**Climate change and energy security – our risks and responsibilities**

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**ABSTRACT**

New Zealand’s national transport sector and its urban transport networks are heavily reliant on imported fossil fuels. This paper outlines some of the risks inherent in that reliance. These result from increasing concerns over the potential impacts of climate change, and our geographic location at the end of a long supply chain originating in politically volatile regions. Actions to mitigate climate change and its potential effects, and to reduce our dependency on imported crude oil and fossil fuels are identified. These include suggested changes to national policies, alternative fuel options, travel demand management including pricing, and associated changes to strategic planning assumptions and targets. It is hoped that the paper will encourage other transport professionals and the IPENZ Transportation Group to take action in recognition of the seriousness of the issues identified.

**1. Introduction**

Our transport system is heavily reliant on fossil fuels which are major contributors to greenhouse gas emissions (GHG). Our urban areas are highly dependent on car travel and hence on the availability and use of petrol and diesel. Diesel is also essential to the movement of freight.

The supply and consumption of energy accounted for 44% of New Zealand’s total greenhouse gas emissions in 2011. Since 1990, the base year for Kyoto Protocol obligations, New Zealand’s energy sector emissions have increased in total by 31%. In 2011, national transport accounted for 45.7% of NZ’s energy-related greenhouse gas emissions, and road transport alone accounted for 41.0% of all energy sector emissions. Road transport emissions grew by over 70% between 1990 and 2011 (MBIE, 2011), although it has tended to level out in recent years.

The evidence is now clear that mankind has initiated changes to the world’s climate whose consequences for future generations are potentially catastrophic. It is essential that all nations contribute towards reducing our greenhouse gas emissions to keep warming below the 2oC maximum identified by climate scientists. To argue that New Zealand can make little difference as it only produces 0.2% of the world’s GHG emissions is little better than to argue that individually we have no responsibility to take action.

Our isolated location in the South Pacific may reduce some of the more severe impacts of climate change. We will, however, have to deal with the effects of sea level rise, increasing severe weather events resulting in increased flooding due to high rainfall intensities and storm surges, an increased frequency of droughts, and changing weather patterns.

Most of the crude oil produced in New Zealand is exported. It is mostly light, sweet crude whereas New Zealand’s Marsden Point oil refinery is designed to process heavier, cheaper crude, just over half of which is sourced from the Middle East which is an increasingly politically volatile region. The Marsden Point refinery supplies all of the country’s jet fuel, nearly 80% of diesel, around half of all petrol, between 75 and 85% of bitumen for roading and all fuel oil for ships (Refining NZ website). New Zealand’s domestic oil production is currently equivalent to just under one third of the total demand. As most of it is exported, it offsets a significant part of the cost of oil imports, but does little to reduce our crude oil or oil product import dependency. A major and long lasting disruption to supplies would have a severe effect on our economy. Our current response to these risks is to rely on our 90 day strategic reserve.

This paper, written from a transportation perspective, discusses current New Zealand Government Policies in a climate change and energy security context and suggests some changes. It then identifies some actions that should be taken to mitigate climate change and its effects while improving energy security. It starts with some current climate change facts.

**2. Some Climate Change Facts**

* According to the United Nations Annual Emissions Gap Report (EGR, 2013) the world needs to reduce its total emissions to 44 gigatonnes CO2 equivalent by 2020 to keep below the 2oC warming target. It is currently 50 gigatonnes and could potentially increase to 52-56 gigatonnes by 2020 even when all pledges made by governments in 2010 are added together.
* The global level of CO2 reached a record of 393 ppm in 2012 (WMO, 2013). The warming effect on our climate has increased by almost one third since 1990.
* The ocean has stored over 90% of the increase in energy in the climate system over recent decades, resulting in thermal expansion[[1]](#footnote-1) from the additional heat stored in the ocean. Ocean thermal expansion and glacier melting have been the dominant contributors to 20th century global sea level rise. The latest scientific information (IPCC, 2013) indicates a range of seal level rise between mid-range points of 0.43m to 0.73m by 2100. Low-lying coastal regions in developing countries such as Bangladesh, Vietnam, India and China have especially large populations living in at-risk areas such as deltas, where rivers enter the ocean. Some Pacific island nations are at risk because they do not have enough land at higher elevations to support displaced populations.

**3. New Zealand Government Policies**

This section discusses national transport policies which have an important influence on New Zealand’s responses to energy security and climate change issues.

**3.1 Land Transport Management Act (LTMA)**

The LTMA 2008 is the primary legislation affecting the transport sector in New Zealand. The 2013 amendment changed the purpose of the act to read “to contribute to an effective, efficient and safe land transport system in the public interest”, replacing the words “integrated, affordable, safe, responsive and sustainable transport system”.

The removal of the word “sustainable” is one of the most significant changes to the purpose. New Zealand is a major food producer. Our primary sector exports now make up 70% of NZ’s exports. As a trading nation with a high proportion of its income from exporting food products it is essential that New Zealand be seen to be environmentally responsible. It surely follows that sustainability should be at the core of our national policies including our transport policies.

In my view we should aim for an effective, efficient, safe and sustainable transport system.Among other things that would emphasise the importance of travel demand management measures, reducing reliance on fossil fuels, and reducing travel distances by single occupant cars.

**3.2 Greenhouse Gas Emissions Policy**

In August 2013, the New Zealand Government announced that it had scaled back its target (set in 2009) for GHG emissions from 10-20% below 1990 levels to 5% below 1990 levels by 2020. This was stated as being an interim step ahead of a new United Nations pact which is to be agreed in 2015. It was initially intended that the 2015 pact would impose binding emission cuts from 2020. However, the 2015 pact may end up being a looser agreement whereby countries set their own targets, but are subject to some form of review by other nations.

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| **NZ GHG Emissions** | **1990 (MtCO2e)** | **2012 (MtCO2e)** | **1990-2012 Increase** |
| Gross Emissions | 59.6 | 73.3 | 23% |
| Net Emissions | 31.5 | 58.4[[2]](#footnote-2) | 85% |

**Table 1: New Zealand Total Greenhouse Gas Emissions, 1990 and 2012**

In 1990, New Zealand’s gross GHG emissions were 59.6 Mt CO2e (million tonnes of carbon dioxide equivalent), and the net emissions were 31.5 Mt CO2e (MfE, 2009). The difference between gross and net emissions is largely due to the effect of forestry planting and harvesting cycles. It is also influenced by international units surrendered under the NZ Emissions Trading Scheme. In 2012, gross GHG emissions were 73.3 Mt CO2e, and net emissions were 58.4 Mt CO2e (MfE, 2013). As can be seen from Table 1, NZ’s gross GHG emissions are currently 23% above the 1990 level.

If you take the 1990 gross total of 59.6 MtCO2e and reduce it by 5%, you have a 2020 target of 56.6 Mt CO2e, which is not far below the current (2012) net emissions. This suggests that a 5% reduction target measured in this way may not be very difficult to achieve. However, achieving a gross emissions target of 56.6 MtCO2e would require a 22.8% reduction from the current 73.3 Mt CO2e by 2020 – a far more challenging and, I suggest, a far more genuine target.

The forests planted in the 1990s are due for harvest in the 2020s. On being harvested, trees switch from being a carbon sink to a carbon source (under the Kyoto Protocol it is assumed that all the carbon stored in wood is emitted at the time of harvest). It follows that New Zealand is likely to face a sharp increase in net GHG emissions in the 2020s, just at a time when international pressure appears likely to increase sharply. For this reason alone, we should be anticipating this by adopting a far more aggressive 2020 GHG reductions target now. The current apparent complacency is inappropriate and short sighted.

**3.3 NZ Energy Strategy and Energy Efficiency & Conservation Strategy**

The NZ Energy Strategy 2011-2021 (NZES, 2011) includes the following transport actions which “are intended to create the most efficient mix of integrated modes and travel options by continuing to invest in”:

* Roads of national significance (i.e. selected state highways)
* A rail system that enables efficient movement of freight
* Reliable and more cost effective public transport systems that offer benefits to attract a greater percentage of long-term users
* Improvements to infrastructure for cycling and walking funded through the National land Transport Fund.

A section on Oil Security and Transport includes:

* Improving the efficiency of our fleets and transport networks
* Placing a cost on carbon emissions through the ETS (since halted at the transitional measures stage)
* Maintain the 90-day oil reserve

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 **Figure1: Projected future sources of oil (NZES, 2011)**

The reliance placed on increased oil exploration from around 2020 is clear from Figure 1. Without new sources of transport fuels, oil imports may increase rapidly.

A comparison of the 2007 and 2011 NZ Energy Strategy and the NZ Energy and Efficiency Conservation Strategy (EECS, 2011) reveals some interesting changes.

NZ Energy Strategy 2011 vs 2007

* The strategy’s time horizon has been substantially reduced from 30 to 10 years
* The NZES 2007 transport objective “to reduce the overall energy use and greenhouse gas emissions from New Zealand’s transport system” is not included in the 2011 strategy, nor is reference to a low carbon future.
* Travel demand management is no longer directly referred to.
* The aim of increasing freight movement by rail and coastal shipping has been replaced by a reference to efficient movement of freight by rail
* Roading investment through “Roads of National Significance” investment is now specifically mentioned
* Energy/oil security and pricing are now referred to, as is increasing oil exploration activity
* There is a target to reduce GHG emissions by 10-20% below 1990 levels by 2020, “if there is a comprehensive global agreement and certain conditions are met”. This target has subsequently been replaced by the 5% reduction mentioned above.
* The target that 90% of electricity generation be from renewable sources by 2025 (74% in 2010) is included in NZES 2011 “provided that this does not affect security of supply”.

Energy Efficiency and Conservation Strategy 2011 vs 2007

* The strategy is now limited to a very short 5 year horizon and is reduced in scope
* The 2011 EECS has a transport objective which is “a more energy efficient transport system with a greater diversity of fuels and alternative energy technologies”.
* Targets relating to reducing GHG emissions, the use of electric vehicles, or the reduction in single occupancy vehicle travel have been removed although they are included in the (yet to be replaced) New Zealand Transport Strategy 2040.
* Specific mention is made of electrifying Auckland’s passenger rail network.
* The use of different modes of travel is to be encouraged as is the entry of alternative transport fuels and electric vehicles into the NZ market, although the means of doing so are not identified.

**3.4 Government Policy Statement on land transport funding**

The LTMA 2008 requires the Government to prepare a policy statement on land transport every 3 years. It must take into account any NZES and EECS. The NZTA must give effect to the Government Policy Statement on land transport funding.

The latest Government Policy Statement (GPS, 2011) focuses on economic growth and productivity, value for money and road safety. Particular importance is given to investment in state highways particularly the seven Roads of National Significance (RoNS), and to road safety improvements through the Safer Journeys Strategy. Reference is made to the need for reliable and cost effective public transport in main centres, and to investing in walking and cycling to contribute to economic growth. The importance of value for money is emphasised.

The 2011 GPS on land transport funding states that the NZES and EECS “highlight reliable and more cost effective public transport systems that offer benefits to attract a greater percentage of long-term users”, but makes no reference to a greenhouse gas emissions target or specific actions to reduce GHG emissions.

**3.5 Comment**

Earlier efforts to deal with climate change and transport energy were well intentioned but relied on setting targets which typically had timeframes which were far too short. Unachievable targets are worse than useless as they raise expectations, but in practice are largely ignored.

The current focus on economic growth and efficiency reflects a preoccupation with short term issues. Risks associated with longer term strategic issues such as climate change have been downplayed or ignored. Energy security has been recognised as an issue, but the response has largely been limited to encouraging and facilitating off-shore oil exploration. Targets have been removed or rendered less effective through conditional statements. National energy and transport policies are often phrased in a manner allowing wide interpretation.

What is required is a set of stretch, but achievable long term and interim targets accompanied by measures aimed at achieving the targets. There should be regular monitoring of progress accompanied by interventions where required. Clear strategic objectives need to be set and stuck to unless evidence indicates the need for change.

Energy and transport policies (including pricing) should be derived from fact-based analysis to help ensure a much more consistent approach over time and to reduce the risk of changes in direction based on supposition or dogma.

Our emissions trading scheme is our main policy tool to reduce emissions, but it has so far been completely ineffective due to the very low cost of New Zealand Units and the exemption of pastoral agriculture from the scheme. Putting an appropriate price on carbon would enable economic signals to reduce emissions. This may be possible under a revised Emissions Trading Scheme with a much higher charge for New Zealand Units, or it may require moving to a carbon tax levied on all fossil fuels when recovered from the ground or on entry to New Zealand.

**4. SPECIFIC ACTIONS TO REDUCE GHG EMISSIONS AND IMPROVE ENERGY SECURITY**

**4.1 Transport Fuels**

***Natural gas***

Natural gas is becoming much more widely available through activities such as fracking in the US and through drilling in Australia. Natural gas emits approximately 6-11% lower levels of greenhouse gas emissions than petroleum throughout the fuel life cycle (“well to wheel”) (DOE, 2013). Natural gas vehicles use compressed natural gas (CNG) or liquefied natural gas (LNG). They are similar to gasoline or diesel vehicles with regard to power, acceleration and cruising speed. However, the driving range is generally less because less energy content can be stored in the same size tank.

Renewable Natural Gas, also known as biogas, refers to natural gas from unconventional sources where biological processes produce biomethane from organic matter. Because it is chemically identical to fossil natural gas, yet produces far fewer GHG emissions, the blending of relatively small quantities of renewable natural gas with fossil natural gas can provide significant life cycle GHG benefits (DOE, 2013). Blends of 20% RNG and 80% fossil NG have been found to yield reductions of GHG emissions by 30% or more.

As with other alternative fuels, the use of natural gas requires the development of fuel storage and infrastructure available at fuelling stations. LNG can be an attractive and efficient option for vehicles running high annual mileages, particularly for high fuel use fleet applications. CNG may not seen as an attractive option even for cars with very high annual mileages, because of the perceived loss of engine power and the loss of luggage space (caused by the fuel tank in the boot). However, New Zealand has previous experience in the use of natural gas as a transport fuel and this would assist in its adoption. At one stage following the 1970s oil crisis about 10% of New Zealand cars (about 110,000 vehicles) were converted to CNG use, although this fell away after petrol prices fell. CNG buses currently operate in Brisbane, Sydney and Singapore. Bi-fuel vehicles using CNG and petrol are currently manufactured by Volkswagen and Volvo.

It follows that natural gas appears well worth investigating as a means of both reducing NZ’s reliance on crude oil and reducing our GHG emissions.

***Electric vehicles***

Plug-in electric vehicles could be a very attractive option for NZ in view of its very high proportion of electricity generation from renewable sources. Technological challenges still to be overcome, however, include battery cost and charging time, and the distance vehicles can travel once charged. Current indications are that internationally significant use of electric vehicles may become a reality from about 2030, possibly earlier (REN21, 2013). In the shorter term, electric bicycles and scooters could become much more common**.**

In preparation for the time when electric vehicles may become relatively common, New Zealand should increase the proportion of electricity generation from renewable sources. To assist with this it should be ensured that equitable feed-in tariffs are available for small or new electricity producers using renewable sources.

***Ethanol and Bio-diesel***

Ethanol is a renewable transportation fuel which can be blended with petrol, e.g. as E10, to help reduce imported oil requirements and greenhouse gas emissions. More than 95% of United States petrol contains up to 10% ethanol (DOE, 2013). E85 (up to 85% ethanol) can be used in flex-fuel vehicles which can run on E85, petrol or any blend of the two. Significant technology process has been made over the last couple of years in cellulose-based ethanol production which can use wood, wheat straw etc as feedstock. One process converts the cellulose to sugars then converts the sugars to ethanol. A second uses biomass gasification then microbial fermentation.

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| Radiata pine plantation |  | http://www.ernstseed.com/files/general_images/biomass/mower_in_sg260.jpg |

 **Figure 2: Kaingaroa Forest** **Figure 3: Switch grass**

Forestry waste/wood chips and other organic sources could also be used to produce biodiesel in New Zealand. Radiata pine dominates the Kaingaroa Forest in the central North Island with an area of 189,000 hectares (Figure 2). In 2010 the Parliamentary Commissioner for the Environment proposed that NZ focus on biodiesel as the economy is critically reliant on diesel including freight by road and bus transport. The Commissioner identified wood as an appropriate feedstock for producing drop-in biodiesel using the Fischer Tropsch process. Potentially 6,000 dry tonnes of low-quality wood could be delivered to Kawerau which could produce about 10% of NZ’s diesel needs. The estimated production cost was $1.85 per litre. Fast growing grasses such as switch grass (Figure 3) and miscanthus have also been identified as potential feedstocks. They can be grown on marginal land, are drought resistant, minimal or no fertiliser is needed, and there is no need to till the land for 10 years.

Due to the potential strategic and GHG reduction benefits, New Zealand should update previous investigations into the use of forestry waste/wood chips, fast growing grasses and other organic residue (such as water weed from lakes and algae from sewage ponds) to produce bioethanol or biodiesel with a view to supporting future investment in a large scale production plant or plants.

**4.2 Innovative/emerging electric public transport**

In Europe and the United States trials are currently underway of wireless charging of electric buses though inductive charging (Figure 4). In Mannheim electric buses recharge wirelessly while passengers get on and off the vehicles at bus stops along an inner city route (Barry, 2013). While this technology is clearly at the developmental stage it could offer real benefits by providing low noise, CO2-free bus transport in place of diesel buses without the need for overhead wiring. Auckland University engineers have been leading the development of wireless electric vehicle charging technology, and are currently working with Qualcomm.

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| http://www.emoss.biz/images/EMOSS_Powertrain_IPT_primary-coil-E-Bus_Den_Bosch-150x150.jpg |   | pods-004 |

 **Fig 4: Wireless bus charging trial** **Fig 5: ULTra guideway and pods**

Fully automated battery powered public transport using pods (small, lightweight, driverless electric vehicles) running on relatively slender guideways is now entering commercial operation and could provide a real option for congested inner city areas. The ULTra system (Figure 5) is currently operating at Heathrow Terminal 4. The first urban PRT is being built in Amritsar, India and is to go live in 2014. It consists of an 8km elevated guideway and 7 stations with 200 pods which is capable of carrying 50,000 passengers/day (ULT, 2013).

I suggest that it is time we looked beyond diesel buses to innovative public transport options that have the potential to reduce operating costs, reduce GHG emissions and pollution, and improve our transport energy security.

**4.3 Managing Travel Demands**

Travel demand management has to be a core element of policies for reducing GHG emissions and improving energy security by reducing transport energy demands.

***Road Pricing***

In my view it is essential that congestion charging be introduced in New Zealand’s major cities starting with Auckland. By increasing the cost of travel during congested periods to better reflect the true marginal social costs more efficient use can be made of the existing road network. Road users can pay the charge, choose to travel at a different time or by a different route if available, or use a different mode of transport.

Congestion charging has been successfully introduced in a growing number of cities including Singapore, central London and Stockholm. It generally applies to travel within a congested area, typically the city centre, defined by a cordon. Charges can vary according to the time of day/ level of congestion and by type of vehicle.

 Although charges are designed primarily to influence travel behaviour not to maximise (net) income, congestion charging schemes generate income which can be used to improve the transport system. To ensure that public transport offers a good alternative, the Auckland congestion charging scheme should be implemented after completion of the current redesign of the bus network and construction of the City Rail Link is completed.

***Transport Funding***

Central Government sets out the parameters for the New Zealand Transport Agency’s policies for funding assistance through the national land transport fund in its 3-yearly GPS for land transport funding. This includes the funding envelopes for the activity groups such as state highway, local roads, public transport, and walking and cycling infrastructure.

 While the current emphasis on the RoNS could be seen as supporting short-term economic development, it reduces funds available for the other activity classes. A reprioritising of national land transport expenditure is required as New Zealand moves its focus from the short term to longer term issues and objectives. This should include a reduction in funding for the RoNS - in effect a slowdown in construction. The funds released should be directed towards facilitating the movement of people and freight, particularly in urban areas.

Among other things there needs to be an increase in funding for public transport services and infrastructure, accompanied by measures to encourage and facilitate walking and cycling for shorter distance travel.

The main bus routes and many key freight routes are generally located on arterial roads whose funding should be placed on a more level field with state highways.

Measures which reduce travel distances or the need to travel at all should be actively supported.

***Bus Priority Measures***

The momentum for introducing bus priority measures in the Auckland region has slowed in recent years. Part of the explanation is that the relatively straightforward schemes which required the removal of on-street parking in peak periods or minor intersection adjustments have been largely implemented. Future priority measures will increasingly require the reduction in capacity for non-priority users, which can raise strong objections from those disadvantaged.

To assist in overcoming objections from other road users, Auckland Council (and other Councils) and Auckland Transport should clearly identify those corridors for which road space will be specifically prioritised for buses or high occupancy vehicles, and those where freight and/or general traffic movement will be prioritised. Difficult decisions must be made and the reasons must be clearly articulated.

***Car Pools and Car Share Clubs***

Increased availability of transit priority lanes (T2 or T3 lanes) coupled with on-ramp priority measures can encourage higher vehicle occupancies. Currently, however, such facilities are limited which reduces their attractiveness. A series of such facilities through congested sections along a route would, however, significantly increase their benefits to users and hence be more effective in encouraging higher occupancies.

Car share clubs are likely to increase in popularity, particularly in denser urban areas where a car is unnecessary for many trips, and particularly among younger people for whom direct car ownership may be a lower priority. Club members can book a car by the hour or day, online or by mobile phone, and return it to the same reserved spot. Incentives applying to car share clubs can include allocating public parking spaces for their exclusive use. Local authorities can support such schemes through the dedication of parking spaces to car share vehicles.

***Interurban Freight Movement***

The electrification of the rail lines linking Tauranga, Hamilton and Auckland would reduce GHG emissions, reduce reliance on diesel, and encourage more use of rail for freight movement.

***Walking & Cycling***

The walking mode share can be increased by providing attractive, direct and safe pedestrian routes, including access routes to public transport; providing more and safer pedestrian crossing facilities; and reducing vehicle speeds in residential areas and town centres. The cycling mode share can be increased by providing an extensive system of safe, convenient and continuous routes; modifying intersections and giving cyclists more priority at traffic signals; reducing traffic speeds where appropriate; and improving end of trip facilities including bicycle parking.

The share of national land transport fund allocated to these ‘active’ modes should be increased in recognition of their contributions to GHG reductions and sustainability.

**4.4 Strategic Planning**

The Auckland Transport’s Integrated Transport Programme 2012-41 is a 30-year investment programme to meet the transport priorities outlined in the Auckland Plan. The land use scenarios assume a population increase from 1.5 million to 2.5 million by 2041. The ‘fully funded’ total transport investment amounts to a total of $60 billion. Despite this investment congestion is expected to worsen. The proportion of the strategic freight network operating at level of service E or F increases from 12.0% to 27.1% in the AM peak period, and from 5.8% to 28.4% interpeak. GHG emissions increase by 17%. Vehicle travel distance by private transport per person (VKT per person) is not included in the criteria, but a quick calculation shows that it is virtually the same in 2041 as today (both modelled total private vehicle travel distance and population increase by 67-68%).

On the subject of VKT and urban form, a recent World Bank publication points out that “.....urban form plays a key role in determining transport mode choice – many studies have shown that vehicle dependence and transport energy consumption per capita are far higher for low-density suburban neighbourhoods”. “The population density-VKT relationship can be weakened according to the type of land-use policies in place, such as zoning for mixed use, raising density maximums, and eliminating minimum parking regulations. From a transport perspective, urban sprawl has a number of negative effects, apart from increasing VKT. It also makes it more difficult to develop financially viable mass transit systems.”

The Auckland Plan’s focus on land use intensification is entirely appropriate. However, the finding that VKT per person remains unchanged from today indicates that little real progress is made towards reducing the transport effects of sprawl. In addition, it means that many people would be very exposed to any sharp increases in future transport fuel costs.

By 2041 climate change may be a far greater issue than it is currently, yet Auckland’s transport system may be generating significantly more greenhouse gas emissions.

***Suggested Strategic Planning Changes for major urban areas***

* Include a target for the reduction in vehicle travel distance per person as a key measure.
* Include the implementation congestion pricing at an appropriate year as an integral component of the transport strategy. At a minimum include a strategic option with congestion pricing to demonstrate its potential benefits.
* Place more emphasis on ensuring that total GHG emissions reduce progressively over time. Any increase should be seen as unacceptable.
* Emphasise the importance of targeting traffic congestion reduction to key freight routes and of minimising the effects of congestion on bus services and the movement of goods.

**4.5 Other Actions**

* Influence driver behaviour through training in fuel efficient driving techniques. It is claimed that such training can enable drivers to reduce their fuel consumption by up to 15%, with associated cost and CO2 savings (EST, 2013).
* Specifically include potential future climate change risks such as flooding due to increased rainfall intensities, and potential sea level rise scenarios in transport infrastructure decision making. Based on the most recent data, prudent planning should be based on a sea level rise of at least 0.5m.
* Identify and take action to protect existing highway infrastructure vulnerable to coastal erosion and more intense and frequent storm events. This includes bridge and culvert retrofits.

**5. CONCLUSION**

Our transport system relies extensively on the availability and use of fossil fuels in the form of petrol and diesel. New Zealand is at the end of a long supply chain. From a national energy security perspective we need to reduce our heavy reliance on imported crude oil and imported refined petroleum products. From a climate change perspective we need to progressively reduce our consumption of fossil fuels. Taken together these major challenges require a concerted effort to reduce our transport energy consumption and its greenhouse gas emissions. This requires actions to improved efficiency, to reduce demand, and to progressively substitute fossil fuels with fuels produced sustainably in New Zealand.

Natural gas, while a fossil fuel, can be an effective substitute for petrol and can help reduce CO2 emissions. It is becoming widely available internationally, and exploration may well identify a major new source or sources in New Zealand. In addition New Zealand has relatively recent experience in using CNG as a transport fuel. The cost of producing ethanol and/or diesel from sustainable sources such as wood chips and fast growing grasses on marginal land is reducing. Technology advances in recent years are encouraging, and commercial production may become a reality within a few years. Electrically-powered cars are coming onto the market in increasing numbers.

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This paper identifies a number of actions to mitigate the potential effects of future climate change and to improve New Zealand’s transport energy security. Some of the actions can be implemented in the near future, others are longer term. An essential change that must take place at the national level is to move from a short term horizon to looking at least 30 years ahead. We need to think much more seriously about the needs of future generations.

There is a need for strong and consistent national leadership and for effective Government support for local initiatives. It is in New Zealand’s wider interests as a food exporting nation to be seen as a nation which takes its environmental responsibilities seriously. Effective action is required, not vague promises or excuses.

At a more local level, our cities and towns need to incorporate climate change into their strategic planning as a core element, and need to think much more seriously about how they would function in a future with significantly higher transport fuel costs. A strong and competitive economy is, of course, important, as is ‘liveability’. However, liveability will increasingly be associated with sustainability and environmental responsibility. Urban areas must adapt and respond effectively if they are to prosper in an increasingly competitive world.

The IPENZ Transportation Group in particular, and transportation professionals in general, are urged to take leadership in raising climate change and transport energy security risks, and in identifying actions that can and should be taken to mitigate those risks.

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1. Thermal expansion is the tendency for matter to change in volume in response to a change in temperature [↑](#footnote-ref-1)
2. Adjusted to take into account international units surrendered under the NZ ETS [↑](#footnote-ref-2)