transport, short- and long-term bicycle hire, installing bicycle carriers on buses, and using smaller buses/taxis.
- ▶ Improve cycling safety, including installing speed cameras, instituting a one metre clearance law for drivers, and factoring e-bikes into cycleway design.
- ▶ Improve linkages between rail and industrial areas, position industrial areas near railroads, build inland ports and transfer facilities, fund branch lines to large businesses and ports, and fix tunnels that limit freight size.
- ▶ Increase the uptake of low-emission vehicles, such as through lower fees for lower-emission vehicles and a graded tax on vehicle imports based on their fuel efficiency or GHG emissions.

We conclude from these results that substantial adjustments are required in order for New Zealand's transport system to support a thriving nation in the long term. As indicated by the figure below, changes are needed at two levels: in overarching *legislative and policy settings* as well as within the *mobility cultures of transport agencies* that are responsible for day-to-day decisions and operations.



# 1. Introduction

Transport plays a central role in the economy and in the wellbeing of society. However, the use of vehicles also has undesirable consequences such as particulate emissions, road accidents and greenhouse gas emissions. Transport systems globally are also facing major changes, such as the emergence of new and improved technologies, changing demographics, and shifting societal norms. What might these changes and challenges mean for the future of New Zealand's transport system, and what interventions might be needed to ensure a transport system which will enable New Zealand to thrive in this changing environment?

This report describes findings from the fourth and final round of a Delphi study conducted with New Zealand transport experts over 2014-2015. The overall aim of the study was to gain insights from transport experts about the potential future of New Zealand's transport system. The results from Rounds 1-3, which focused on identifying destabilising influences to the status quo, and the characteristics of a sustainable transport system for New Zealand, were reported earlier <sup>1</sup>.

In brief, stages 1-3 of the Delphi study involved identifying the evolving constraints and opportunities in transport systems globally and how influential those factors might be in shifting transport systems in new directions. Experts also ranked the characteristics of a sustainable transport system. During stage 3 of the Delphi study, experts nominated the trends, innovations, and step changes that most urgently required interventions in order to enable New Zealand to thrive economically, environmentally, and socially.

In the fourth and final round of the Delphi study, participants were provided with the resulting list of the 10 highest priority areas and asked to describe interventions that they considered were most critically needed to support at least three of those priorities. This report focuses on the outcomes of this final stage, and the implications for New Zealand's transport system.

---

<sup>1</sup> Stephenson, J., Hopkins, D., & McCarthy, A. (2014). New Zealand's future transport system: drivers of change. Initial report from the NZ Delphi study. Energy Cultures research programme, Centre for Sustainability, University of Otago, Dunedin, New Zealand. ([Click here to view](#))

## 2. Method

The Delphi technique uses a multi-stage and iterative process for bringing together a range of expert perspectives on complex issues. The technique provides participants in each round the opportunity to respond to the findings developed in prior rounds, so enables the development of a broadly agreed set of perspectives on a problem.

The Delphi for this study involved four rounds with contributions from a total of 86 transport-related experts. Seventy-five experts participated in Round 1, 67 participated in Round 2, 55 participated in Round 3 and 42 participated in Round 4. Each round of the Delphi was an online survey. Rounds 2-4 built on the findings of the previous rounds.

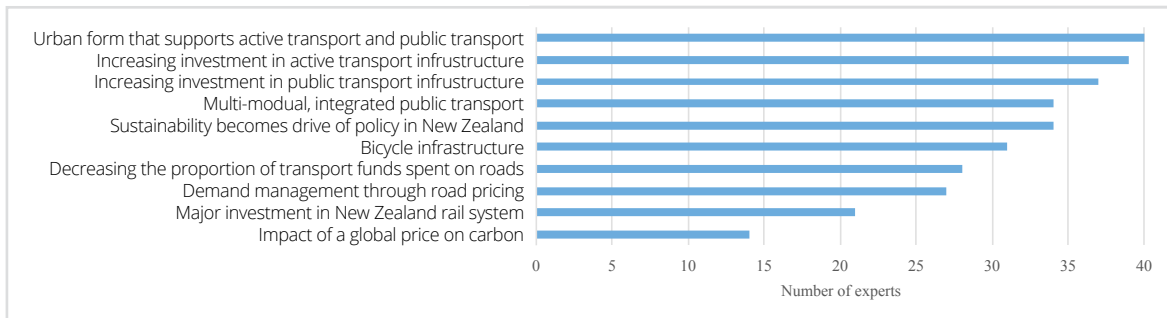
In Round 1, participants were asked (amongst other things) a series of open-ended questions on the trends, innovations and step-changes that they perceived to be likely to lead to changes in New Zealand's transport system. In Round 2, participants were asked to state the likelihood of the trends, innovations and step-changes becoming widespread, and their potential to transform New Zealand's transport system away from business-as-usual (BAU) in the long term, along with expected timeframes. Round 3 asked the participants to select the three trends, innovations and step changes for which interventions were most urgently needed to achieve a transport system that would enable New Zealand to thrive socially, economically and environmentally. Findings from Rounds 1-3 are described in Appendix A, and are fully reported [here](#).

Forty-two experts participated in Round 4. All but one of these experts participated in previous rounds of the Delphi. The experts in Round 4 had an average of 14.5 years of experience (with a standard error of  $\pm 1.8$  years). A wide variety of sectors were represented, with 11 experts working in Government, nine in independent research, seven in non-governmental organisation, six in academia, five in industry, and the remaining four in other sectors such as consultancy and advocacy. The majority of participants had expertise in transport in New Zealand as a whole; eight experts noted particular experience with Wellington, seven with Auckland, four with Dunedin, and two with Christchurch.

Round 4 presented the participants with the ten top priority areas for intervention from the previous round. These were:

- Urban form that supports active transport and public transport
- Increasing investment in active transport infrastructure
- Increasing investment in public transport infrastructure
- Multi-modal, integrated public transport
- Sustainability becoming a driver of transport policy
- Bicycle infrastructure
- Decreasing the proportion of transport funds spent on roads
- Demand management through road pricing
- Major investment in the rail system
- Preparing for the impact of a global price on carbon

Participants were asked to select three of these priority areas and describe the interventions that were needed to achieve the priority. There were no limits on what the participants could write, and responses were anything from a bullet point to several paragraphs for each priority. Figure 1 shows the number of experts who proposed interventions relating to each of these priority areas.



**Figure 1.** The number of experts in Round 4 who chose to write interventions for each of the 10 priorities for intervention (left hand side) that resulted from Round 3.

Two researchers coded the interventions that were identified by the experts into 24 topics, and these were clustered into nine categories, as follows:

1. Change how transport is funded
2. Improve mode-share
3. Change urban form
4. Recognise the implications of climate change
5. Improve rail
6. Change overarching Government policy
7. Increase the uptake of low-emission vehicles
8. Change the consultation process
9. Improve education

The specific interventions proposed in each of the above categories are discussed in the next section.

# 3. Interventions

The most frequently identified interventions aimed to change *how transport is funded* and to *improve mode-share*. These two categories were also notable in having an impact across all priorities. Figure 2 shows the relationship between the experts' proposed interventions and the priorities each would address. The participants frequently identified multiple priorities as being addressed by a single proposed intervention. Thicker lines indicate a higher frequency of that intervention being identified as addressing that priority.

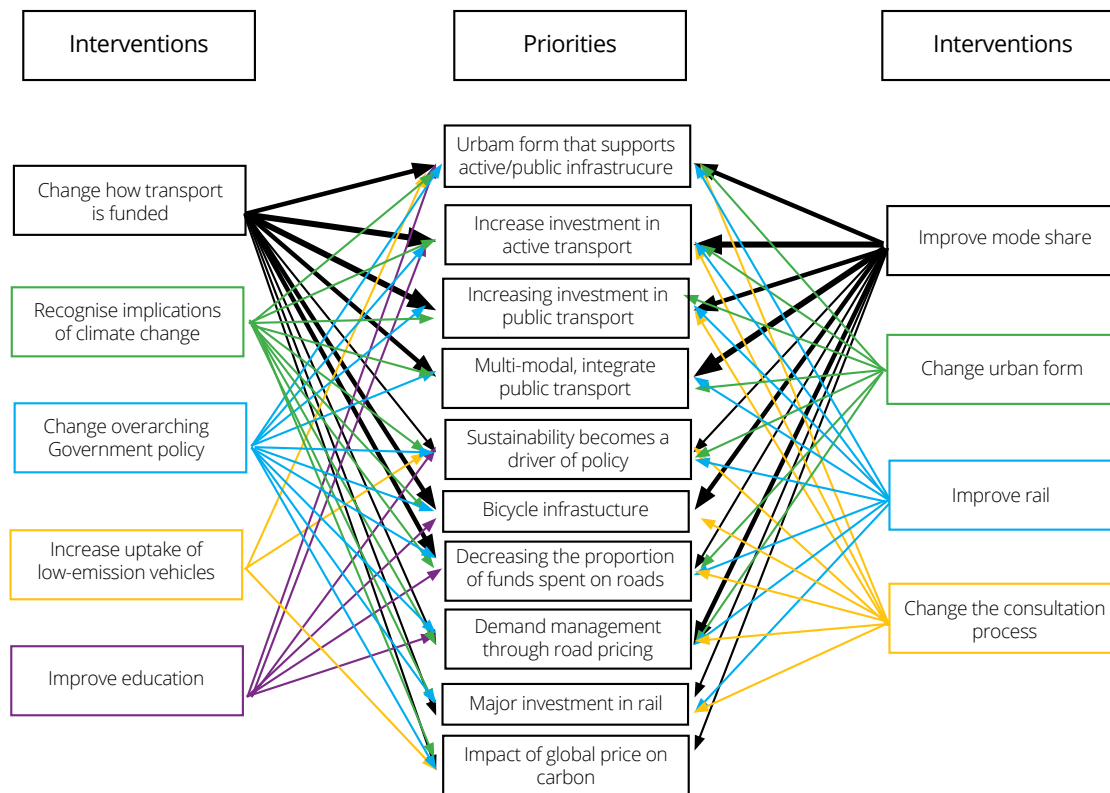


Figure 2. Relationships between interventions and priorities.

## 3.1. Change how transport is funded.

Changing how transport is funded was seen collectively by the experts as addressing all 10 of the priorities that arose from Round 3 of the Delphi. Interventions in this category were particularly associated with the following priorities: *increasing investment in public/active transport*; *improving bicycle infrastructure*; *decreasing the proportion of transport funds spent on roads in New Zealand*; and *instituting multi-modal, integrated public transport*.

Table 1. Experts (out of n=42) citing interventions related to changing how transport is funded.

Interventions related to funding	# of experts
Re-allocate transport funds	28 (67%)
Structural and cultural changes in funding agencies	14 (33%)
Account for the impacts and co-benefits of transport	12 (29%)
Change the funding system for transport	10 (24%)



A number of experts raised the need to rethink the *transport funding system* in order to more fairly recognise costs and benefits and to provide a better basis for investment in more sustainable solutions. Suggestions for different sources of funding included road pricing; carbon taxes; government income from mineral rights; local authority petrol taxes; GST; and taxes on rail, airports, port companies, or coastal shipping. One suggested partially funding active travel from the health budget, and another advocated collecting taxes from cyclists to fund cycling infrastructure.

One expert discussed at length the way in which the current *funding system* has the effect of prioritising spending on roads for motor vehicles. The majority of the National Land Transport Fund is derived from fuel surcharges and road user charges, which is paid by road users and thus creates an expectation that it should be spent on roads. To achieve investment for a more sustainable transport system, the National Land Transport Fund should be de-linked from funds derived from on-road vehicle use, so as to dissipate the expectation that the majority of funding should go into roads because it is derived from road use. One proposed option was for funds from road user charges and fuel excise taxes be sent to Treasury for general allocation, and for Government funding into the transport budget to be allocated separately.

Experts also proposed *structural and cultural changes* in how local and national authorities allocate transport funding. Currently, many road-related expenditures can be fully funded out of the National Land Transport Fund whereas public transport projects are usually classified as local projects and receive 66% funding from the Fund (this figure is set to decrease to 50% over the next 6-9 years). This arrangement lowers local authorities' motivations for investing in public or active transport expenditures as a significant percentage must come from local rates.

Experts also argued for a cultural shift towards prioritising active/public transport and recognising co-benefits. One participant suggested central Government, via the New Zealand Transport Agency (NZTA), should initiate active/public transport development rather than waiting for local councils to begin those projects. Other suggestions for change included giving the Ministry of Transport more independence from central Government and ensuring local authorities can set their own priorities (with guidance from national transport authorities). Another idea was to split the NZTA into three groups – state highways construction and maintenance, road design, and a transport funding organisation for partial or full funding of active/public transport.

Two thirds of the experts described interventions to *re-allocate transport funds* by using different criteria and funding more evenly across modes. Experts' suggestions included cancelling or curtailing many of the 'roads of national significance'; maintaining existing roads and investing all additional funds in active/public transport; devoting 10% of the budget to public transport and 10% to active transport; funding projects based on greenhouse gas emissions per kilometre; and linking Councils' funding to achieving mode-share. Designating funding to make townships more walkable was another suggested intervention.

Experts argued for interventions that encourage *a broader view of the impacts and co-benefits of transport* when making funding decisions. The experts noted that transport modes could be more fairly compared by factoring in co-benefits related to health, emissions, air quality, productivity, and the local economy. It was suggested that the NZTA economic evaluations manual be updated to account for such factors, and also that recent research findings that the availability of public transport enhances property values be considered. Another expert advocated incorporating vulnerability of different modes to changing energy costs. There was also a theme of differentiating between public costs and benefits compared to private costs and benefits when making funding decisions, with one participant arguing that rail and public transport should be treated as public goods.

One participant emphasised the need to *ensure the poor do not bear an unfair burden* in terms of emissions costs and other financial measures such as road pricing and tolls.

### 3.2 Improve mode-share.

Improving mode-share was also seen as addressing all of the 10 priorities. The interventions in this category were particularly relevant in relation to the following priorities: increasing investment in active transport; demand management through road pricing; urban form that supports active transport and public transport; increasing investment in public transport infrastructure; multi-modal, integrated public transport; and bicycle infrastructure.

**Table 2.** Experts (out of n=42) citing interventions related to improving mode-share.

Interventions related to mode-share	# of experts
Change legislation and policies	27 (64%)
Institute network design changes	12 (29%)
Enhance connectivity and integration across modes	10 (24%)
Institute infrastructure and policy interventions for cycling safety	7 (17%)
Institute technology-based interventions	5 (12%)

Two-thirds of the experts described changes needed to legislation and policies which would both broaden the sources of transport funding and contribute to modal shift. These included congestion charging, regional fuel taxes, tolls, road pricing (potentially higher for low occupancy vehicles), a graded tax on vehicle imports based on their fuel usage, restricted private car entry to CBDs, and the elimination of minimum parking requirements. Some of the participants suggested users should be charged for road use, either via smart systems using GPS or tolls. One participant argued the NZTA should coordinate and oversee time-of-use road pricing trials. Other experts suggested instituting development charges and property rates that will incentivise building denser, more walkable communities; passing a Complete Streets Act; and changing the Resource Management Act to better account for co-benefits.

There was a high level of agreement on the need to achieve more widespread provision of alternatives to single-car use and increase the adoption of alternate modes across the population. In addition to changing funding models (see 3.1), interventions were required to improve connectivity and integration across modes, change network design, improve cycle safety, and adopt beneficial technologies.

Many experts cited the need for improving connectivity and integration across transport modes. Instituting a 'one ticket system' that allows travel across all forms was seen as a key intervention to accomplish this goal. Other ideas included developing scheduling apps, linking public buildings with public transport, offering cheap short- and long-term bicycle hire, installing bicycle carriers on buses, and having smaller buses and taxis.

Network design changes were also commonly proposed. These included interventions such as reducing the road space given to cars to make space for segregated cycle lanes and designating priority parking for carpoolers. Experts called for urban design codes and best practices guidelines for public transport (e.g. to optimise interchange design, segregation, and priority rights) and other transport (e.g. removing traffic signals at the opposite side of interchanges as they encourage running red lights and maximising the curb radius at junctions to reduce speeds). Participants also advocated offering public transit on all arterial routes.

Several infrastructure and policy interventions for improving cycling safety were suggested including installing speed cameras, instituting a one metre clearance law for drivers, placing de facto blame for pedestrian and cycle accidents on car drivers, giving cyclists priority but also enforcing that they follow road rules, and factoring e-bikes into cycle-way design.

Proposed technology-based interventions to help support improving mode share included developing web-based carpooling apps, installing speed cameras and/or GPS to reduce speeding, and installing e-bicycle charging stations.

One expert argued for focusing on freight and businesses rather than only personal transport when endeavouring to achieve mode-share. Another expert cautioned that we must ensure public transport is relevant to less populated regions before investing.

### 3.3. Change urban form.

Changing urban form interventions were most closely related to the priority of urban form supporting active and public transport, but also relevant for increasing investment in active/public transport; improving bicycle infrastructure; achieving multi-modal, integrated public transport; sustainability becoming a driver of policy; and instituting demand management through road pricing.

**Table 3.** Experts (out of n=42) citing interventions related to changing urban form.

Interventions related to urban form	# of experts
Change policies for urban form and infrastructure	18 (43%)
Improve links between urban form and transport policies	8 (19%)
Change urban form related to suburbs and public transit	7 (17%)

The experts proposed a number of ways to change policies for urban form and infrastructure including redeveloping urban design codes and best practice guidelines. One expert argued priority in urban form policies should be given to pedestrians, then cyclists, then public transport, then cars, and that road design should facilitate this hierarchy. Other interventions in this vein included adopting national cycling infrastructure standards, removing parking or using it as protection for cycle paths, installing additional bicycle parking and pedestrian infrastructure, instituting pedestrian only zones, and passing a Complete Streets Act.

Eight participants discussed the need for better linkages between urban form and transport policies. Investments in active/public transport should be linked with broader urban form policies.

Experts noted the need for changes in urban form related to suburbs and public transit. A key proposed intervention was treating suburbs as urban islands, whereby public transit hubs are within five minutes' walk of high density housing and 90% of shopping needs are able to be met at those hubs. Another participant advocated offering low-interest financing for mixed use cooperatives and apartments near public transit hubs.

Several other related proposals included revising the RMA to include better consideration of co-benefits, and new provisions for greenfield and brownfield developments. As per Section 3.4 below, incorporating vulnerability to energy risk in the policymaking process was seen as an important step. Creating a government urban development agency which can produce and enforce guidelines was suggested as a method of accomplishing the desired changes in urban form.

### 3.4. Better recognise the implications of climate change.

Interventions related to better recognising the implications of climate change were seen as addressing all of the 10 priorities. These were particularly relevant for the following priorities: sustainability becoming a driver of policy in New Zealand, safeguarding against a global price on carbon, and increasing investment in active/public transport infrastructure.

**Table 4.** Experts (out of n=42) citing interventions related to recognising the implications of climate change.

Interventions related to the implications of climate change	# of experts
Recognise the costs of climate change	12 (29%)
Price carbon	8 (19%)
Factor in risks associated with vulnerability to energy markets	2 (5%)

Better recognising the costs of climate change was an important theme. Interventions here related to the discussion of co-benefits in Section 3.1; the experts argued for taking into account the effects transport policy options have on contributing to or mitigating climate change. Eight experts argued for pricing carbon in New Zealand to send signals to transport investors and users through measures such as an improved emissions-trading scheme and a minimum carbon price. Investment decisions also need to factor in risks associated with vulnerability to energy markets such as volatile oil prices. One expert considered that New Zealand should institute a minimum price on carbon now rather than waiting for a global agreement. Another expert advocated a price of \$25/tonne of CO<sub>2</sub>-e for electricity and transport, brought in incrementally over three years. Updating the Governmental Policy Statement on Land Transport to give greater weight to energy usage and climate change was suggested as one method of better recognising the plausible costs of climate change on the economy.

### 3.5. Improve rail.

Interventions in this category addressed the priorities of achieving a major investment in New Zealand rail systems, increasing investment in public transport infrastructure, sustainability becoming a driver of policy, decreasing the proportion of funds spent on roads, and achieving urban form that supports active/public transport.

**Table 5.** Experts (out of n=42) citing interventions related to improving rail.

Interventions related to rail	# of experts
Expand passenger and light rail services	9 (21%)
Improve links between industrial areas and rail	6 (14%)

Nine experts suggested expanding passenger and light rail services. One participant suggested offering rail to/from airports and another suggested linking housing developments with rail.

Experts called for better linkages between rail and industrial areas for the purposes of freight. Actions included positioning industrial areas near railroads, building inland ports and transfer facilities, funding branch lines to large businesses and ports, fixing tunnels that limit freight size, and re-opening old rails. A participant called for investing in research and development for tracking, transfer, security, and handling technologies.

Incorporating co-benefits, such as reduced emissions and improved air quality, was considered necessary for recognising the true cost of rail versus road. One expert cited the need to address the threat that unstable coastlines pose to rail systems.

### 3.6. Change overarching Government policy.

Shifting Government policy was seen as addressing all of the 10 priorities, particularly sustainability becoming a driver of policy in New Zealand.

**Table 6.** Experts (out of n=42) citing interventions related to shifting Government policy.

Interventions related to overarching Government policy	# of experts
Ensure laws impacting transport better prioritise sustainability	11 (26%)

Experts proposed that laws impacting on transport decisions should prioritise sustainability, including changing the Land Transport Management Act and RMA to account for the co-benefits of multi-modal transport developments. More broadly, experts called for a cultural shift in Government and the NZTA which normalised sustainability through all decision-making. It was also suggested that New Zealand should strive to become a leader in sustainable transport solutions instead of follower.

### 3.7. Increase uptake of low-emission vehicles.

Interventions in this category were related to the priorities of sustainability becoming a driver of policy, instituting a global price on carbon, and achieving urban form that supports active/public transport.

**Table 7.** Experts (out of n=42) citing interventions related to increasing the uptake of low-emission vehicles.

Interventions related to low-emission vehicles	# of experts
Institute policy- and technology-based interventions	4 (10%)
Recognise the co-benefits of low-emissions transport	4 (10%)

Experts proposed both policy and technological interventions to increase the uptake of low-emission vehicles. Suggestions included having lower fees for lower-emission vehicles and building widespread charging infrastructure for EVs. One expert said that disincentivising fossil fuel use via fuel taxes may not be enough to increase uptake of electric vehicles and that proactive measures were needed. Another expert emphasised the need to also focus on transitioning the commercial fleet to low-emission vehicles.

Experts noted the importance of recognising the co-benefits of low-emission vehicles such as reduced health costs, increased productivity, job creation, and improved energy security.

### 3.8. Change the consultation process.

Interventions in this category addressed the priorities of increasing investment in active/public transport, achieving urban form that supports active/public transport, decreasing the proportion of transport funds spent on roads, investing heavily in rail, sustainability becoming a driver of policy, improving bicycle infrastructure, and demand management through road pricing.

**Table 8.** Experts (out of n=42) citing interventions related to changing the consultation process.

Interventions related to consultation processes	# of experts
Use cross-governmental working groups	3 (7%)
Consult with cycling advocates and other stakeholders	2 (5%)

Experts argued for changing the consultation processes both between governmental agencies and between governments and the public. Cross-governmental working groups were proposed as a key method of achieving the former. In terms of the latter, the experts suggested soliciting a wider range of views in the decision-making process, instituting a public consultation process, consulting with cycling advocates, and consulting with freight and Automobile Association lobbyists.

### 3.9. Improve education.

Interventions related to improving education were noted as addressing the priorities of instituting demand management through road pricing, decreasing the proportion of transport funds spent on roads, improving bicycle infrastructure, sustainability becoming a driver of policy, increasing investment in active transport, and achieving urban form that supports active/public transport.

**Table 9.** Experts (out of n=42) citing interventions related to improving education.

Interventions related to education	# of experts
Re-frame information to the public to emphasise co-benefits	3 (7%)
Improve education of engineers and planners	2 (5%)

Experts cited interventions to improve education such as emphasising the importance of active/public transport when training engineers and planners. Re-framing information to the public to include co-benefits was also important to gain acceptance for policies.

## 4. Policy Implications

New Zealand transport experts consider that significant changes are required to develop a transport system that allows NZ to thrive economically, environmentally, and socially during this time of adjustment to new constraints and opportunities. These include the need to decarbonise transport systems, account for the impacts of new and emerging technologies, and address the risks of plausible shocks such as oil price fluctuations. A sustainable transport system includes greater use of multi-modal travel and urban form that reduces the need to travel as well as encourages uptake of active and public transport. Interventions are needed to change many aspects of the transport system in order to achieve these priorities.

The five priorities that attracted most intervention proposals were: sustainability becoming a driver of transport-related policy; urban form that supports active/public transport; increasing investment in active transport infrastructure; increasing investment in public transport infrastructure; and multi-modal, integrated public transport.

The most prominent categories of interventions considered necessary to achieve those priorities involved changing how transport is funded and improving mode-share when planning, building, and managing networks. Key interventions proposed by the experts are summarised below.

- ▶ A cultural and structural shift in transport agencies to support consistent investment in sustainable transport.
- ▶ Change legislation and policies
  - to prioritise sustainable transport across all laws that affect transport including the Land Transport Management Act and the Resource Management Act.
  - to eliminate minimum parking requirements.
  - to ensure a sufficient carbon price to influence transport choices.
  - to prioritise the status of pedestrians and users of active transport in road networks.
- ▶ Alter the transport funding system to consistently reflect costs, benefits, and a long-term perspective. Consider options for revenue generation including congestion charging, carbon taxes, regional fuel taxes, road pricing (more for low occupancy vehicles), and the health budget (for active travel).
- ▶ Change allocation priorities for transport funds to
  - incorporate the impacts and co-benefits of transport when making funding allocations.
  - cancel or curtail many of the roads of national significance.
  - maintain existing roads and invest all additional funds in active/public transport.
  - increase the percentage of transport investment in public and active transport.
  - fund projects based on greenhouse gas emissions per kilometre.
  - link councils' transport funding to achieving mode-share.
  - designate R&D funding to make townships more walkable and accessible.
- ▶ Design or retrofit urban areas to support use of walking, cycling, and public transport.
- ▶ Increase investment in public and active transport infrastructure.
- ▶ Undertake network design changes, including reducing the road space given to cars, segregated cycle lanes, priority parking for carpoolers, and best practices guidelines for public transport (e.g. to optimise interchange design, segregation, and priority rights).
- ▶ Improve connectivity and integration across transport modes, such as via a 'one ticket system', scheduling apps, linking public buildings with public transport, short- and long-term bicycle hire, installing bicycle carriers on buses, and using smaller buses/taxis.
- ▶ Improve cycling safety, including installing speed cameras, instituting a one metre clearance law for drivers, and factoring e-bikes into cycleway design.
- ▶ Improve linkages between rail and industrial areas, position industrial areas near railroads, build inland ports and transfer facilities, fund branch lines to large businesses and ports, and fix tunnels that limit freight size.
- ▶ Increase the uptake of low-emission vehicles, such as through lower fees for lower-emission vehicles and a graded tax on vehicle imports based on their fuel efficiency or GHG emissions.

A common theme underpinning many of the interventions is the need for better recognition of co-benefits. Considering co-benefits, including those related to health benefits and the impacts of climate change, will clarify the advantages of active/public transport, low-emission vehicles, and rail. This will make such initiatives appear more attractive when making resource-allocation and funding decisions. Adjusting funding mechanisms to reflect the full costs and benefits of different transport choices can have the co-benefit of encouraging greater use of multiple modes of transport to suit different trip purposes and lengths. Substantial changes are also needed to overcome the path dependencies embedded in much of the current transport infrastructure.

The findings indicate the need for a fundamental shift in the expectations, investments and procedures undertaken by transport agencies – a culture change. For this to occur, government leadership is also needed. Figure 3 below uses the energy cultures framework<sup>2</sup> to visually depict the necessary changes. Change is needed at a government level to adjust the legal and policy framework in addition to at the level of local government and in government transport agencies to support decision-making for a resilient and sustainable transport future.

We conclude from these results that substantial and far-reaching changes are required for New Zealand's transport system to support a thriving nation during a period of rapid adjustment to new constraints and opportunities. As indicated by the model in Figure 3, these changes are needed concurrently in the legislative and policy settings and within the agencies responsible for day-to-day transport decision-making.

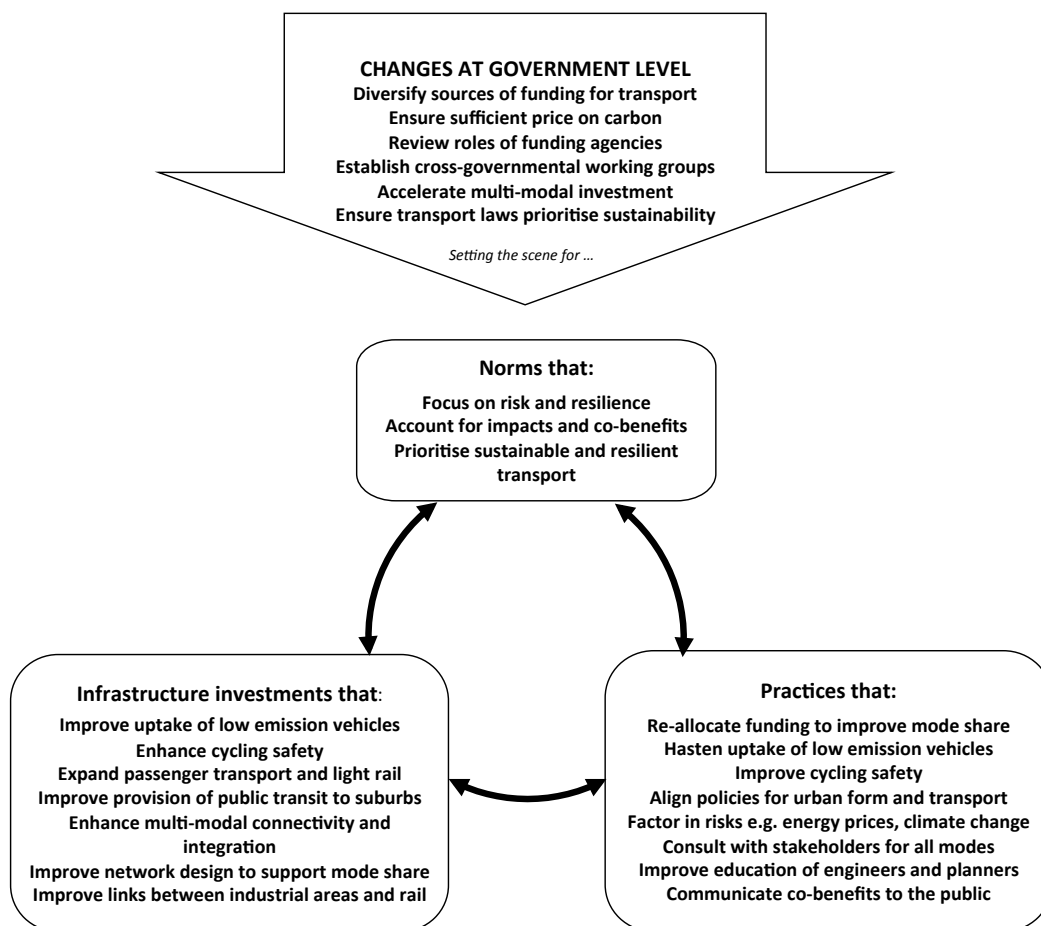


Figure 3. The levels of change required to enact the experts' interventions.

<sup>2</sup>See Stephenson, J., Hopkins, D., & Doering, A. (2014). *Conceptualizing transport transitions: Energy Cultures as an organizing framework*. *Wiley Interdisciplinary Reviews: Energy & Environment*, 4, 354–364.

# Appendix A

Summary of findings from stages 1-3 of the Delphi study<sup>3</sup>.

## Delphi Round 1

The experts were asked a series of open-ended questions about the three most influential trends, innovations, and step changes that could lead to changes in the country's transport systems.

- The most frequently identified influential trends driving change in NZ's transport system were technological advancements of various types.
- The most frequently identified influential innovations were IT developments, EVs, smart cars, and battery technologies.
- Rising and/or volatile oil/gas prices was the most frequently identified step change.
- Increasing climate change issues/concerns were the 3rd most frequently identified trend and the 2nd most frequently identified step change.

## Delphi Round 2

The experts were presented with a list of the trends, innovations, and step changes that were mentioned by at least two of the experts in Round 1. The participants were asked to rate the likelihood those factors will become widespread within 10 years and their potential to transform BAU in the long-term.

### Trends:

- *Rising fuel prices* scored as both the most likely trend to become widespread within 10 years and the trend most likely to transform the transport system away from BAU in the long term.
- *Ageing population and increasing percent of population in urban areas* were the second and third most likely influential trends to become widespread within 10 years.
- The trends that ranked second and third in their potential to transform NZ's transport system away from BAU were *urban form that supports active transport and public transport, and increasing investment in public transport infrastructure*.

### Innovations:

- *Ultrafast broadband and high quality videoconferencing* were identified as the most likely influential innovations to become widespread within 10 years, followed by small EVs.
- The innovation with the greatest potential to transform the transport system away from BAU was *demand management through road pricing*.
- This was closely followed by *multi-modal integrated public transport systems and bicycle infrastructure*.

### Step changes:

- The top three step changes deemed most likely to become widespread within 10 years were all oil related: *spikes in the price of liquid fossil fuels, political instability in oil rich countries, and constraints in oil supply*. Note that there are likely to be strong interrelationships between these factors.
- *A significant breakthrough in battery/storage technologies* is fourth ranked in both likelihood and ability to transform.
- The step change deemed most likely to lead to transformation of NZ's transport system away from BAU is *sustainability becoming a major driver of policy at all levels of NZ government and for business*.
- This is followed by *constraints in oil supply and political instability in oil-rich countries*.

### Estimated timeframes:

- There is a high level of agreement that battery technologies enabling a 300km range for EVs will be readily available within 10 years.
- The take-up of EVs in NZ's private and commercial fleets is expected to be slow, with a median of 15-20 years to reach 20% of the fleet, and many anticipating that this will take over 20 years.
- Almost all believe that within 15 years there will be a global price on carbon.

---

<sup>3</sup> For the full report see: Stephenson, J., Hopkins, D., & McCarthy, A. (2014). *New Zealand's future transport system: drivers of change. Initial report from the NZ Delphi study*. Energy Cultures research programme, Centre for Sustainability, University of Otago, Dunedin, New Zealand. Available at: [energycultures.org/our-work/future-transport-for-new-zealand/](http://energycultures.org/our-work/future-transport-for-new-zealand/)



## Delphi Round 3

### Features of a sustainable transport system

In this round, participants were asked to rank their level of agreement with the features of a sustainable transport system that had been identified in Round 2.

- 90% or more of the participants agree or strongly agree with the following features of a sustainable transport system for NZ:
  - o Integrated multi-modal transport system in urban areas over 100,000 people
  - o Cross modal ticketing systems
- 80 – 89% of the participants agree or strongly agree with the following features of a sustainable transport system for NZ:
  - o Having different transport options for different length trips (e.g. 1-2km, 3-5km, 10-20km, 50km+)
  - o Ensuring rural areas have access to information & communication technologies (ICT), to support travel substitution
  - o Collective, cross-party vision of NZ's future transport
  - o Make the full cost of car ownership evident to the general public so that all transport modes are on a level playing field
  - o Changing urban form and functioning to reduce need to travel to work / shopping / school
  - o Being proactive so alternate travel modes are readily available prior to dis-incentivising personal vehicles
  - o Targeting transport options to size and density of the population (e.g. public transport for cities, car sharing for towns)
- Between 66% and 79% agree or strongly agree with the following features:
  - o Time of use variable pricing for roads
  - o Exploit renewables through uptake and incentivisation of electric vehicles
  - o Technologies (apps) to support modal choice
  - o Car sharing schemes (both businesses and community based)
  - o Improving environmental credentials of imported cars
- Between half and two-thirds agree or strongly agree with the following features:
  - o Increasing the use of rail for inter-city travel
  - o Biofuels for freight and long distance travel
  - o Electrifying the entire rail system
  - o Using electrified rail rather than roads for freight transport, thereby decreasing road traffic and exploiting renewable energy availability

The experts were then asked to nominate the top trends, innovations, and step changes for which they thought interventions were most urgently needed to achieve a transport system that allows NZ to thrive economically, environmentally, and socially.



## Trends, innovations and step changes requiring intervention:

- The most frequently identified top priority trends requiring intervention to enable NZ to thrive, were (in order of frequency) *increasing investment in public transport infrastructure, rising fuel prices, and urban form that supports active and public transport*. The three most frequently identified trends requiring intervention, when combining participants' first, second and third priorities, were *increasing investment in public transport infrastructure; urban form that supports active and public transport, and increasing investment in active transport infrastructure*. These were prioritised by at least twice as many participants as any other trend.
- The most frequently identified top priority innovations were (in order of frequency) *integrated, multi modal transport; demand management through road pricing; and bicycle infrastructure*. These were also the most frequently identified innovations when combining first, second and third priorities.
- The most frequently identified top priority step changes requiring intervention were (in order of frequency) *sustainability becomes a driver of policy in NZ; constraints in oil supply; spikes in the price of liquid fossil fuels, and decreasing the proportion of transport spend on roads* (the latter two being equal). The most frequently identified step changes requiring intervention, when combining first, second and third priorities, were: *sustainability becomes a driver of policy in NZ; decreasing the proportion of transport spend on roads; global price on carbon, and major investment in NZ rail system* (the latter two being equal).



Sam Spector, Janet Stephenson, and Debbie Hopkins  
A report from the Energy Cultures research programme  
Centre for Sustainability, University of Otago  
January 2017

