“Sustainable transportation strategies for meeting the Paris Climate Agreement – a case study of Wellington, New Zealand”

Global Transport Trends:

Transport brings development for "quality of life", but it is fuelled by non-renewable resources at the cost of damaging sustainability in the form of global warming by greenhouse gas (GHG) emissions. CO_2 emissions largely dominate the global GHG emissions and have risen 86% between 1970 and 2005 or 1.8% per year. The transport sector remains the last sector where fossil fuel dependency has not been substantially reduced making it a leading source of CO_2 emissions which cause climate change (Jochem et al., 2015). Transportation consumes annually more than half of the entire global fossil fuels and emits around a quarter of the energy related CO_2 (OECD 2005). In spite of concerns about air travel emissions, land transport accounts for roughly 74% of the transport sector’s total CO_2 emissions and more than 80% of the predicted growth in transport emissions is expected to come from road transport alone (IEA 2009). That is why this research focuses only on land transportation.

Why a City-based Consideration?

Existing policies and social attitudes will require significant changes to meet the challenges posed by trying to avoid climate change. New Zealand ratified the Paris Climate Agreement on 4th October, 2016 (Ministry for the Environment 2016) so these changes will have to be addressed. This research seeks to establish the extent to which the transport system may need to change.

To grasp the transport changes needed to meet the reductions implied by the Paris Agreement it makes more sense to look at a city rather than a whole country. Studying transport in a single city can provide a clearer view of what changes might be needed (UITP, 2014) and helps to provide a sense of what they might be like in terms of daily life. The city of Wellington for example, the capital of New Zealand, has put in place a policy to reduce its emissions by 80% (WCC, undated). This research attempts to identify what this might mean for transport.

Transport in Wellington:

In New Zealand’s total greenhouse gas emissions, transport accounts for 20% and out of this 89% is from road transport with 81% from the light passenger (LPV) and light commercial (LCV) vehicles fleets (NZ Govt. 2015). This research looks at a reduction of 80% by 2050 from current transport emissions levels, in line with Wellington City Council's target. This target means an allowable CO_2 emissions level of 160,000 tCO_2e (tonnes of Carbon dioxide equivalent) from LPVs in 2050. In 2000, the Wellington region’s LPV fleet of 230,000 vehicles caused 710,000 tCO_2e emissions, the current (2015) fleet is 277,000 while the total reduction in CO_2 emissions during the same period was 1.4%, barely 0.1% per year against the reduction target of 80% by 2050. If the growth trend of LPVs continues the same as currently then probably by 2050 the fleet will have increased to 440,000 vehicles.

The problem is that in a business-as-usual situation by 2050 an LPV fleet of 440,000 vehicles with current (2015) average emission for light vehicles entering the fleet of 170 gm/km and current annual travel in Wellington of 12,231 km (MoT, 2015) will emit more than 900,000 tCO_2e, compared with the target of 160,000 tCO_2e.

The emissions limit

The question is how can these emissions be reduced and what might this mean for current patterns both of vehicle ownership and of use? The key point is that given the expected future fleet size and current annual travel distance, the emissions limit for individual cars will have to fall from the current 170 gm/km to no more than 30 gm/km to meet the emissions target.

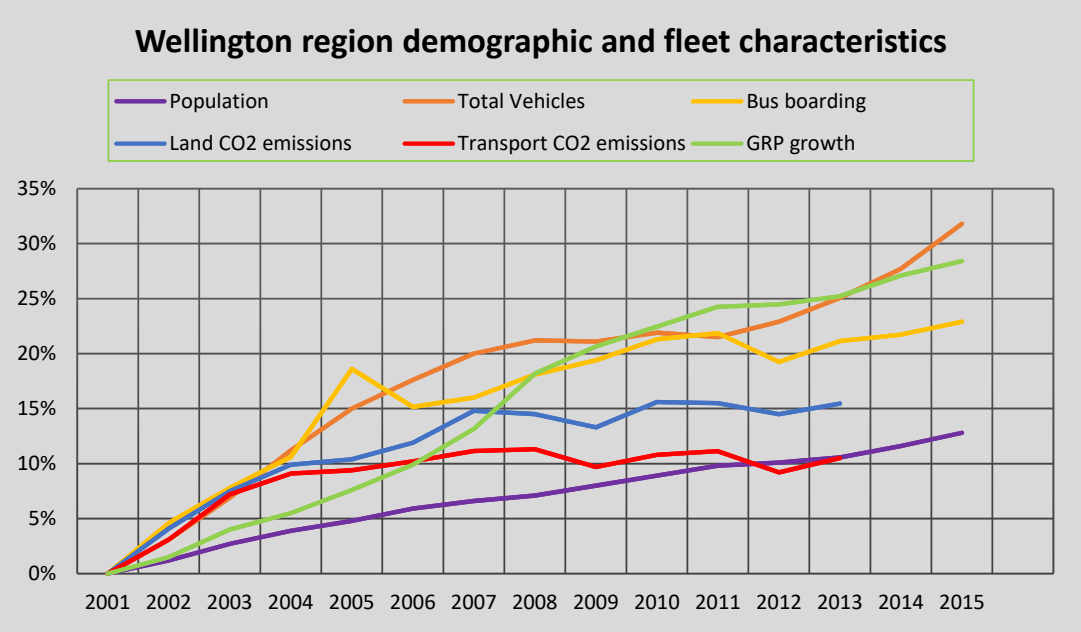

Figure 1: Wellington region demographic and fleet overview in terms of annual percentage increases since 2001

What is technically possible?

Better petrol cars?

One approach is improvements to the fuel efficiency of the conventional engine and drive train. The average CO_2 emission of light vehicles entering the fleet in New Zealand (MoT, 2016: p55) shows gradual improvement over time with a reduction in CO_2 emissions from 225 gm/km in 2005 to less than 170 gm/km in 2015. If this trend continues average fleet emissions could fall to less than 100 gm/km by 2050. It is worth noting that 100 gm/km is nowhere near the limit of technology for conventional engines, Volkswagen has already marketed a diesel electric hybrid two-seater that gets 110 km/litre and has emissions of 21 gm/km (VW, undated). Such performance will not represent the fleet average in 2050 although cars with emissions below 100 gm/km are already available in New Zealand and are relatively inexpensive (data from AA Motoring, 2016)

Even if technical efficiencies can achieve a fossil fuelled fleet average emission of 90 gm/km by 2050 then the estimated future LPV fleet of 440,000 vehicles will need to be limited to travel not more than 10 km per day each in order to stay within the targeted CO_2 emissions limit of 160,000 tCO_2e. This allowable per day range of 10 km is less than half of the current daily median urban travel distance of 22 km per day (EECA 2015). The growing wealth of the region, meaning there is more money to spend, makes it likely to be difficult to reduce car ownership.

What all this suggests is that possible technical improvements to conventional petrol fuelled vehicles are unlikely to be able to make the required difference to emissions without very large changes in

private car use requiring quite radical pressure from government, such as the need to use petrol rationing to control travel distance.

Electric cars?

Although often seen as the answer for sustainable transport, electric vehicles (EVs) are quoted as having a typical CO_2 emissions level of 50 gm/km (Manjunath and Gross, 2017, Jochem et al., 2015). This is nearly twice the 30 gm/km limit but could allow a greater daily travel distance, giving an incentive to shift from conventional to electrified cars. The strategy of electrified vehicles is relevant in Wellington and overall in New Zealand because the high proportion of renewable electricity generation in the NZ grid makes electric vehicles a low-carbon option (Miller & Mason, 2017) although a recent report suggests that the emissions from operation of EVs in New Zealand are the same as elsewhere at 50 gm/km (EECA 2015, Fig 10: 47).

Can we change our behaviour?

Non-motorised transport modes:

Behavioural shifting from private vehicles to non-motorised transport, i.e. cycling and walking, could be helpful in CO_2 emissions control. In the Netherlands, with 47% of trips by non-motorised transport, cycling plays a significant role up to a distance of 7.5 km and walking up to 2.5 km (Michel Beuthe et al., 2007). In New Zealand 30% of car trips are less than 2 km, a distance which can be easily covered by walking, the cheapest as well as healthiest way of travel (NZTA, 2016) as it is recommended for health that people should walk 10,000 steps a day, a distance of 8 km (NHS Choices, 2014). For short distances the fastest way to travel is cycling, which combines low cost travel with good exercise. The recommendation for moderate exercise is 8 km of bicycling (Gotschi & Mills, 2008, 29).

These non-motorised modes can potentially replace up to 50% of the current car traffic load as almost half of car trips are less than 6 km (NZTA 2011). This would then mean that car travel would fall within the 10km per day limit to meet the emissions target. The European Cyclists Federation (2011: 10) found that the CO_2 emissions of both pedal powered and electrically-assisted bicycles were similar due to the food eaten by the pedal cyclist, and electric bicycles would be beneficial given the many hills of Wellington.

Public Transport: Buses

Wellington is the New Zealand city which has the largest percentage of commuters using public transport. Approximately 25% of commuters in the Wellington region use public transport, compared with 4% of commuters to the Auckland metropolis from surrounding districts and 1% of people travelling to work in Christchurch from surrounding districts (Goodyear and Ralphs, 2009, 1).

Bus travel in Wellington since 2000 has increased by around 14% or around 1% per year. In spite of this increase in bus travel the CO_2 emissions per passenger-km have fallen from 54 gm/passenger-km in 2000 to 41 gm/passenger-km in 2015. It is assumed that bus usage will be able to increase at slightly more than the current rate up to 2050 with increased bus occupancy meaning little or no additional overall emissions, meaning that the average emissions will be 23 gm/passenger-km.

Public transport: Trains

Between 2000 and 2015 train boarding has increased by 10% whereas the decrease in train-related CO_2 emissions over the same period is 1.7% (URS Report 2014). The figures for 2000 and 2015 show figures of 52 gm/pass-km and 38 gm/pass-km respectively for Wellington's mostly electric trains. Assuming an increase roughly in line with the current trend by 2050 increased train ridership will give a per head emissions contribution of 22 gm/pass-km.

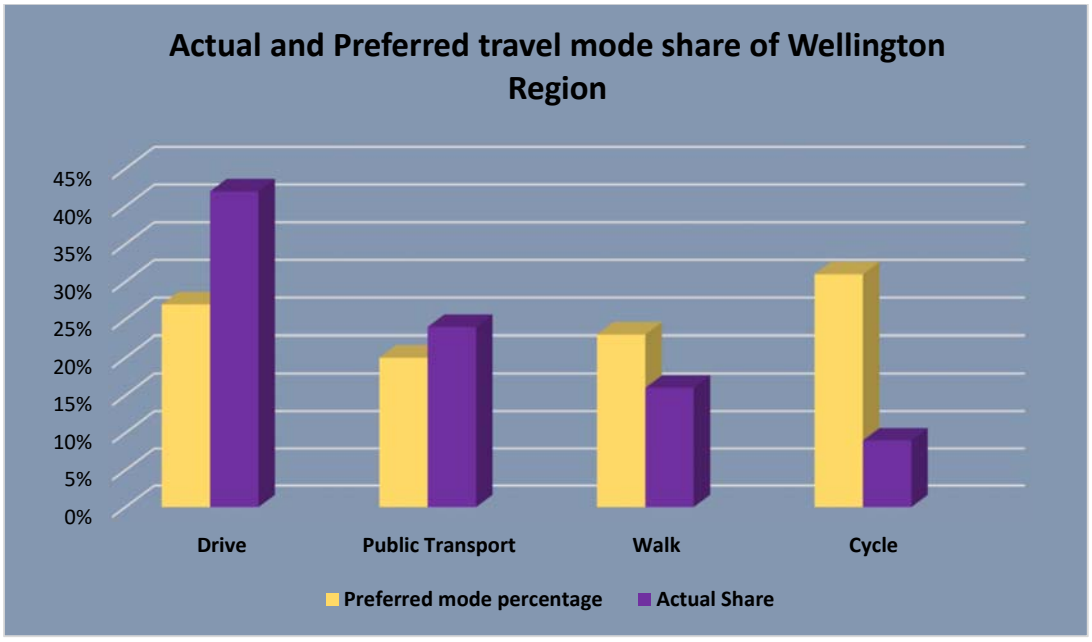

Figure 2: Actual and preferred travel mode share of Wellington region.

The importance of changing motivation:

It is important to motivate individuals to use public transport, especially among the younger age group. The percentage of 13-17 and 18-29 year olds who currently do not use public transport is 41% and 57% respectively (MoT 2016 figure 37 page 51). Driving licence records in NZ show that the highest proportion of learner licence holders is 16-18 year olds and about a quarter of 18 and 19 year olds have a restricted licence. If the minimum age limit for a driving licence were increased by 2 to 3 years in order to shift them to public transport this could reduce the load on private vehicle travel distance. Additional motivation will be required to increase public transport use for 'personal business/shopping' (the largest travel category) and 'social purpose' travel from the current shares of 14% and 12% respectively (MoT 2016).

Summary

Partly because of ever-increasing growth in population it seems clear that technology will not be enough to maintain the existing level of transport provision. We will have to travel less by car, whether petrol or electric, if we are to avoid climate change. However, a combination of driving less distance combined with a lot more walking and cycling (either pedal or electrically assisted), increased use of the existing public transport system, more efficient cars, electric cars and more car sharing could be sufficient to achieve the targeted 250,000 tCO_2e emissions from land transportation.

The bottom line of this study is that we are dealing with a long run problem and now is the time to think of what structure should be adopted for Wellington's transport at the earliest possible time since this structure will determine energy and emissions intensities for many years to come. The

policy actions suggested here could result in the desired and necessary outcome of dramatically lower CO_2 emissions but whether these actions will be acceptable to a population that is still wedded to the private car is uncertain. What is certain is that the future of all coming generations depends on achieving these sorts of emissions reductions.

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