

Lets Get Wellington Moving's Mass Rapid Transit proposal

A review of the economics

August 2022



About Tailrisk economics

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Part one: Introduction

This paper discusses three important aspects of the economics of Lets Get Wellington Moving's (LGWM) four mass rapid transit (MRT) options. The most expensive of these, option one, with a light rail line, a new Mount Victoria tunnel and a price tag of \$6.4 billion, is LGWM's preferred option.

Our discussion covers:

- The impact on carbon emissions
Reducing carbon issues is pushed as the primary rationale for the MRT. But this is misconceived. With the electric car revolution the private vehicle emissions problem will take care of itself. By 2050 only around 10 percent of Wellington's private light vehicles will have internal combustion engines (ICE) and the MRT will have only a minor and declining impact on Wellington's emissions. Once account is taken of emissions embedded in the MRT capital works, Option one could well increase the aggregate emissions over the period thought to 2050.
- The cost benefit analysis
As a benefit to cost ratio of more than one is the indicator of value for money a MRT proposal should not proceed unless this test is met. LGWM present a scenario where the benefits exceed the costs for option one but this is not reassuring. This was just a scenario purposely designed to generate a positive result.

The problem here is that LGWM has not provided a cost benefit paper so it is difficult to understand how their modeling works and how key results were derived. However, it is clear that their favorable result relied on some implausible assumptions and possibly some flawed analytics. It was assumed that the bulk of Wellingtons new dwellings built over the next forty years would be small apartment in the CDB - Newtown corridor.

- The LGWM's congestion charging analysis.
A serious consideration of congestion charging should precede any decision on the MRT options. It might be that congestion charging is the better solution to the Wellington's congestion issues without the need to spend billions of dollars on the MRT.

The starting point of our analysis is a presentation of a rather scathing review of aspects of the LGWM's analysis by the New Zealand Infrastructure Commission (Infracom), and the LGWM immediate response. Some of the analysis in the subsequent LGWM papers can only be understood as a response to Infracom so it is useful to examine their critique first. Given Infracom's expertise in the area their review is obviously worth considering.

This paper is structured as follows:

Part two presents our key findings.

Part three sets out Infracom's critique and the LGWM's response.

Part four looks at the contribution of option one to the reduction in carbon emissions.

Part five critiques the LGWM's cost benefit analysis and presents alternative calculations.

Part six engages with LGWM's response on the congestion charging issue.

Part two: Key findings

MRT not likely to reduce carbon emissions materially

In the most plausible population growth scenarios the embedded carbon emissions in the construction of the infrastructure are likely to outweigh the savings when commuters switch from cars to public transport. The reason is that by 2050 the electric car revolution will be getting near to completion. Electric cars do not emit carbon emissions so there is no gain, from a climate change perspective, from switching from private to public transport at that point. The MRT is not a climate change issue and should not be marketed as such.

Infrastructure Commission's report on the MRT economics scathing

The Commission said

all the options presented have very high costs relative to the scale of emissions reductions, leading to a very high cost per ton of carbon abated. Ideally, options would be developed that provide more cost-efficient means of reducing emissions.

Benefit to cost ratio very low

Our estimate of the most benefit to cost ratio is 0.24. That is for every dollar spent the return is only 24 cents.

Description of the cost benefit modeling deficient

LGWM's cost benefit model is mostly a black box. There is no detail on key elements of the outputs and the analysis has not been subject to genuinely independent and transparent reviews.

Risk of further restrictions on greenfields development to support the MRT

To make the cost benefit of the MRT 'work' by forcing more people into the mass transit catchment the possibility of further restrictions on greenfield developments is raised by LGWM. The negative cost benefit effects of such a move were not considered.

Congestion charging should be seriously considered before further work on the MRT

A congestion charge offers many advantages over a major infrastructure spend:

- There is huge savings in capital costs.
- It is not exposed to the risk of a wasted capital spend if the large central city population increase needed to support the MRT, doesn't emerge.
- It directly targets the real problem, which is congestion.
- It targets those who are causing the congestion.
- It can address traffic issues for all of Wellington, not just the southern and eastern third.

The likely optimal option is congestion charging and an enhanced conventional bus service. The Wellington and the Regional Councils have already made some sort of commitment to congestion charging but not now. It appears that they just don't want it to interfere with this pet project.

Light rail solution wanted at all costs

It is obvious that the analysis has been systematically slanted to favor light rail. The real motivation for is that LGWM and the Wellington City Council just want a light rail system regardless of cost.

Part three: The New Zealand Infrastructure Commission's review

Infracom was requested by the chair of LGWM to review the Economics and Carbon Technical reports. Because of time constraints Infracom restricted themselves to a consideration of the likely magnitude of carbon emission reductions.

Their key findings were:

- 1. Option 4 is the best option from both a climate and economic perspective, and the only option that is likely to be compatible with our international commitments on carbon emissions.*
- 2. The level of carbon emissions reductions is highly dependent on land use intensification. Enabling intensification is critical for the programme to succeed in cutting emissions.*
- 3. Congestion charging has not been included in the carbon assessment or economic analysis. Congestion charging is a critical tool for improving access and mobility (while reducing carbon emissions) and should be considered an indispensable part of the programme.*
- 4. The total magnitude of carbon savings is subject to uncertainty due to insufficient analysis in four areas: the level of intensification, construction times, the embodied emissions from construction, and the speed of electric vehicle uptake. However, evidence suggests that further work in these areas is likely to favour Option 4 (over Option 1/2).*
- 5. More work is needed at the detailed business case stage to provide certainty around intensification, carbon outcomes, and delivery planning.*

More generally they added:

Consideration of low-cost options before higher cost options is a fundamental infrastructure decision-making principle that is outlined in the New Zealand Infrastructure Strategy, as well as core guidance documents such as the Monetised Costs and Benefits Manual. The incremental cost of higher cost alternatives and options is only justified when it is outweighed by the incremental benefits gained. From an economic standpoint, the incremental cost of the higher cost option has not been justified.

And

all the options presented have very high costs relative to the scale of emissions reductions, leading to a very high cost per ton of carbon abated. Ideally, options would be developed that provide more cost-efficient means of reducing emissions.

It was also noted that embedded emissions had not been included in the cost benefit analysis. If it had been there would have been an emissions dis-benefit in some scenarios.

An error in the analysis was also identified:

it is assumed that Options 1/2 and 4 have the same benefits realisation period. For both options, construction is completed in 2033 and benefits are not fully realised until 2036. However, these assumptions are at odds with other LGWM documentation, which indicates a 10-15-year construction period for Options 1/2 and an 8–12-year construction period for Option 4.

On electric vehicle takeup rates and the implications for carbon emissions it was noted:

As electric vehicles become an increasing share of the vehicle fleet, the carbon savings from enabled emissions decreases. Slower electric vehicle uptake will favour Option 1 because it would increase the size of enabled emissions reductions over the long term, while faster electric vehicle uptake would favour Option 4.

But LGWM was using an out-of-date data source.

The LGWM carbon assessment has used VEPM 6.2 national level fleet projections for its analysis, which projected that 61% of distance travelled would be by electric vehicles by 2050. The latest release, VEPM 6.3, has increased estimates of electric vehicle uptake, to 68% electric by 2050

And

the analysis has used national level fleet projections, which are likely inappropriate given the high level of electric vehicle uptake in the Wellington region. In March 2022, electric vehicle uptake in Wellington was 2.3 times higher than the national average (0.8% of vehicles vs. 1.8% of vehicles).

As a result LGWM would have overstated the emissions reduction impact of all the options and particularly option one on.

LGWM's response to Infracom

LGWM 's Chief Executive's response to the report was as follows:

We see three broad areas where we would challenge the conclusions reached by Te Waihangā:

1. *LGWM alignment with Net Zero Carbon targets*

The LGWM Indicative Business Case was commissioned before Net Zero target was established in legislation, and before the Commission published its strategy. Hence, criticism that the LGWM programme is misaligned to the Net Zero target and the Infrastructure Strategy's climate change guidance are misplaced, when they are clearly out of the original scope.

Really. Surely it could not have been too hard to amend the business case.

2. *Factoring in urban density changes when assessing LGWM investment options*

We recognise and acknowledge the analysis of the Carbon and Economic assessment methodologies. However, in reaching the conclusion that Option 4 is the highest performer for carbon reductions under the core (current) land use scenario, we feel the Commission has unweighted the role of urban intensification in achieving LGWM's dual objectives of encouraging mode shift and to develop greater public and active transport options.

This gets to the heart of the issue. Intensification has become an end in itself without any economic justification. We see just a single line that just suggested that intensification reduced infrastructure costs. With this mindset anything like light rail that might promote intensification must be good.

We note your concerns around the certainty of the land use and urban intensification changes required under each option, and while these are again outside the original scope of the project, are matters that can be subsequently addressed.

Again why wasn't the scope extended to address uncertainty at an earlier stage.

3. *Congestion charging*

We also note your comments about congestion charging. Travel behaviour change is part of the programme, but congestion charging was out of scope.

This does not explain why congestion charging was placed out of scope when it is such an obvious preliminary to a large congestion related infrastructure spend.

Part four: The relevance of emissions reductions

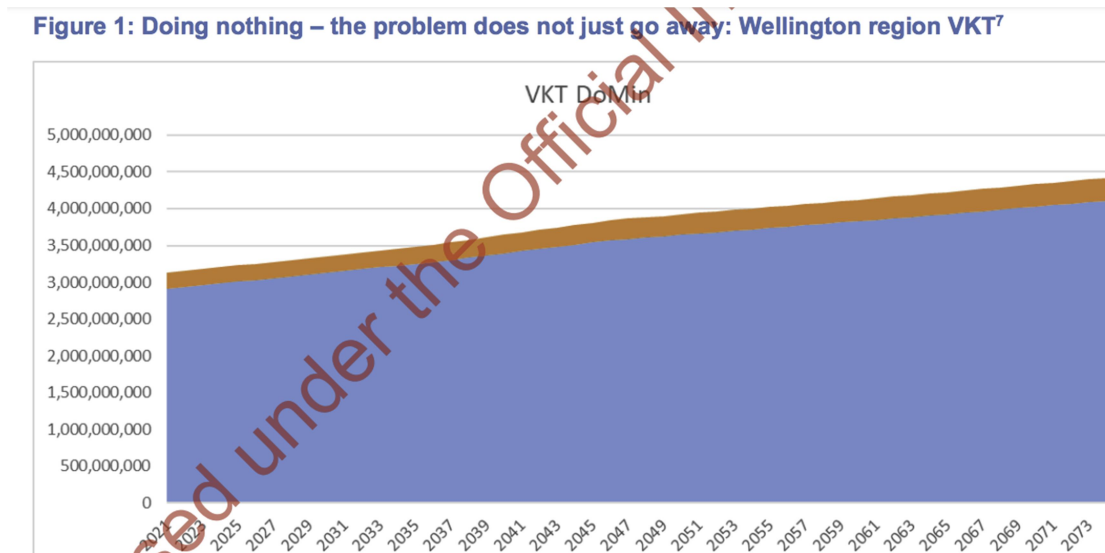
Despite the obvious fact that that electrification of the light private cars fleet would limit the emissions reduction effect of the MRT, LGWM tried to built a sense of the need for urgent climate change related action.

In the relevant paper: Appendix C - Carbon Analysis Technical Report it is stated:

Transport is responsible for around 43 percent of total domestic carbon dioxide (CO2) emissions, and 20 percent of total greenhouse gas (GHG) emissions . Therefore, transport emissions need to fall significantly, and quickly, to achieve our emissions reductions commitments and targets.

The following figure, showing increasing Vehicle kilometres travelled (VKT) out to 2075 had the caption 'the problem does not just go away'. This was misleading. With electrification the problem does go away. VKT is not a proxy for emissions as the figure suggests.

Figure one: LGWM Vehicle kilometers travelled



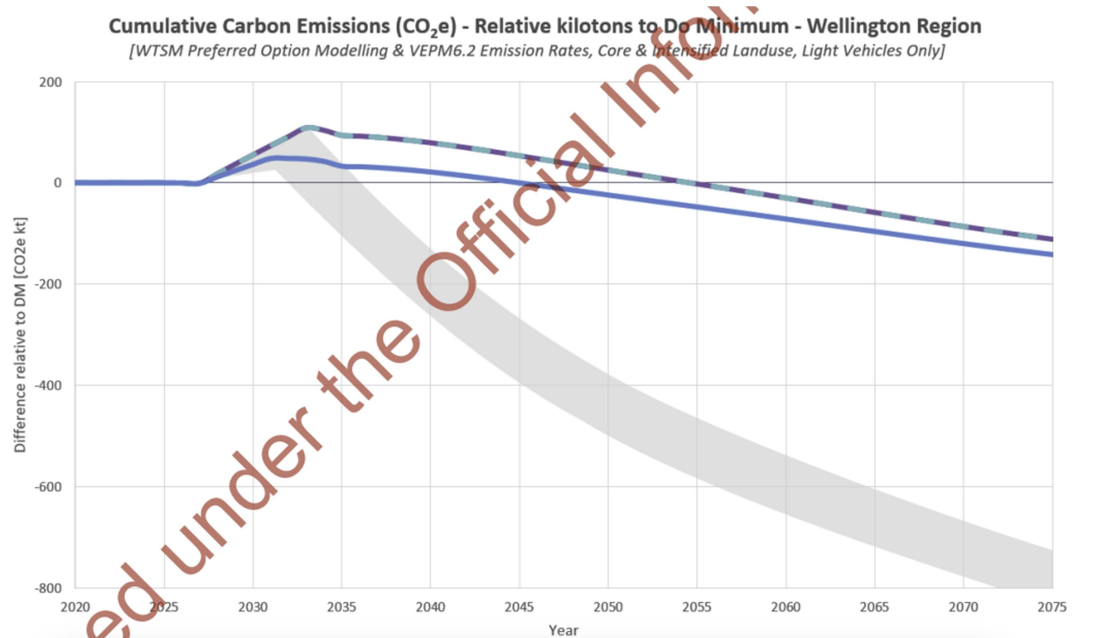
LGWM then sets out to demonstrate that, despite the heavy embodied emissions in construction, option one it will generate enough savings over time to more than compensate.

Figure two, which shows LGWM estimates of cumulative additions and reductions to emissions, out to 2075. There are two scenarios, core and intensive, for the number of household built, and two options, one and four. The blue and red line shows option four with the core building assumption. The breakeven point, where the reduction in vehicle emissions offsets the construction emissions, is 2045. The breakeven point on the lower blue line (option one and the core housing scenario) is 2055. This was Infracom’s point. If you want rapid action on emissions reductions then option one is the worst of the options.

However, the graph is dominated by the grey swath, which represents a higher and lower version of option one with the intensified building assumption. This shows cumulative emissions savings of 800,000 tons of carbon by 2075.

The core building scenario assumption is a reasonable outcome, with 10,000 new dwellings, but the intensified scenario is a very implausible. It assumes that great bulk of Wellington’s new dwellings in the next 40 years will occur in Central Wellington and the southern suburbs. However, the way this emission path is depicted in the figure gives the impression that a large emissions saving over time is a likely outcome, which is misleading. We discuss the housing assumptions further in part five.

Figure two: Emissions increases and reductions

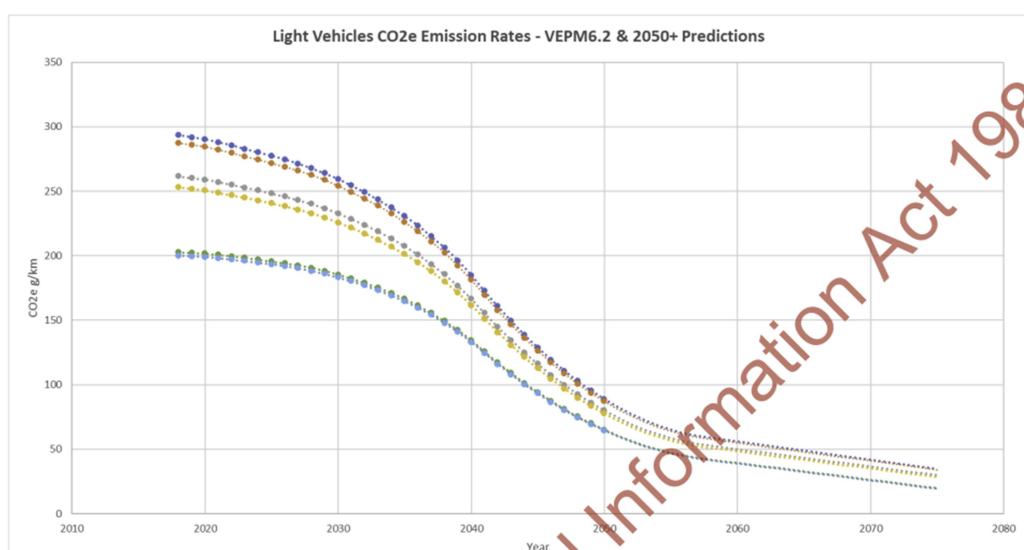


There are several more problems with this modelling.

The first is that emissions reductions occur before the light rail system is completed. Infracom pointed this out in their paper. But LGWM just ignored the issue. The second issue relates to emissions reductions over time. Figure three shows the average light vehicle emission rate. It is a proxy for the share of electric vehicles in the light fleet. The data is based on Waka Kotahi modelling to 2050 and LGWM has produced its own estimates out to 2075. The implied EV share falls sharply from 2035 to 2050, reflecting the assumption that there will be no significant new additions to the ICE fleet from about 2035 (driven by market forces and/or regulation).

Thereafter the rate of decline tails off and by 2075 ICE vehicles still account for a significant proportion (perhaps 10- 15 percent) of the light fleet. So according to LGWM there is ample scope for Option one to reduce light vehicle fleet emissions over time.

Figure three: LGWM emission rate estimates



The problem here is that LGWM did not use the latest Waka Kotahi data in its modelling, despite being advised to so by Infracom. Table one shows that the differences between VEP6.2 and VEP6.3 (the latest version)¹ are material.

¹ Note that the shares refer to the entire fleet including light commercial and heavy vehicles so the shares in light private vehicle fleet area little understated. However this does not affect the rates of changes.

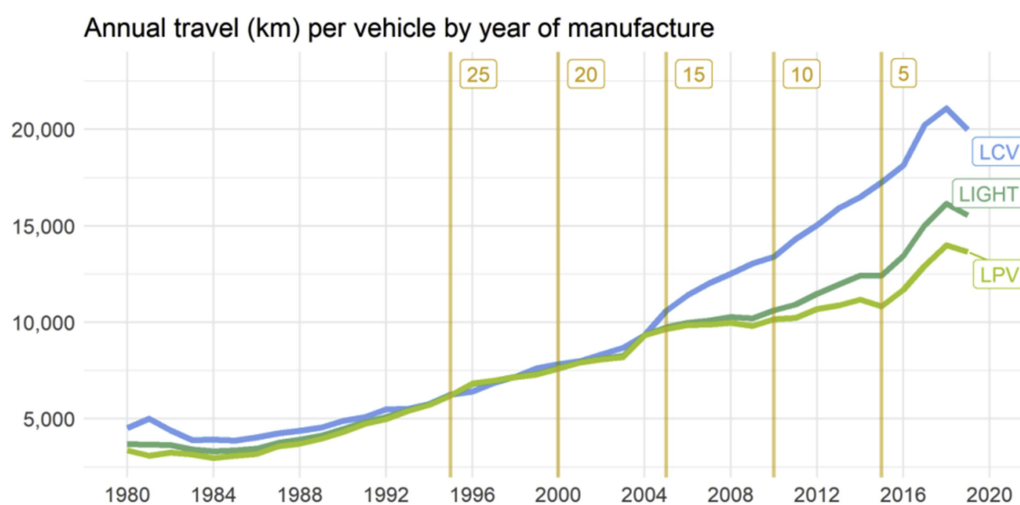
The data shows an accelerating rate of decrease which does not appear to be consistent with LGWMs post 2050 estimates, which seem to assume a slowing in the rate of decline. An accelerated rate of decline is not a surprise. The average age of withdrawal from the fleet is 20 years, so by 2050 a large part of the remaining ICE fleet will be nearing that age. What is clear is that LGWMs forecast that ICE vehicles could be 10-15 percent (or over 300,000 vehicles) of the New Zealand fleet by 2075 is highly unlikely. By then these vehicles will be 40-45 years old.

Table one: Vehicle fleet shares to 2050

| Petrol cars | Petrol, diesel and hybrid cars VEPM2 | Petrol, diesel and hybrid cars VEPM3 | Rate of change in share % VEPM2 | Rate of change in share % VEPM3 |
|-------------|--------------------------------------|--------------------------------------|---------------------------------|---------------------------------|
| 2025 | 72.1 | 72.1 | | |
| 2030 | 68.9 | 68.7 | | |
| 2035 | 62.9 | 61.2 | | |
| 2040 | 48.7 | 47.0 | 22.6 | 23.0 |
| 2045 | 32.3 | 28.4 | 33.7 | 39.6 |
| 2050 | 19.8 | 15.6 | 40.3 | 45.0 |

Even if there is a largish rump of surviving old ICE vehicles post 2050 they will not be driven much and so will not generate many emissions. Figure four shows travel by light vehicles by year of manufacture. A 36 year old light private vehicle is driven about 25 percent as much as a newish vehicle.

Figure four: Travel by age of vehicle



Finally we get to Infracom's point that Wellington is making the electric transition more quickly than New Zealand on average (the current Wellington fleet is 2.3 times bigger per capita). Again LGWM does not adjust for this despite being aware of the issue.

It is obvious that climate change mitigation does not provide a rationale for an accelerated approach to these infrastructure investments. They are probably more likely to increase emissions than reduce them.

Part five: The cost benefit analysis

The problems with assessing LGWM cost benefit analysis is that there is no cost benefit paper. There are only a couple of pages on the economics in the Preferred Program Option report that does little more than set out some of the high level cost benefit results. There is a little more information in the Economics Technical report (28 May 2022) by Earnst Young, which was intended to provide a strategic review of the cost benefit analysis methodology.

EY concluded:

The LGWM Programme Team have undertaken multiple rounds of transport modelling and economic evaluation using outputs from WTSM and WPTM since the Programme Business Case in 2019 and since through the development of the IBC in 2020 and 2021. This large body of evidence provides us with sufficiently detailed information about how notable transport interventions affects transport network and generates economic benefits for the programme.

And

Our conversations with the wider LGWM team and review of CBA documentation indicates that an appropriate and proportionate range of costs and benefits have been modelled for the purposes of IBC development.

But this tells us little about the content and robustness of the LGWM cost benefit analysis.

At a more detailed level there were a couple of pages that listed some assumptions and two pages of high level results cost benefit results . The discussion of these results in its entirety (six lines) was:

examining the detail of the CBA reveals a substantial increase in health benefits for users of active modes of transport. Walking and cycling benefits are distributed across the city but concentrate in and around the CBD where pedestrians and cyclists gain significantly improved infrastructure, leading to greater demand. The high land use scenario also introduces a noticeable additional increase in health benefits for pedestrians and cyclists from the core land use scenario.

Nor was the LGWM's peer review of the economic analysis helpful. It consisted of a brief summary by LGWM of a review by an unidentified peer reviewer. This was the substance:

In summary all comments have been closed out to the satisfaction of the programme team, the authors and the peer reviewer. There were no fundamental disagreements between the parties.

Testing the Key cost benefit results

In the remainder of this part we shine a light on the LGWM cost benefit analysis and present our own results. Our starting point are the results from the EY economics review paper, set out in figures five and six .

The population growth assumptions

The cost benefit analysis depends critically on the assumptions on the amount of housing development in the central, southern and eastern development areas. The higher the population increase the greater the benefits from the MRT because more people will switch from cars to public transport. With the core assumption of 10,000 new dwellings (26000 people) the present value of the option one benefits are \$2363 million. With the intensified assumption (26000 dwellings and 68,000 people) the benefits are \$4197 million.

A range of new housing build numbers was assumed, starting with the business as usual assumption (the core assumptio) of 10,000 new dwellings over the calculation period. This is increased to 16,000 with the Rapid Bus Transit (BRT) option. Of this 3000 is induced by the very presense of the BRT. That is 3000 household will move (mainly central Wellington and Newtown, just for the pleasure of having the bus close to their door. A further increase of 3000 is due to 'development enhancing' initiatives. With light rail the number of builds increases to 21,000. 6000 is due to the prescence of the light rail line and 5000 due to the enhancements.

Finally, there is an intensification scenario where the number of dwelling is increased to 26,000. There is no justification for the additional 5000 dwellings. Rather it added just to push the option one benefit/cost ratio to above 1.

Figure five: Cost benefit results core housing assumption

Table 4-3: Core land use preliminary CBA Results (Discounted, \$2021 millions)

| | Option 1 | Option 2 | Option 4 |
|--|----------------|----------------|----------------|
| Viability metrics | | | |
| NPV (excluding agglomeration) | -\$1,896 | -\$1,634 | -\$1,317 |
| BCR (excluding agglomeration) | 0.46 | 0.51 | 0.58 |
| NPV (including agglomeration) | -\$1,137 | -\$924 | -\$780 |
| BCR (including agglomeration) | 0.68 | 0.72 | 0.72 |
| Costs | | | |
| Total costs | \$3,500 | \$3,312 | \$2,781 |
| Benefits | | | |
| Public transport – travel time benefits | \$640 | \$679 | \$603 |
| Public transport – incremental fare revenue benefits | \$101 | \$107 | \$87 |
| Private vehicle – travel time benefits | \$143 | \$147 | \$135 |
| Private vehicle – travel time reliability benefits | \$11 | \$12 | \$9 |
| Private vehicle – reduction in vehicle operating costs | \$91 | \$91 | \$82 |
| Safety benefits | \$109 | \$112 | \$85 |
| Environmental Benefits - Harmful pollutant and CO2 reduction | \$31 | \$31 | \$27 |
| Health Benefits for additional walking trips | \$405 | \$423 | \$369 |
| Health Benefits for additional cycling trips | \$73 | \$76 | \$66 |
| Agglomeration | \$759 | \$710 | \$537 |
| Total benefits | \$2,363 | \$2,388 | \$2,001 |

Figure six: Cost benefit results intensified housing assumption

| | Option 1 | Option 2 | Option 4 |
|--|----------------|----------------|----------------|
| Viability metrics | | | |
| NPV (excluding agglomeration) | -\$334 | -\$686 | -\$168 |
| BCR (excluding agglomeration) | 0.90 | 0.79 | 0.93 |
| NPV (including agglomeration) | \$697 | \$223 | \$278 |
| BCR (including agglomeration) | 1.20 | 1.07 | 1.10 |
| Costs | | | |
| Total costs | \$3,500 | \$3,312 | \$2,781 |
| Benefits | | | |
| Public transport – travel time benefits | \$740 | \$714 | \$624 |
| Public transport – incremental fare revenue benefits | \$819 | \$273 | \$226 |
| Private vehicle – travel time benefits | \$353 | \$245 | \$293 |
| Private vehicle – travel time reliability benefits | \$21 | \$15 | \$19 |
| Private vehicle – reduction in vehicle operating costs | \$302 | \$203 | \$263 |
| Safety benefits | \$391 | \$261 | \$327 |
| Environmental Benefits - Harmful pollutant and CO2 reduction | \$97 | \$66 | \$84 |
| Health Benefits for additional walking trips | \$799 | \$720 | \$659 |
| Health Benefits for additional cycling trips | \$144 | \$130 | \$118 |
| Agglomeration | \$1,031 | \$908 | \$447 |
| Total benefits | \$4,197 | \$3,535 | \$3,059 |

The required level of intensification appears implausible. 26,000 dwelling is close to all of the additional dwellings to be built in Wellington over the period. The Urban Development Summary Report forecasts 24600-32300 new dwellings. The intensified scenario must assume that the bulk of the demand for new dwellings will be apartments in the 50 - 80 sq metre range in the Central Wellington Wellington to Newtown corridor. While there will be a demand for more new small apartments if it is fanciful they will completely dominate demand in the entire Wellington market.

The population projections are admitted to be a point of vulnerability in the case for option one and the other options.

It relies on acceptability and market delivery of high-density urban development in the MRT corridor.. The public acceptability and commercial attractiveness of intensification, and the number of existing opportunities for more dispersed development may limit the intensified land use modelled in this report, and the outcomes that can be achieved.

And more pointedly:

If intensification levels greater than those represented in the “core land use scenario” are not able to be achieved, roll out of any form of MRT system is unlikely to be value for money and a ‘Continuous Bus Priority’ network may provide appropriate outcomes and a lower cost.

It is intended to do more work on the demand issue at the detailed cost benefit stage. But this is unlikely to help. No one can say with confidence how the demand for dwellings will evolve over the coming decades no matter how detailed the analysis. All we can say is that the intensification scenario is a relatively low probability outcome and not an appropriate assumption for the cost benefit analysis. This should have identified a mean assumption.

There is a risk that LGWM will push for constraints on housing development elsewhere in Wellington and the region to promote the required intensification needed so rescue option one.

During 2022, the WRLC is advancing work on a regional emissions reduction plan and also undertaking further work on the sequencing of growth across the region. LGWM analysis will support this activity and greater ambition needs to be sought via the WRLC and WRGF to more actively prioritise transitorientated development growth along the MRT corridor and discourage growth in greenfield areas or more dispersed growth through the greater land use controls.

This play to increase the option one benefit cost ratio to above one does not work. In a robust cost benefit analysis there will be a cost in imposing constraints on greenfields housing developments that is likely to outweigh the gains from greater intensification.

If people are forced into the central city they will make various savings on transport, which will be counted in a cost benefit analysis, increasing the BCR. But what is ignored is the relative cost of new properties in downtown high rises and in greenfield developments. The property occupant might well save, say, \$100,000 on time and vehicle running costs over 40 years if they live in the centre of Wellington. But if the downtown property costs \$400,000 more than a suburban property yielding an equivalent amount of utility, then he will be substantially worse off.

Tailrisk benefit/cost ratio estimates

Our first step is to adjust the capital cost assumption. In the LGWM papers it was noted that the capital cost estimates are already out of date. Further, infrastructure projects are notorious for running over budget. We have made a \$500 million adjustment to the option one cost estimate.

Our adjustments to the LGWM benefit estimates for the Core and Intensified scenarios for option one are presented in table two. The LGWM results are also presented for ease of comparison.

Table two: Cost benefit assessments for Option 1

| | 1 Core Tailrisk Op1 | 2 Core LGWM Option 1 | 3 Intensified LGWM Option 1 | 4 Intensified Tailrisk Option 1 |
|-----------------------------------|------------------------------------|-------------------------------------|--|--|
| Total costs \$'m | 4000 | 3500 | 3500 | 4000 |
| | | | | |
| | | | | |
| Benefits | | | | |
| Public transport travel time | 643 | 643 | 740 | 740 |
| Public transport Incremental fare | 0 | 101 | 319 | 0 |
| Private vehicles – travel time | 72 | 143 | 353 | 174 |
| Private vehicle – reliability | 11 | 11 | 21 | 21 |
| Private vehicle – operating cost | 91 | 91 | 302 | 302 |
| Safety benefits | 109 | 109 | 391 | 391 |
| Environmental benefits | 0 | 31 | 91 | 0 |
| Health benefits - walking | 41 | 405 | 799 | 80 |
| Health benefits – cycling | 0 | 79 | 144 | 0 |
| Agglomeration benefits | 0 | 753 | 1031 | 0 |
| Total benefits \$m | 967 | 1513 | 4199 | 1773 |
| | | | | |
| BCR | 0.24 | 0.46 ex agglom. | 0.90 (ex agglom) | 0.51 |
| | | | 1.20 (inc agglom) | |
| NPV \$m | -3033 | -1896 ex.agglom | 697 (Inc.agglom) | -1727 |
| | | | | |

In the more credible core scenario the net present value is - \$2962 million and the Benefit Cost ratio is 0.24 compared to the LGWM's estimates of -\$1896 million and 0.51 (ex agglomeration) respectively.

For the intensification scenario our estimates are 0.51 and -\$1727 million. The significance of these results is that there is no plausible building/population scenario that would push the option BCR above one. The 26000 dwellings scenario is unlikely enough, but assuming more than 50,000 more dwellings and 130,000 more people to push the BCR to one goes well beyond the bounds of credulity.

LGWM will likely say that their cost benefit analysis is just an initial attempt, with the implication that all will be well when the detailed analysis is done. This is not the case. The problem is structural. Option one is simply too expensive. Paying consultants to devise ever more outlandishly optimistic cost benefit analyses will not change that underlying reality.

Benefits: Discussion and estimates

Public transport travel time

Savings on public transport travel time is a conventional benefit and we have used the LGWM's estimate.

Public transport incremental fare

We do not know what this refers to and how it was derived. We have applied the rule: 'if you haven't disclosed it you can't count it' and applied a zero value.

Private Vehicle travel time

It is not clear that there will be a net benefit here. We understand that Customhouse Quay will be reduced to one car lane from the current two and three to accommodate the light rail line. This would seem to pose a risk of increased congestion but we did not see any reference to this possibility in the LGWM documents. Absent any relevant information we have reduced the LGWM's private vehicle travel time estimates by 50 percent.

Private vehicle reliability

We have used the LGWM estimate of this fairly inconsequential item.

Private vehicle operating costs

This reflects the reduction in vehicle use. We have used the LGWM estimate.

Safety benefits

We assume that the safety benefits are based on the reduction in car travel, which is not as safe as bus travel. The numbers look suspiciously high, because deaths and serious injuries in urban areas are not high. However, we have used the LGWM figures.

Environmental benefits

These benefits presumably primarily reflect the reductions in the social costs of carbon emissions. Based on our discussion in part four we have set this at zero.

Health benefits of walking

One of the biggest benefits is the health benefit of walking, which come to \$799 million in the intensified scenario. This might seem odd, as the point of the exercise is to encourage people to take public transport rather than to encourage walking. What seems to be going on here is that when people are encouraged to shift from their cars to public transport they get in some walking from their house to and from the public transport stop and then again from the public transport stop to their work. LGWM have added up these short strolls and calculated the health benefit for the distance travelled. In the Waka Kotahi methodology², the benefit is set at \$4.40 a kilometer. It is derived from an estimate of the value of a human life and the reduction in the deaths as people becoming healthier by walking. A maximum benefit of \$1250 per year is imposed.

The current \$4.40 per kilometer benefit from walking for everyone who converts from a car to public transport does not seem plausible, and it is not. The Waka Kotahi paper explains why.

Over 80% of the total deaths related to diseases associated with physical inactivity in New Zealand occurred in the age group of people aged 65 years and above. Excluding people aged 65 years and above resulted in the total benefits being reduced by almost 90%.

But the Waka Kotahi recommendation did not adjust for the fact that the target commuter group will be dominated by 18-65 year olds. The rationale was that their original 1991 study of the value of a statistical life did not adjust for age. Or the death of a 90 year old is as costly as the death of a 10 year old, which is at odds with all the analysis that uses the QALY (quality adjusted life years) metric. Being wrong historically is not a justification for continuing to be wrong but Waka Kotahi did not change, possibly under political pressure to deliver a methodology that generated high health benefits for public transport.

Our conclusion is that the health benefits from the walking associated with the MTR are tenuous. These are largely restricted to the over 65's who might use the

² HEALTH AND ACTIVE MODES IMPACTS A technical paper prepared for the Investment DecisionMaking Framework Review 11 MARCH 2020

MRT two or three times a week and the most inactive are unlikely to change their driving behavior just because light rail is available. And there also may be some diversion from walking to the MRT if it is more attractive and reliable, which could have a health disbenefit. We don't know where the exact balance lies but have reduced the LGWM estimate by 90 percent, which might still be a generous assessment.

Health benefits of cycling

We can think of no obvious reason why a MRT will encourage cycling and so secure the health benefits from cycling. Absent any explanation in the LGWM documents we have set this benefit at zero.

Agglomeration benefits

Agglomeration benefits normally refer to people becoming more productive due to larger networks etc. as cities become larger. It does not refer to people in those networks being more densely packed in their residences. Here LGWM does not seem to be very convinced by their own analysis. The aggregate results are presented with and without agglomeration benefits. As LGWM has not explained how their number was generated we have applied the no disclosure rule rule and set the value at zero.

A new Haitaitai cycling/pedestrian tunnel

A new Haitaitai pedestrian and cycling tunnel costing \$402 million is part of option four. As the investment is separable from the other elements in the option it can be evaluated on a stand alone basis.

The benefits are described, in qualitative terms, as follows:

Livability

Has some local urban amenity effects at tunnel portals. Does not enable intensification in the eastern suburbs.

Access

Improves access for walking and cycling

Mode Shift and Carbon

Improved mode share for walking and cycling. Lower levels of embodied carbon

Minor improvements to safety, particularly for pedestrians and cyclists

As the existing Mount Victoria tunnel already allows walkers and cyclists to access the city from Haitaitai the marginal benefits from the new tunnel will be small.

There might be a few motorists who currently drive to the city who would be induced to walk or cycle because using a dedicated tunnel would be a more enjoyable experience. The users of the existing path would also gain some utility.. But we doubt whether the present value of these benefits would amount to any more than, say, \$5-10 million.

The new Mount Victoria tunnel would be a terrible investment and would very likely be rejected by the public if it were presented as a stand alone project and they were provided with the relevant information. Instead it is bundled with the other investments in option 4 hiding the true economics. It also makes option 4 look worse relative to the more favoured option one.

Part six: The role of congestion charging

As Infracom noted, an assessment of a role for congestion pricing should be an essential part of the initial business case assessment. If congestion charging is the best option then it would be pointless to further pursue the development of option one.

Despite LGWM chief executive's statement that congestion charging was out of scope a report on the subject by PwC³ was commissioned and delivered in August 2021. This was basically a primer on the subject with a simple, illustrative, example of one possible congestion charging option.

While there were many caveats on the value of this modelling exercise it was concluded, just on the basis that the congestion charge reduced travel that:

Overall, the introduction or inclusion of congestion pricing can be seen to be complementary to the programme and will make a meaningful contribution to shifting the dial on some of the LGWM objectives.

LGWM seized on this rather slender piece in its June 2022 Options report.

³ Let's Get Wellington Moving Initial assessment of travel demand management (congestion) pricing
PwC

The conclusion in the PBC was that a combination of infrastructure investment, service improvement and travel demand management was required to maximise delivery on the overall investment objectives. That conclusion remains the same.

The thinking that congestion pricing is a complement rather than a substitute for the investment programme is unproven and probably wrong. While a congestion charge will further reduce private vehicle travel the same overall reduction in travel could, in principle, be generated by congestion charges with appropriately calibrated prices.

To illustrate. Suppose city A has a congestion problem with a present value cost of \$1 billion. It imposes a congestion charge (a **substitute** for a proposed infrastructure investment) with implementation and running costs with a PV of \$100 million. Private travel is reduced by 20 percent and gets rid of the congestion. The charge has reduced the relative price of public transport and so ridership increases. \$200 million is spent to enlarge the existing public transport fleet. This investment is complementary to the congestion charge, which is the driver of the congestion reduction. There is a welfare gain of \$700 million.

City B spends \$1 billion on infrastructure that only reduces private travel by 10 percent (the projection of a 20 percent fall turns out to be optimistic). There is still a \$500 million congestion problem. It then decides to impose a congestion charge, costing \$100 million, to **complement** the infrastructure investment. The congestion problem has been solved but there has been an overall welfare loss of \$100 million. City B \$800 is worse off than the city A .

City B rues the fact that it did not correctly analyse the problem and substitute the congestion charge for the investment in the first place.

References

LGWM 2022 Preferred Programme Options Report

LGWM Appendix A - Modelling Appendix

LGWM Appendix B - Economics Technical Report

LGWM Appendix C - Carbon Analysis Technical Report

LGWM Preferred Programme Options Report Peer Review

LGWM 2022 Infracom Memo

LGWM Let's Get Wellington Moving response to Infracom

PwC 2021 Lets get Wellington Moving Initial assessment of travel demand management (congestion) pricing

Waka Kotahi 2022 Vehicle Emissions Prediction Model: VEPM 6.3 update technical report Jayne Metcalfe & Serge Peeters

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