

SUCCESS AND FAILURE FACTORS IN ROAD CHARGING SCHEMES: INTERNATIONAL EXPERIENCE

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ABSTRACT

Revenue for road infrastructure in New Zealand has traditionally not come from road use charging. However, road charging schemes have been implemented around the world with varying degrees of success. Charging schemes are motivated by either revenue raising or demand management, or both.

Successful congestion charging schemes are operating in London, Stockholm and Gothenburg, but implementation failed in Manchester, which appears to have been due to a failure to effectively communicate goals and benefits. In contrast, humanising goals and the courage of decision makers to make tough decisions in Stockholm and Gothenburg has been effective. In Oregon, an innovative distance-based charging scheme is under trial as a complement to fuel taxation in the wake of reduced revenues from increasingly efficient vehicles.

With increasing use of more efficient vehicles, the traditional method of revenue raising through fuel taxation may become unviable. Leveraging off developments in mobile technology and accurate GPS makes intelligent charging systems a realistic alternative. It offers the possibility of both raising revenue through road charging and more accurate charging for the costs of road use to better reflect externalities. For charging schemes to succeed, visionary leadership, clear goals, humanised communication and investment in technology will be necessary.

INTRODUCTION

The objective of this study is to investigate a cross-section of road pricing and tolling schemes from around the world, focussing on the communication strategies which led to their success or failure, in order to educate the implementers of future New Zealand road pricing or tolling schemes.

In New Zealand the majority of revenue for roading infrastructure is generated from a combination of fuel taxation for petrol vehicles, road user charging for diesel vehicles and annual registration fees (NZ Transport Agency, 2016). Revenue from these funding sources is hypothecated for the National Land Transport Programme. There are also three operational toll roads, two in Tauranga and one north of Auckland, offering an alternative to an existing inferior route. Revenue from these toll roads repays the cost of their construction.

The schemes investigated span a cross section of types of road charging schemes from simple tolls through to distance based charging schemes, and focusses on some notable successes and failures. The methodology, motivations for implementation and communication strategies employed in each of the schemes was investigated via interviews with those involved. A list of key sources and contributors is provided at Appendix 1 and the schemes are summarised below:

- The Auckland Road Pricing Investigation (2015)
- The Oregon Road Pricing Trial (2001-2015)
- Greater Manchester Congestion Charging Referendum (2008)
- The London Congestion Charge (2003-2011)
- The Nottingham Workplace Parking Scheme (2012)
- The Stockholm and Gothenburg Congestion Taxation Schemes (2006 & 2013)
- The Sydney Harbour Bridge Toll (2009-2015)

WHY CHARGE FOR DRIVING?

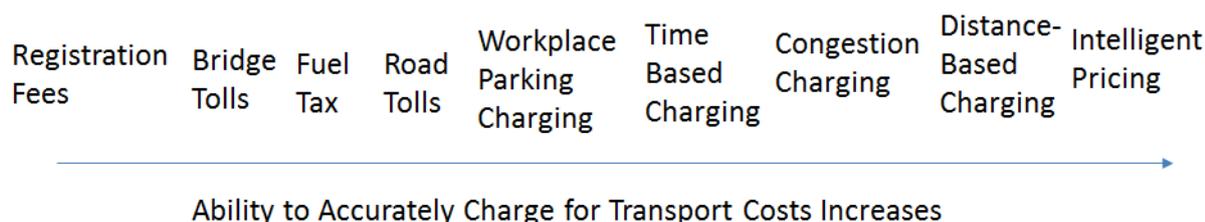
Charging for driving is not a new concept. For example, in the UK, turnpike trusts were established in 1706 to administer and toll users of non-urban roads in order to pay for their maintenance. (O'Flaherty et al, 2002). Petrol taxation was established in Oregon, USA, in 1919 (Oregon, 2015). The first congestion charging scheme, the Singapore Area Licensing Scheme, was set up in 1973.

In some places, often associated with bridge construction, tolls repay the cost of the infrastructure. By contrast, petrol taxation is often intended to pay for generic road infrastructure (or transport infrastructure more generally), while congestion charging schemes often focus on demand management. Motivations for charging schemes broadly fall into two purposes: either revenue generation, or demand management (or both).

TYPES OF ROAD CHARGING SCHEMES

If charging schemes are regarded as a form of taxation, and it is assumed that everyone in society should be free to travel wherever they want, then charging schemes can be visualised on a continuum of taxation from the most crude to the most able to reflect differing costs and benefits of road usage, with the charges broadly becoming more progressive as they become more sophisticated¹. This continuum is illustrated and discussed below.

¹ For charging schemes a regressive charge would apply equally regardless of distance travelled or fuel consumed, thereby penalising lower users proportionately more. A progressive charge would increase in proportion to usage.

Figure 1 Continuum of Ability of Road Charging Schemes to reflect Transport Costs**Registration Fees**

This a simple, one charge for all payment system usually paid annually per vehicle. It is regressive and is often combined with fuel taxation as a revenue source.

Bridge Tolls

A bridge toll is a very simple form of taxation, since (assuming in most cases the alternate route is an infeasibly long diversion) there is no choice but for drivers to pay the toll, and it is also partly regressive since the cost is same regardless of efficiency of vehicle and length of trip as a whole.

Fuel Taxation

Fuel taxation is paid by all drivers and is a more progressive form of taxation since the more a driver uses the vehicle, the more they pay, (noting that the tax is applied by volume of fuel, so that a more efficient vehicle pays less to travel the same distance, and that in some jurisdictions different fuels attract different tax levels). Its global usage reflects the simplicity of its implementation, but it fails to capture many location and time related costs of driving.

Road Tolls

Road tolls are theoretically progressive since the penalty on the driver increases with usage. In New Zealand, however, current legislation dictates that an alternate route is provided, which allows for greater choice. This has the flip side of penalising a lower income driver, since they would not have the perception of choice which a higher income driver would.

Workplace Parking Charging

Workplace parking charging targets those imposing the greatest cost on the transport system (under the assumption that workers mainly travel at peak), but it is a crude and indirect measure which fails to successfully reflect, for example, shift work for which driving off-peak has a lower burden on the roading network. Requiring employers to pay the charge rather than employees also means the link between costs and payment for them is weak.

Time-based Charging and Congestion Charging

Time-based charging and congestion charging systems are a further step along the continuum since they penalise driving at times or in places where the transport externalities are high. By definition these systems offer alternatives; either cheaper travel at a different time, or use of a public transport system in city-based congestion charging schemes.

Distance-based Charging

Distance based schemes are the most intelligent currently available form of road charging. They record distance travelled rather than fuel used². Some systems leverage off recent developments in GPS technology, thereby having the potential to replace or complement fuel taxation and

² In New Zealand Road User Charges for diesel vehicles are a simple form of distance-based charging.

equitably charge for usage of the network regardless of vehicle selected.

Intelligent Pricing

Uniquely amongst the schemes summarised above, a distance-based scheme has the potential to evolve into a truly intelligent road charging system, which in an idealised scenario would accurately reflect costs, including time of travel, location of travel, distance travelled, volume of fuel used, type of vehicle, and even risk factors associated with a particular driver, reflecting on their driving history, and likelihood of them imposing a cost on society by causing a crash.

ABILITY OF ROAD CHARGING TO REFLECT EXTERNALITIES

In addition to maintenance costs discussed above, usage of transport infrastructure incurs other costs, some of which are difficult to evaluate and may not be borne by the road user directly but by society as a whole. The Economic Evaluation Manual (2016) (EEM) sets out costs and benefits of transport schemes and defines other impacts of transport schemes which cannot be monetised. Those impacts which are not directly borne by the transport user (as travel time would be, for example) are commonly known as externalities. Examples include community severance, noise, and ecological impacts.

Methods have been developed for evaluating some of these environmental impacts. In many cases, they are difficult to monetise, and in some cases, for example vehicle emissions, the limitations of the monetisation procedure are clearly set out in the EEM.

Some road pricing schemes have environmental goals. Congestion charging schemes for example have the potential to make users pay for (and by disincentivising travel, even lessen) a number of the externalities of transport, particularly those caused by or exacerbated by congestion such as isolation, severance, noise, and vibration. Because externalities are by definition difficult to monetise and are poorly understood by the general public, communicating the link between the fees associated with a road pricing scheme and its environmental benefits will be challenging. While it is attractive to communicate a road pricing scheme as a tool for congestion relief, this is in fact communicating only one of the many costs of road transport which pricing schemes have the potential to mitigate.

SCHEME OVERVIEW

A brief summary of the schemes discussed in this paper and the success of the scheme in terms of its survival is provided below.

Table 1 Summary of Schemes studied

Location	Type of Scheme	Primary Motivation for Scheme	Year Implemented	Successful?*
Auckland	Motorway Charging	Revenue for specific infrastructure	Development 2015	-
Oregon	Distance-based charging	General roading revenue	Trial 2015	-
Greater Manchester Congestion Charge	Congestion Charge	Revenue for specific infrastructure	2008	Failure
London Congestion Charging Scheme	Congestion Charge	Congestion Relief	2003	Success
London Congestion Charge Western Extension	Congestion Charge	Congestion Relief	2007-2011	Failure
Nottingham	Workplace	Revenue for specific	2012	Success

Workplace Parking Scheme	Parking	infrastructure		
Stockholm Congestion Tax	Congestion Charge	Congestion Relief	2006	Success
Gothenburg Congestion Tax	Congestion Charge	Revenue for specific infrastructure	2013	Success
Sydney Harbour Bridge Time-Based toll	Toll	Congestion Relief	2009	Success

*Scheme's survival, not a reflection of the success of the objectives of the scheme.

INDIVIDUAL SCHEME SUMMARY

Auckland

Auckland Council is leading a discussion on methods for funding a step change in transport infrastructure. Conversations on how to fund Auckland's infrastructure have been ongoing since around 2012 when a consensus building group (later known as an independent advisory group) was established by the Office of the Mayor of Auckland with an independent facilitator hired, to workshop options for funding and how to consult on them. In late 2014 the council asked the public two key questions on options for funding future transport infrastructure in Auckland:

1. Is the public happy with a basic level of infrastructure, (making it clear that to achieve a bigger package of transport improvements, including fast-forwarding a significant rail expansion, would require additional payment from the public).
2. Assuming the public wished for a bigger package of measures, how would the public prefer to pay for this measure; through higher rates (taxation on residents) and fuel taxation, or through motorway charges?

The response was a vote in favour of a bigger package of transport improvements, funded by motorway charges as cited in Auckland Council (2015). However, despite this mandate, Auckland Council elected not to immediately progress motorway charges. Legislative and technical changes would be necessary to implement a motorway charging system, and more time was necessary to confirm the programme with central government. Auckland council instead elected to implement an interim transport levy (rates increase) for the next three years to fill a funding gap and form an accord for delivery with central government.

Key Success/Failure Factors

- Strong political and visionary support for funding scheme from mayor of Auckland.
- The choices in the scheme were clearly communicated. The public understood that there was no alternative but for citizens to pay over and above normal city rate charges for the city to continue to thrive and develop in the short term.
- The motorway charging scheme was promoted as a revenue raising tool, however, messages of additional benefits associated with charging (eg congestion relief) were also raised in the consultation material.
- Collaboration with community representatives was strong during the development of the scheme. The collaboration and consensus was so successful that the Office of the Mayor believe that there is a groundswell of belief amongst Aucklanders that it was their idea for road pricing and they have taken ownership of the concept.
- Council implied that the public vote would dictate the charging mechanism employed: while a motorway charging scheme was favoured by voters, the Council then were forced to announce that an interim transport levy on rates would be necessary (at least partially since the motorway charging scheme is technically illegal).
- The delay in implementing the charging scheme despite mandate from the consultation could be construed as a u-turn from the Council who could be criticised for not following

through on promises. Three years could be too long a period to wait after a consensus was built. As James Bews-Hair stated: *“There’s a shelf life for a consensus”*.

Oregon, USA

Oregon is at the forefront of addressing a worldwide challenge in funding for road use. Currently each state levies both a federal and state gasoline tax component of fuel tax, which is hypothecated for transport infrastructure. However, the fuel tax rate has not been increased since 1993. With increasingly fuel efficient cars, revenues are not keeping up with vehicle distance travelled. There is a recognition within the Oregon Department of Transportation that the current fuel taxation system is becoming unsustainable, and also that it is inequitable since the most efficient vehicles are permitted to exert proportionately more wear and tear on the road, contribute to congestion and safety risks while contributing less through fuel taxes to measures to address these externalities. Oregon is also perceived as a free-thinking, environmentally conscious state which is a good place to develop completely new concepts.

A Road User Fee Task Force (RUFTF or RUFTUF) was implemented in 2001 to come up with ideas to combat this increasingly significant problem. The outcome was a distance-based charging trial which was implemented from 2006/7. New legislation in 2013 allowed implementation in 2015 for volunteers.

Participants who join the scheme choose a method to record their distance travelled, either a provider to install a GPS device, daily diary or odometer device. Then vehicles are either reimbursed³ (in the case of inefficient vehicles) at the fuel pump for the excess fuel charge they have paid, or charged more (in the case of efficient vehicles such as hybrids) to reflect the other costs they impose on the roading network but which they have underpaid through fuel taxation. At present the system is voluntary and has around 1000 participants.

45% volunteer users drive high MPG (efficient) or electric vehicles, despite having to pay extra. It is believed this is because these users are sympathetic to the view that they should pay equitably for road use, and also value the driving usage metrics offered by joining the system.

A Western Road User Charging Group was developed in 2013 involving 13 states predominantly in the west of the USA. It is anticipated that California will be the next of this group to implement a trial scheme.

Key Success/Failure Factors

- A visionary leader (James Whitty, Manager, Office of Innovative Partnership Programs) was specifically appointed to manage the scheme in 2001.
- New technology (GPS tracking) enables a new way to record distance travelled.
- Strong political advocates in the senate have backed the scheme.
- The main challenge has been overcoming privacy concerns. The GPS-based nature of the scheme means that it is possible that the state could know where drivers have been travelling (there appears to be an inherent distrust of state officials). To protect data from being publicly discoverable, other distance tracking options are offered and private companies have been used to host data.
- Not a purely penalty based system; replaces fuel taxation
- Oregonians see themselves as free-thinking innovators.
- Oregon (especially the cities of Portland and Eugene) is a traditionally politically left-leaning state, although the rural areas tend to be more politically right-leaning.
- Politically, the scheme is appealing to both sides of the political spectrum. Democrats like taxation methods of raising revenue and perceive this to be a taxation scheme. They also find the way that it evens out inequalities to be appealing. Republicans like the system

³ This reimbursement system is unusual – most charging schemes will take payment rather than pay back.

because it is not regressive (ie, fees paid directly relate to use). Also, Republicans tend to prefer user fee systems to taxes (and perceive this to be a user fee).

- The communications strategy focussed on personalising the benefits of the system while also educating volunteers on the costs which driving imposes on the roading network.

UK

The UK Government passed the Transport Act in 2000 permitting road user charging (DfT (2000)). This legislation was the catalyst underlying the three UK examples explored in this paper. It permitted organisations employing road user charging or workplace parking charging to access the Transport Innovation Fund to implement infrastructure improvements. Currently, revenue from transport (fuel tax, registration etc) is not hypothecated for transport in the UK.

London

In 2003 a congestion charging scheme was implemented in central London using Automatic Number Plate Recognition (ANPR), a cheap implementation system. The scheme was successful in reducing congestion in a limited geographic area of central London. Revenue was used to implement a number of public transport improvements. The scheme was implemented by a left-wing mayor with the congestion charge in his manifesto, under a left-wing national government but has continued to be supported by both succeeding right wing mayor and central government.

The original congestion charge was £5 per day, raised to £8 in 2005, £10 in 2011 and again to £11.50 (around NZD \$25) in 2014

Subsequently, a western extension to the scheme was implemented, approximately doubling the size of the scheme. This scheme was implemented between 2007 and 2011 by Ken Livingstone, a left wing mayor under a (left-wing) Labour Government but was subsequently removed under the new right wing Conservative government and new right-wing mayor.

Key Success/Failure Factors

- The initial scheme was pushed through rapidly in one political cycle.
- There was already excellent public transport in place with additional services implemented in support of the scheme.
- The case for a western extension does not appear to have been well supported and while mayor Ken Livingstone implemented it, the subsequent London Mayor (Boris Johnson) felt that the mandate for maintaining it was not present.
- The incoming Conservative government in 2010 used language along the lines of “the war on the motorist is over” (Daily Mail, 2010) to describe a shift away from policies discouraging motoring and supporting road user charging. The western extension may well have been a victim of a change in government rather than evidential base.
- The wider benefits of the congestion charging scheme in terms of congestion relief have since been diluted by growth.

Manchester

After the success of the London Congestion Charging scheme, other parts of the UK investigated implementing their own schemes⁴. The Greater Manchester Passenger Transport Executive (GMPTE) proposed a congestion charging scheme in the mid 2000s in order to fund significant infrastructure improvements, including new tram routes.

The concept was a “tipping point”, ie that Manchester had been growing rapidly, but that with too much growth eventually a tipping point is reached whereby congestion stifles further growth.

⁴ A congestion charging scheme was also subject to a failed referendum in Edinburgh in 2005.

The Manchester system involved two cordons – the first being around the City Centre and the second around the M60 with graduated zonal charging as each cordon was crossed. A typical 2 zone trip into the city centre would cost around £5 (approximately NZ \$10). Because of the wide cordons a large proportion of people would be affected by the system. ANPR was to be used.

GMPTE campaigned in favour of the congestion charging scheme, and there was also dedicated and organised opposition to the proposals. A referendum was held in 2008 with an 80% no vote. Although the referendum was not binding the scheme was not progressed further.

Key Success/Failure Factors

- The focus was on the public transport benefits which would be gained through the scheme, but since the key improvement was tram links, this only resonated if someone lived near a new line. Although there were significant bus investments, these were often dispersed and it was difficult to link them in the communications with the congestion charge.
- There was political buy in to the scheme from across the Greater Manchester council.
- There was a view that the time savings associated with the congestion charge and PT improvements were subjective, and that they could not be used as a communication tool. The potential benefits of the scheme therefore appear to have been undersold.
- The goals of the scheme also do not appear to have been clearly communicated – were they to fund infrastructure or to combat congestion?
- Subsequently, the tram extensions which were apparently dependent on the congestion charge have been implemented. It will be difficult to implement a similar charging scheme again in Manchester since residents now have evidence that congestion charges are not necessary to deliver infrastructure.
- Once a referendum was chosen, it appears that the scheme's failure was sealed.

Nottingham

The Nottingham Workplace Parking Charging Scheme is the only use of the Transport Innovation Fund (TIF) which the Transport Act (2000) set up. Nottingham had in 2004 implemented stage one of the Nottingham Express Transit (NET) tram network between the suburb of Hucknall and Nottingham City Centre. This was successful and popular and there was a desire to progress a second phase but at that point government funding was limited.

The TIF provided funding for public transport schemes if an authority was prepared to employ some form of pricing measure. Parking was acknowledged as one way of addressing both demand concerns and need for revenue which was felt to be less draconian than congestion charging. The levy was therefore intended to pay for the NET line two south to QMC, and Toton, and other improvements, including the Nottingham Station upgrade and bus improvements.

The workplace parking charge was a manifesto pledge of the Labour Party holding the balance of power in Nottingham City. Therefore once elected, the city had an election mandate to proceed. Scrutiny and feedback of proposals was permitted, but not a vote.

The City Council levies large employers (>11 employees) per parking space provided. The current fee is £379 (around NZD \$850) per annum per space. The employer can then decide what to do with the charge. Some employers choose to pass the charge on, some employers removed spaces and some employers absorbed costs. The result of this was:

- a) Revenue to be used for new Nottingham Station hub and NET Line two.
- b) Limited modal shift benefits

The second NET line was 75% government funded (TIF) and 25% levy-funded (25% Private Finance input will be repaid by the levy). It opened in 2015.

Key Success/Failure Factors

- Nottingham had historically been successful at attracting investment and had a history of trying out new techniques, eg the “Cap and Collar” in the 1970s (collar was the ring road), and a Park and Ride strategy.
- The system is easy to understand and simple to implement – it also allows employers to choose how or whether to pass on charges.
- There was already a significant volume of long-stay parking in the city
- The communication was clearly linked to the delivery of the second stage of the tram.
- Council’s message was that they had an election mandate to implement workplace parking charges and they could therefore **tell** the public rather than ask the public for permission
- Referenda were **chosen** in Edinburgh and Manchester. Nottingham **chose** to have no referendum.

Sweden

Swedish legislation does not permit tolls except for on new infrastructure. However, taxes to reflect costs (eg congestion costs) are permitted, hence the taxation schemes charging for congestion in Stockholm and Gothenburg discussed in this paper. All congestion taxation and tolling systems in Sweden are state-owned. Users incurring costs under the taxation systems are invoiced for their tax bill three months after they incur the costs.

The project of implementing the congestion tax system in Gothenburg and Stockholm is a joint cooperation between the Swedish Transport Agency and the Swedish Transport Administration⁵. Congestion tax is not hypothecated for transport although in Gothenburg it is likely to be spent on the West Swedish Agreement (see below).

Stockholm

In Stockholm there was an aspiration to reduce congestion. Other ideas to reduce congestion were investigated but not progressed, eg removing parking. The concept for a tax came from the City of Stockholm, supported by politicians. The Green Party were advocates for the scheme and as the support partner for the Social Democrats, congestion taxes were a deal-breaker for their support. As the City of Stockholm couldn’t tax inhabitants of other cities, central government (the Swedish Road Administration) managed the system and the congestion tax concept emerged.

An ANPR system with cordon charges was implemented. This was simple in Stockholm because the city is built on a series of islands, meaning limited street infrastructure which is easy to cordon. Data is collected and stored by the government.

The scheme was clearly targeted as congestion relief, with revenue was a side benefit. The communication message was personal: *“Tomorrow you will have less competition going to work”*.

The decision to implement was taken in around 2002 and implemented for a trial in 2006. In the same year, after implementation, a referendum resulted in Stockholm city voting in favour (56-57%) while surrounding communities voted in opposition. The referendum was not binding, and the City of Stockholm elected to continue with the scheme. Generally the system and its goals to reduce congestion and improve the environment are both successful and widely supported.

Capturing foreign vehicles with differently formatted number plates is a big challenge for the system and ongoing discussions with neighbouring states will continue. The future of road charging schemes could be in-car electronics (phone technology could be bypassed). While ANPR is cheap to implement it is limited, particularly with regard to capturing foreign drivers.

⁵ The Swedish Transport Agency is responsible for rules and regulations in transport while the Swedish Transport Administration is the delivery arm for transport in Sweden.

After implementation, traffic levels declined by 18-20%. However, recently traffic growth has reduced the effectiveness of the tax. Future plans for the system include:

- a) Expansion of the Stockholm subway
- b) Increased prices for congestion tax to combat growth (Current prices are 10-20 SKR or around NZD \$1.80-\$3.50 depending on travel time)
- c) New tax on Essingeleden through road⁶. Most traffic is local. Planned tax levels for this through road will be lower than for traffic entering the city.

Key Success/Failure Factors

- Additional public transport services were added with the congestion tax.
- Support for taxation concepts seems to be high in Sweden.
- Trust of the state appears to be high; a prerequisite of the system is that it is managed by the state, not by a private company because of the trust of the state.
- Revenue goals appear to be unimportant in Sweden but the public responds well to environmental goals.
- Stockholm has a left-leaning government, with a strong green component.

Gothenburg

Following the successful implementation of the Stockholm Congestion Tax, the city of Gothenburg planned to implement a congestion tax in the city of Gothenburg with a triple goal of:

- a) Improving Accessibility
- b) Improving the Environment
- c) Part-financing the West Swedish Agreement

The West Swedish Agreement is an infrastructure plan for the western coast of Sweden which includes, amongst other goals, a plan to provide a through rail connection from the congested rail terminus in Gothenburg and a new road tunnel. The 25 year duration of the West Swedish Agreement implies that the Gothenburg congestion tax will end after 25 years.

Communications were clear that the money would be used on projects as part of the West Swedish Agreement. This was unpopular to start with, with questions about whether/why schemes were necessary (particularly the rail scheme).

The congestion/accessibility goal is to reduce peak travel by varying charges by time. As well as being a congestion tax, charges are time based with penalties for travelling at peak times, and free travel at evenings and weekends. Charges vary from 9-22 SKR or around NZD \$1.50 - \$3.80.

The scheme was implemented in 2013 using an ANPR with cordons. A referendum was held due to a citizens' initiative after implementation resulting in a slight "no" to the congestion tax. The referendum is not binding and there are currently no plans to abandon the scheme.

The scheme has resulted in around a 20% reduction in traffic at peaks, with additional reductions in non-charging times. Public transport patronage has also increased by between 13-18%.

Key Success/Failure Factors

- Despite being an additional charge, it was marketed as being beneficial.
- It is not felt to be a tax on the poor, but a fair, controllable tax. Eva Rosman: "Tax isn't

⁶ Essingeleden is currently the only untaxed through road through Stockholm. The diversionary route is around 200km. IPENZ Transportation Group Conference, Auckland 7 - 9 March 2016

about social inequality equalisation... but this is only true in the context of the strong Swedish social welfare system.”

- Gothenburg is traditionally a place which is a “car city” – cars are imported in Gothenburg.
- Has experienced less public acceptance (so far) than the Stockholm system. There is scepticism particularly about the need for rail schemes which are part of the West Swedish Agreement, but not the road tunnel which is also part of the West Swedish Agreement.
- There are ongoing problems in charging foreign-registered vehicles. Many of these need to be manually processed and invoiced.
- The communication strategy was personalised: *“How will it affect me and my daily life?”*
- Huge efforts were exerted to ensure the scheme was ready to start operation on day one. Therefore technical problems were largely eliminated prior to the scheme start.

Sydney Harbour Bridge Time of Day Tolling

Sydney has a number of toll roads. Most of them are privately run and linked to repayment for infrastructure. The exception is the Sydney Harbour Bridge and Sydney Harbour Toll Tunnel, which are tolled southbound only via e-tolls with funding collected by government. Funding is not hypothecated for transport but contributes to the consolidated roading fund.

In 2009 time of day tolling was introduced on the Sydney Harbour Bridge in order to spread the peak (due to limited bridge capacity). There was an existing toll on the bridge, but peak tolls increased, while shoulder peak tolls were reduced to encourage peak spreading. As there was an existing toll on the bridge, the charging step up at peak time needed to be enough to change behaviour. The modelling found that behaviour was not that sensitive to price change **because it was already tolled**. A step of around \$1 is currently used.

An intensive 6 month programme of communications, including signs, ministerials, media, radio, VMS signage. The most effective communication method was backending advertorials onto radio traffic updates. The system was introduced during January, the quietest month.

The scheme successfully effected peak spreading. However with traffic growth over time it has become less effective, so it may be necessary to increase the peak charges again.

Key Success/Failure Factors

- All toll roads, apart from the Sydney Harbour Bridge and Sydney Harbour Toll, have alternative free roads.
- The Harbour Bridge and tunnel toll revenue is the only state revenue for infrastructure. All other funding is federal.
- There is evidence supporting the extension of toll schemes after their concession period. For example, on the M4 Motorway, the toll was taken off after the concession ended. Subsequent growth meant that widening was required, so now a toll is to be reinstated.

IS REVENUE OR DEMAND MANAGEMENT A BETTER MOTIVATOR?

It is difficult to be sure whether revenue or demand management is a stronger motivator. However, it seems if the ideology of demand management resonates, it is more successful motivator than revenue generation which the public may feel is an endless bucket of money to be tapped. Mixing motivations can be problematic, (as demonstrated in Gothenburg as compared with Stockholm).

- Where revenue is hypothecated for transport (New Zealand, USA) it is easier for decision makers to link revenue with infrastructure in communication.
- Without public support for infrastructure promised as a result of revenue generation the scheme is unlikely to succeed.
- If the public do not believe that funds will be used for the infrastructure promised then the

scheme is unlikely to succeed.

- If a tolling scheme fails and the infrastructure is constructed anyway it will be difficult to regain trust. (Manchester, Auckland)
- A focus on environmental goals with a secondary benefit of infrastructure appears to be a successful strategy where implemented. (Stockholm)
- Effectiveness of schemes diminishes over time (London, Sydney, Stockholm). It is necessary to monitor and adjust pricing accordingly.

WHAT ARE THE BEST COMMUNICATION TOOLS?

- Schemes are often driven by left-wing governments. With a focus on the progressive nature of pricing schemes, they can also be appealing to right-wing governments.
- The product must be tailored to the market. The requirement for private management in Oregon runs counter to the requirement for public management in Sweden.
- Open communication of the benefits of a scheme is essential. The Swedish schemes have been successful at humanising their messaging and making the benefits of the scheme relate directly to people's own experiences. Oregon has had similar success on a smaller scale at communicating the costs of driving more clearly. In contrast, where goals are unclear success levels are lower. (Manchester)
- Asking "*turkeys to vote for Christmas*" in Manchester did not succeed. Other schemes have demonstrated that asking is not necessary, and buy in can be achieved after implementation. This is particularly true where the scheme is perceived to penalise rather than reward drivers. (Nottingham, Manchester, Stockholm, Gothenburg)
- Technology working is a prerequisite. The Gothenburg and Oregon schemes invested heavily in the upfront technology, and there is evidence to suggest that the value of quality software provided in Oregon has outweighed monetary investment.
- In Auckland messaging made it clear that citizens had Hobson's choice – ie they would have to pay, one way or another. The public voting in favour of motorway charging reflected this clear messaging. (Auckland).
- A history of free thinking, political leadership and a willingness to be bold and make tough decisions appears to link successful schemes. (Nottingham, Oregon, Stockholm)

CONCLUSIONS

Ultimately any move towards charging for road usage will be a step towards a fairer pricing system which better reflects externalities. This is particularly true of those schemes which target travel at times and in locations which impose a greater social and environmental cost. While this is a motivation and success factor in some parts of the world (eg Stockholm), the primary motivation for most charging schemes will continue to be to generate revenue in order that a high quality of infrastructure provision can be maintained and enhanced.

With the increasing use of more efficient or electric vehicles, the traditional revenue source (fuel taxation) is likely to become less reliable, and the burden of payment for all costs of road use will unfairly shift towards drivers of less efficient (typically older and cheaper) vehicles. A road charging scheme could prove to be a fairer long-term replacement or complement to fuel taxation.

Recent advances in mobile technology and GPS accuracy make more equitable charging schemes an increasingly real possibility which have the potential to go some way towards making payment for road use more closely match costs. However, this will not be possible without clear goals, humanised communication and unambiguous links between the scheme and rewards to ensure public support. NZ's hypothecated road transport fund places it in an advantageous position for ensuring links between revenue and schemes can be used as a positive communication tool.

APPENDICES

Appendix 1: Key Contributors

Scheme	Interviewee	Organisation	Date
Background Research into Distance-based charging	Arya Malek	New Zealand Transport Agency	10 July 2015
Auckland Plan transport network	Joshua Arbury	Auckland Council	10 July 2015
	James Bews-Hair	Office of the Mayor of Auckland (OMA)	12 August 2015
Orego	Tom Fuller	Communications Manager, Oregon Department of Transportation	28 October 2015
	James Whitty	Programme Director, Oregon Department of Transportation	29 October 2015
Greater Manchester Congestion Charging Scheme	Nick Benbow	Systra, Manchester	3 November 2015
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