INFRASTRUCTURE

DRIVING CHANGE

How Road Pricing Can Improve Our Roads

Matthew Birchall
Foreword by Oliver Hartwich

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About the New Zealand Initiative

The New Zealand Initiative is an independent public policy think tank supported by chief executives of New Zealand businesses. We believe in evidence-based policy and are committed to developing policies that work for all New Zealanders.

Our mission is to help build a better, stronger New Zealand. We are taking the initiative to promote a prosperous, free and fair society with a competitive, open and dynamic economy. We are developing and contributing bold ideas that will have a profound, positive and long-term impact.

ABOUT THE AUTHOR

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A historian by training, Matthew's writing on the British Empire has been published in the *Journal of Global History* and *Global Intellectual History*. He was awarded the Royal Historical Society's prestigious Alexander Prize in 2021 for the best scholarly article based upon original historical research.

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Foreword

As an economist, I have long been a proponent of road pricing. How could any economist not be?

Road pricing is a simple idea, grounded in basic economic principles, that has the potential to revolutionise how we manage and fund our transport infrastructure. Yet, despite its clear benefits, road pricing has often struggled to gain political traction. The public resistance to the idea, fuelled by misperceptions about fairness and fears of increased costs, has been a formidable obstacle.

This is why Matthew Birchall's new report *Driving Change: How Road Pricing Can Improve Our Roads* is such a timely and important contribution to the debate. It presents a compelling case for comprehensive road pricing reform in New Zealand and charts a pragmatic path forward, drawing on international best practices and innovative thinking to overcome the political hurdles that have stymied progress in the past.

At the heart of the report is a recognition that the status quo is no longer sustainable. New Zealand's transport system is at a crossroads, buckling under the pressure of chronic underfunding, mounting congestion and a looming revenue crisis.

The current fuel excise duty model, long the backbone of transport funding, is increasingly unfit for purpose in an era of electric vehicles and evolving mobility patterns. A fundamental rethink is needed, and road pricing offers a powerful solution.

The economic rationale for road pricing is clear. Directly linking charges to road use ensures that those who use the roads the most (and impose the greatest costs through congestion and wear-and-tear) pay their fair share. It sends clear price signals encouraging more efficient use of scarce road space, reducing congestion and unlocking productivity gains. It also provides a stable, sustainable revenue stream to fund much-needed infrastructure investments.

But as Matthew rightly notes, the economic elegance of road pricing has often run headlong into the messy realities of politics. Fears about privacy, concerns about equity and a deep-seated belief that roads are a "public good" that should be free to use have all conspired to block necessary reform. It is a frustrating reality for economists, who see the clear benefits of pricing but struggle to translate that into public acceptance.

This is where Matthew's report truly shines. It takes on these political challenges head-on, drawing on a wealth of international evidence to debunk common myths and misconceptions about road pricing. It shows how privacy concerns can be addressed through robust data protection safeguards, how equity can be enhanced through phasing out the current regressive fuel tax, and how the "user pays" principle is widely accepted in other domains.

But perhaps most importantly, the report offers a pragmatic, staged approach to implementation designed to build public trust and support over time. By starting with modest charges, investing the revenues in visible transport improvements and gradually phasing in more sophisticated pricing over time, Matthew argues that New Zealand can achieve a smooth, politically sustainable transition to a comprehensive road pricing system.

As someone who has long championed road pricing, I find this approach both compelling

and refreshing. Too often, the perfect has been the enemy of the good when it comes to transport reform. By embracing an incremental, adaptive approach that responds to public feedback and builds on success, Matthew Birchall offers a realistic roadmap for change that policymakers would be wise to follow.

I wholeheartedly commend this report to anyone who cares about New Zealand's transport future. It is a clarion call for reform grounded in rigorous analysis and innovative thinking. And it gives me renewed hope that, with the right approach, we can finally unlock the transformative potential of road pricing and build a transport system that is fit for the 21st century.

Dr Oliver Hartwich
Executive Director, The New Zealand Initiative
Wellington, June 2024

Executive Summary

New Zealand's transport system faces significant challenges. Congested roads, potholes and a looming funding crisis threaten the very foundations of our network. The current fuel excise duty (FED) model is no longer fit for purpose and is unable to keep pace with the growing demands placed on our roads. It is time for bold action and fresh thinking to put New Zealand's transport network back on track.

This report proposes an innovative solution: a comprehensive, distance-based road pricing system called Smart Road User Charges (Smart RUC). By taking advantage of cutting-edge technology and drawing on international best practices, Smart RUC represents a paradigm shift in transport funding, offering a fairer, more efficient and more sustainable way forward.

Under Smart RUC, all vehicles would be subject to distance-based charges, with rates varying based on factors such as vehicle type, weight and time of day. Road users would have the choice between an automated "pay-as-you-drive" (PAYD) system, using in-vehicle technology to track road usage or a pre-purchase RUC license, similar to the existing diesel RUC system. This flexible approach ensures that all road users pay their fair share while respecting individual preferences.

The transition to Smart RUC would occur gradually over a five-year period, with FED being phased out as RUC rates are progressively increased. Key milestones include mandating electronic distance recorders for all new vehicles, launching public awareness campaigns, establishing partnerships with RUC service providers and fine-tuning rates to ensure a sustainable funding stream.

As the Smart RUC system matures, control over rates would ideally shift from the government to independent road managers, operating under a robust regulatory framework. This would promote long-term stability, efficiency and accountability in transport funding. A contestable market for RUC service provision would drive innovation and create a more user-focused approach, offering motorists tailored products and services.

Crucially, Smart RUC would incorporate best-in-class privacy and data protection safeguards. Drawing on the experiences of jurisdictions like Singapore and Oregon, the system would operate on the principle of data minimisation, collecting only the information essential for charge calculation and system operation. Strict access controls, regular audits and robust legislative protections would ensure that road users' personal information remains secure.

The report also addresses common myths and misconceptions surrounding road pricing. Far from being an untested or technologically infeasible idea, road pricing has a long and distinguished pedigree, with roots stretching back to Adam Smith and real-world successes in places like Singapore, Japan and Stockholm. These examples demonstrate that road pricing can deliver tangible benefits, from reduced congestion and improved network performance to more sustainable infrastructure funding.

Moreover, concerns about social equity and fairness are often overstated. Evidence suggests that road pricing can be progressive, benefiting low-income households by reducing transport costs and improving access to employment and services. Smart RUC would also replace the current regressive FED, ensuring that all road users pay based on their actual usage and the associated costs they impose on the network.

This report presents a compelling case for introducing Smart RUC in New Zealand. By embracing the opportunities of technology and drawing on international best practices, we can create a transport funding system that is fit for the 21st century. The road ahead may be challenging, but the destination – a fairer, more efficient and more sustainable transport network – is well worth the journey.

INTRODUCTION

Road to Reform

New Zealand's transport system has veered off course. Congested roads in our major cities and potholes on our state highways are just some of the challenges Kiwi drivers encounter daily. Our transport infrastructure is struggling to keep up with the growing demand placed upon it, leading to increased travel times and frustration for motorists. In Auckland, the average commuter spends 5 days per year stuck in traffic – that is a full work week spent staring at brake lights.[1]

But the costs of our transport woes extend beyond mere inconvenience – as frustrating as those traffic jams can be. Congestion takes a toll on our economy, our environment and our quality of life. Businesses lose money when goods and workers are stuck in traffic; carbon emissions rise as vehicles idle on crowded motorways. And time spent commuting means less time with family and friends.

Compounding these challenges is a looming funding crisis. The NZ Transport Agency Waka Kotahi, the Crown entity responsible for managing the land transport network, faces a significant funding gap. Over the next decade, the Transport Agency estimates it will need to invest about twice as much as it expects to receive in revenue, resulting in an annual shortfall of around $4 billion to $5 billion.[2] The magnitude of this funding gap raises urgent concerns about the viability of the revenue model that helps pay for New Zealand's roads, rail, public transport and other essential transport services.

It is time to change gear. This report shows how road pricing can help New Zealand create a more efficient and rational transport system, addressing the challenges of congestion and the pressing need for a more sustainable funding model. Road pricing – a system where road users pay charges based on mileage, time of use and vehicle type and weight – can encourage more efficient use of the transport network, alleviate congestion and provide a fair and stable source of revenue for transport infrastructure. It can also provide valuable insights into road user behaviour, enabling transport officials and politicians to make better-informed decisions regarding future investment.

Ultimately, a well-designed road pricing system can put New Zealand's transport network back on track, creating a system that is safer, more efficient and better equipped to meet the needs of all Kiwis.

Chapter 1 traces the intellectual history of road pricing, recovering a rich tradition of economic thought that can inform current debates. It illustrates how economists, from Adam Smith in the 18th century to William Vickrey in the 20th century, developed the idea of using price signals to manage demand, reduce congestion and improve the overall efficiency of road networks. The chapter shows that road pricing is not a novel concept but one firmly grounded in economic theory. These principles remain highly relevant today and offer valuable insights for designing modern road pricing schemes.

From distant times to distant places, Chapter 2 looks beyond New Zealand's shores to examine the successes and shortcomings of international road pricing schemes. It explores congestion charging in Singapore and Stockholm, the triumph of tolling in Japan and the United States and the cautionary tale of Germany's failed attempt to introduce a nationwide tolling system for trucks. It finds that while there is no one-size-fits-all approach,

successful schemes share common features such as clear objectives, robust public engagement and a commitment to improving efficiency rather than revenue generation.

Chapter 3 proposes a new road pricing model for New Zealand called Smart Road User Charges (Smart RUC). This system would replace the current fuel excise duty with a distance-based charging scheme for all vehicles, creating a more direct link between road use and charges. Under Smart RUC, road users would be charged based on mileage, time of day, location and vehicle type. The chapter explains how Smart RUC would work in practice, detailing the use of advanced technology to track road usage, payment options such as pay-as-you-drive and pre-paid plans and enforcement mechanisms. It makes the case that comprehensive road pricing reform is necessary to tackle New Zealand's transport challenges and ensure a fair, sustainable funding model for the future.

The final chapter confronts the myths and misconceptions surrounding road pricing that have hindered its adoption in New Zealand and around the world. As Jean-Claude Juncker, former President of the European Commission, once quipped, "We all know what to do, but we don't know how to get re-elected once we have done it."[3] From concerns about fairness and privacy to doubts about technical feasibility, the chapter separates fact from fiction, providing a clearer understanding of how road pricing can benefit all Kiwis. While acknowledging that there are valid concerns about the implementation of road pricing, it maintains that these challenges are not insurmountable and that the advantages of a more efficient and sustainable transport system are well worth the effort.

New Zealand's current land transport policies have us on a road to nowhere. Implementing a more robust road pricing system can help us change course and build a network that benefits everyone.

CHAPTER 1

Road Pricing – The History of an Idea

> *When the carriages which pass over a highway or a bridge and the lighters which sail upon a navigable canal, pay toll in proportion to their weight or their tunnage, they pay for the maintenance of those public works exactly in proportion to the wear and tear which they occasion of them. It seems scarce possible to invent a more equitable way of maintaining such works.*[4]
>
> — Adam Smith, *The Wealth of Nations* (1776), Book V, Part III

In today's bustling cities, it is easy to take the concept of road pricing for granted. But the idea of charging for road use has a long and fascinating history. From ancient tolls on the Susa-Babylon Highway to medieval charges on bridges and city gates, the principle that travellers should pay for the infrastructure they use has been around for millennia.

However, it was in the 18th and 19th centuries that road pricing first gained serious traction. The rise of turnpike trusts in England and America saw the widespread adoption of tolls as a funding source for road construction and maintenance.[5] These trusts operated on a simple principle: those who use the roads should be the ones to pay for them. This user-pays model also found its way to Britain's settler colonies, with toll roads popping up in places like Australia and New Zealand.[6]

But road pricing is not just a practical way to raise money for infrastructure. It is an idea that has captivated economists for centuries. From the musings of Adam Smith in 18th century Edinburgh to the sophisticated models of modern-day transport economists, the question of how to efficiently and fairly charge for road use has been a perennial topic of debate and analysis.[7]

This chapter explores the intellectual history of road pricing, tracing its evolution over time. It looks at how economists have approached the challenges of managing road demand, tackling congestion and dealing with the external costs of driving, such as pollution. It also introduces some of the key thinkers who have shaped our understanding of road pricing and discusses how their ideas have been applied in practice.

The story of road pricing is an old one, but it is still relevant today. As the New Zealand Transport Agency grapples with an unparalleled funding shortfall, understanding this history becomes increasingly crucial.[8] Centuries of economic thought on road pricing can inform New Zealand's current debates about updating our road user charge system, offering valuable lessons for how to build an efficient and rational transport network that meets the needs of Kiwis while addressing the challenges of modern mobility.

Not all roads in modern economics lead back to Adam Smith, but when it comes to the idea of road pricing, the great Scottish thinker was undoubtedly ahead of the curve. In his magnum opus, *The Wealth of Nations*, Smith devoted several pages to the question of financing roads and other public works.[9] He argued forcefully that the users of infrastructure should bear the cost of their construction and maintenance. Smith's key insight was that charges should be proportional to use, a principle that underlies modern concepts of marginal cost pricing and remains at the heart of road pricing theory to this day.

He also identified the potential for market failure in the provision of roads, noting their characteristics as public goods: that is, they are non-excludable (i.e. it is hard to prevent people from using them) and non-rivalrous (one person's use does not diminish others' ability to use them).[10] However, Smith also cautioned against the centralisation of road management, arguing that socially desirable projects unable to be financed by tolls alone should be supported by local authorities to ensure accountability and efficiency.[11]

Smith may have planted the intellectual seeds, but it was the French engineer-economist Jules Dupuit who nurtured the idea to fruition in the mid-19th century. In the 1840s, Dupuit analysed the most efficient methods of tolling roads and bridges, articulating the concept of what we now call "price discrimination" – charging different prices to different users based on their willingness to pay.[12] Dupuit understood that differential pricing could be harnessed to finance road construction and general maintenance.

However, Dupuit extended his analysis beyond funding and financing considerations to examine the issue of economic efficiency: how to ensure roads were used by those who valued them most highly. To this end, he developed mathematical models to derive optimum tolls, showing that the marginal toll should equal the marginal cost imposed by a user on a given piece of infrastructure.[13] Although the concept of marginal cost was not yet fully developed, Dupuit had alighted upon the key insight.

These ideas resonated with many economists of the time, but they did not immediately translate into practice. In 19th-century Britain and America, private turnpike trusts financed many roads, sparking a lively debate about the merits of tolls versus general taxation.[14] However, the prevailing view regarded roads as public goods funded by the public purse. With the rise of rail and motor transport, the old turnpike system waned.

It was the advent of the automobile in the early 20th century and the ensuing surge in traffic, that brought the question of road pricing to the fore once again. The man who did most to revive the idea was the British economist Arthur Pigou. In a famous passage in *The Economics of Welfare* (1920), Pigou introduced the concept of what came to be known as "Pigouvian taxation":

> Suppose there are two roads, ABD and ACD both leading from A to D. If left to itself, traffic would be so distributed that the trouble involved in driving a "representative" cart along each of the two roads would be equal. But, in some circumstances, it would be possible, by shifting a few carts from route B to route C, greatly to lessen the trouble of driving for those still left on B, while only slightly increasing the trouble of driving along C. In these circumstances a rightly chosen measure of differential taxation against road B would create an "artificial" situation superior to the "natural" one. But the measure of differentiation must be rightly chosen.[15]

Pigou's analysis built on Dupuit's ideas of differential pricing while adding the rider that congestion was a "negative externality": that is, a cost imposed on society that was not borne by the individuals causing it. He advocated for a tax or charge on road users to internalise these social costs, thereby promoting a fairer and more efficient network.[16]

This idea was further refined by Frank Knight in a seminal 1924 article, "Some Fallacies in the Interpretation of Social Costs."[17] Knight, who is best known for distinguishing between risk and uncertainty, pointed out that if roads were privately owned, then the owner would have an incentive to charge Pigouvian tolls without government intervention.[18] In so doing, he linked the question of road pricing to that of property rights and institutional design, themes that later economists would push in new directions.

Despite these intellectual advances, road pricing remained largely an academic concern in the early-to-mid 20th century. Transport policy on both sides of the Atlantic and indeed, New Zealand, instead focused on accommodating motor vehicle growth through the expansion of roads funded through the public purse. Mainstream public finance theory emphasised the provision of public goods out of general taxation and roads fit this model.[19] While occasional toll roads and bridges were built, often sparking controversy, they were more the exception than the norm.

It was not until the post-World War II era that economists began to develop the modern theory of road pricing, combining Pigou's notion of externalities with the insights gleaned from welfare economics that had been developed in the intervening decades. Key figures in this movement included the American economist William Vickrey and his British counterpart Alan Walters.

In a series of landmark papers in the 1960s, Vickrey laid out the case for variable road tolls to manage congestion. He pointed out the inefficiencies of the traditional approach of expanding capacity to meet unrestrained demand, which simply led to more traffic and more congestion in a self-defeating spiral.[20] Economists call this concept induced demand. Vickrey argued that the only way to efficiently ration scarce road space was to make users face the marginal social costs of their travel decisions through tolls that varied by location and time of day. He even proposed technology for implementing such a system using electronic vehicle identification, foreshadowing modern toll-collection systems and electronic road user charging.

Walters, meanwhile, in his 1961 article "The Theory and Measurement of Private and Social Cost of Highway Congestion," supplied a mathematical model of optimal road tolls – a paper worth revisiting, particularly given New Zealand's ongoing challenge in setting appropriate toll rates.[21] Walters's model, which became known as the "fundamental diagram of traffic flow," showed how the average cost of a trip (in terms of time and vehicle operating costs) varies with the traffic volume. As volume increases towards the road's carrying capacity, congestion builds up and costs rise sharply. For Walters, the optimal toll is the gap between the marginal social cost and the average private cost at the efficient level of traffic.[22] To put it another way, tolls should capture the difference between the extra cost to society caused by congestion and what individual drivers usually pay when traffic is flowing smoothly.

The contributions of Vickrey, Walters and others during this period solidified the theoretical foundations of road pricing. However, they were fully aware of the political hurdles associated with implementing such policies – a reality that today's reform-minded politicians and policymakers would be wise to bear in mind. For example, Vickrey acknowledged that marginal-cost pricing was a hard sell to a public accustomed to "free" roads paid for by fuel taxes. "The medieval notion of the just price as an ethical norm, with its implication that the price of a commodity or service that is nominally in some sense the same should not vary according to the circumstance of the moment, has a strong appeal even today," he wrote prophetically in 1971.[23]

The 1960s also marked the beginnings of a move towards real-world implementation of road pricing, with Singapore leading the way.[24] In 1975, the city-state launched the first major road pricing initiative called the Area Licensing Scheme. This charged drivers a flat fee to enter the central city during peak hours, with the goal of reducing traffic congestion. The scheme's success garnered international interest, although it would be more than two decades before another city followed suit. Singapore's congestion charging scheme will be analysed in Chapter 2, alongside other international success stories.

Despite the political challenges, a revival of both academic and policy interest in road pricing emerged in the 1990s. Concerns about urban traffic congestion, air pollution and the limitations of building more roads prompted a search for new solutions. Advances in electronic tolling technology made sophisticated pricing schemes more feasible, while economic ideas about externalities and incentives have now permeated public policy discourse.

In New Zealand, the 1990s represented a golden age of transport policy, marked by milestones such as the Land Transport Pricing Study and the 1998 "Better Transport Better Roads" proposal."[25] During this period, New Zealand briefly led the world in policy innovation, with the World Bank praising the system as "international best practice" due to its focus on economic efficiency, user pays principles, and market-based mechanisms like road pricing. The transport funding system closely adhered to the user pays concept, with funding primarily determined by a benefit/cost threshold. This approach reflected a philosophy of managing roads more like a commercial enterprise.[26]

Overseas, several cities introduced congestion pricing.[27] The Norwegian cities of Bergen and Oslo were the first cabs off the rank, implementing cordon pricing schemes in 1986 and 1990, respectively, followed by London's congestion charge in 2003. Meanwhile, in the United States, transportation authorities began introducing High Occupancy Toll (HOT) lanes on highways from the 1990s onwards, allowing solo drivers to pay a fee to access faster lanes previously reserved for car-pooling (see Chapter 2). Elsewhere, Singapore transitioned to fully electronic road pricing in 1998 and has continued to update its scheme since then.

Economists, meanwhile, continued refining road pricing theory and practice into the 21st century. A major focus was "second-best pricing" – that is, how to design schemes that improve efficiency in a world of multiple distortions and constraints, rather than the ideal "first-best" world of economic models.[28] At the same time, there was a growing appreciation of the importance of public and political acceptability, leading to work on toll revenues and distributional impacts.

The period also saw a lively debate about the potential for private road provision. Some free-market economists argued that the problems of road financing and management could be solved by full privatisation.[29] Critics countered that private toll road operators would face the same information and transaction cost problems as public authorities and may exploit monopoly power.[30] The experience of the late 20th century suggests that, while private roads have a role to play in some contexts, they are not a panacea.

Several themes emerge as we survey the intellectual journey from Adam Smith to the present day. One is the tension between the elegant simplicity of road pricing theory and the messy reality of implementation. As Vickrey and others recognised, moving from stylised models to real-world policies involves grappling with public attitudes, technological limitations and second-best compromises. The fate of the 1998 "Better Transport Better Roads" proposal in New Zealand bears this point out in a local idiom.

Another is the interplay between ideas and context. Developments in economic theory have often been spurred on by pressing practical problems of the day, whether that is the turnpike boom of the early 19th century or the urban traffic crisis of the late 20th century. At the same time, theory has sometimes run ahead of what is politically or technologically feasible, as with Vickrey's visionary proposals in the 1950s. It may be that today's high-tech world is finally ready for these ideas – a theme I return to in Chapter 3 when I outline a universal road pricing system for New Zealand.

A third theme is the enduring relevance of some key economic ideas and principles. From Smith to Dupuit to Pigou to Vickrey, the central idea that users should face the marginal costs of their choices has been a constant thread in the intellectual history of transport economics. Related to this is the notion that prices are a powerful tool for allocating scarce resources and shaping behaviour. While the economic, social and political context of transportation has changed dramatically since the days of horse and carriage, these core economic principles still underpin the case for road pricing. It is an idea that endures.

Looking ahead, as land transport enters a period of potentially revolutionary change – with the rise of electric and autonomous vehicles, shared mobility services and so-called "smart infrastructure" – road pricing theory and practice will need to evolve once again.

But the fundamental logic is likely to persist, and the insights gained from the rich intellectual reservoir built by economists who have thought deeply about these issues over the centuries will remain invaluable. After all, we are not the first generation to encounter transport dilemmas.

The road ahead will undoubtedly have many twists and turns and perhaps the odd pothole. But armed with insights into the history of economic thought to guide us, we are well placed to navigate the challenges that lie ahead. The pioneers of road pricing theory have left us a valuable intellectual toolkit. It is up to the current generation of economists, policymakers and politicians to apply these concepts to the realities of the 21st century.

CHAPTER 2

The Road Well Travelled – Lessons from Abroad

Road pricing is a tried-and-tested solution for tackling traffic congestion and improving transportation efficiency. Cities worldwide, from Singapore to Stockholm, have successfully implemented congestion charging schemes, demonstrating their effectiveness in managing demand and reducing gridlock. However, the international experience with road pricing extends well beyond congestion charging, encompassing diverse approaches such as toll roads and express lanes.[31] As New Zealand prepares to update its road user charge system, it can draw valuable lessons from the successes and failures of international road pricing schemes.

We begin with the pioneering example of Singapore and the innovative approach of Stockholm. Singapore's road pricing system, first introduced in 1975, exemplifies the importance of focusing on congestion management rather than revenue generation. Through continuous refinement and savvy technological integration, Singapore has maintained free-flowing traffic in one of the world's most densely populated countries. In contrast, Stockholm's successful implementation of a congestion charge underscores the pivotal role of an effective communication strategy in garnering public support. By clearly articulating the scheme's purpose and benefits, Stockholm achieved a remarkable turnaround in public opinion.

We then turn to some overlooked examples of road pricing, including Japan's extensive tolling network and the proliferation of express lanes in the United States. These examples demonstrate how road pricing can effectively address a broad range of transportation challenges. However, it does not always work seamlessly. The chapter concludes with a cautionary tale from Germany's recent toll debacle, illustrating how even good ideas can fail when not implemented properly.

By learning from the successes and shortcomings of international road pricing initiatives, New Zealand can craft a tailored approach that aligns with its unique context. The path to a more efficient transportation system is well-trodden – New Zealand needs not to reinvent the wheel, but rather adapt proven strategies to suit Kiwi needs.

Singapore's Road Pricing Journey: From Paper Permits to GPS

In 1975, facing worsening traffic congestion in its central business district, the small island city-state of Singapore made a bold move – it implemented the world's first road pricing initiative. The Area Licensing Scheme (ALS) was a relatively low-tech, manual system that required drivers to purchase and display paper permits to enter the restricted central zone during morning peak hours from 7:30am to 9:30am.[32]

The first iteration of the ALS charged a flat rate of S$3 per day or S$60 per month, which would be equivalent to approximately NZ$7.20 per day or NZ$144 per month in 2024. Despite its simplicity, the ALS achieved immediate results: 73% fewer private cars, 30% more carpools and a doubling in bus ridership, delivering a 13% congestion reduction and 22% speed increase.[33] This world-first proved to be a great success, setting a precedent for urban traffic management globally.

A laser focus on congestion management rather than revenue generation has underpinned Singapore's road pricing journey over the decades. As Gregory B. Christainsen notes, "The main purpose … has been to manage traffic volumes rather than the collection of revenue. Prices have been adjusted as traffic conditions have changed."[34] Unlike traditional tolls, which are primarily used to fund transport infrastructure, Singapore's approach exemplifies a strategic use of pricing to directly influence and optimise traffic flow.

The strategy expanded in 1995 to require permits for using certain expressways during peak hours. But the quantum leap came in 1998 with the launch of the Electronic Road Pricing (ERP) system.[35] Leveraging smart card technology, the ERP automatically deducted charges as vehicles passed under overhead gantries, varying by route, time and vehicle type. This enabled far more dynamic and targeted congestion management.

Over the next two decades, the ERP gradually increased its scope, eventually covering all major routes into the city centre as well as a second outer cordon. Importantly, prices are reviewed quarterly and calibrated to maintain optimal speeds of 20–30km/hr on arterial roads and 45–60km/hr on expressways during peak hours.[36] This iterative, data-driven approach epitomises how Singapore has scaled its road pricing system over time.

Technology has been pivotal to this evolution. In late 2023, the introduction of the next-generation ERP 2.0 marked a shift to GPS-based charging capabilities, though Singapore is still using cordon and point-based pricing for now.[37] Beyond hardware, an integrated back-end system allows close monitoring of real-time traffic conditions to inform dynamic pricing.

The results speak for themselves. Singapore has maintained consistent travel speeds and journey times despite rapid population growth. Even as the number of private cars on the road increased from 401,638 to 536,882 from 2005 to 2014, average peak hour travel speeds have remained stable at around 29km/hr on arterial roads and 64km/hr on Singapore's expressways.[38]

What lessons does Singapore's experience hold for congestion-choked New Zealand cities in 2024? First, it demonstrates the value of appropriately pricing scarce road space to shape behaviour. Second, it underscores the importance of an iterative approach, adapting to changing circumstances and public feedback. Third, it highlights how technology can unlock more targeted and dynamic pricing to manage congestion in real-time.

However, perhaps most crucially, Singapore shows that framing road pricing squarely as a congestion management rather than a fiscal tool is key to public acceptance. Regular, transparent reviews and price adjustments assure citizens that prices are not arbitrary but based on congestion levels. As Kian-Keong Chin from Singapore's Land Transport Authority notes, "ERP has always been positioned as a traffic management tool and revenue was and is never a consideration."[39]

Singapore's relentless focus on using congestion pricing as a tool for traffic management rather than revenue generation, coupled with its embrace of technology to enable increasingly sophisticated pricing, has been key to its success. It is one of many lessons that New Zealand can learn from this prosperous island city-state.

Winning Support for Road Pricing: Stockholm's Public Engagement Playbook

In the early 2000s, Stockholm faced a critical transport challenge: traffic congestion was threatening the city's environment and quality of life. Bold reform was needed, but how could the city secure public support for potentially controversial measures like congestion charging?

Stockholm's answer was a carefully crafted public engagement strategy that provides useful insights for New Zealand transport officials dealing with comparable issues today. When congestion charging was first proposed for Stockholm in the 1990s, it faced fierce public and political backlash. Concerns were raised that it would be ineffective, unfair and hurt businesses.[40] To overcome this resistance, the city adopted a gradual, evidence-based approach focused on demonstrating benefits through a trial period before any permanent decisions.

In 2006, Stockholm launched a 7-month congestion charge trial, imposing fees on vehicles entering the city centre during peak hours.[41] Extensive pre-trial communications highlighted the goals of reducing traffic, increasing public transport usage and improving air quality. The trial had an immediate impact: 20% less traffic entered the city from day one and public transport use increased by around 5%.[42] Despite initial scepticism, Stockholmers experienced tangible benefits like shorter commutes and cleaner air first-hand.

After the trial's success, a public referendum was held in September 2006 on whether to make congestion charging permanent. The city engaged extensively through information campaigns and public meetings to explain the trial results and address lingering concerns. Polling showed two key constituencies: those motivated by environmental benefits and those focused on reduced congestion.[43] Targeted messaging highlighted the scheme's ability to deliver on both fronts and the referendum passed.

However, public engagement did not end with the referendum. When congestion charging was reintroduced permanently in 2007, public messaging continued to inform commuters about traffic data, revenue collected and infrastructure investments made with this revenue. Over time, public acceptance grew as the sustained congestion reductions of 20% and travel time improvements of 30–50% became an established part of city life. By 2011, public approval had risen to over 70%.[44]

Stockholm's experience underscores the critical role of public engagement. Potentially controversial transport policies like road pricing can stoke public backlash if not carefully managed. Without a well-crafted communications strategy and genuine efforts to address public concerns, even the most well-intentioned policies can lose social licence.

The cautionary tale of Edinburgh, Scotland, illustrates this point. In 2005, the city's proposed congestion charging scheme faced fierce opposition from residents and businesses who feared the economic impact and perceived unfairness of the charges. A public referendum resoundingly rejected the proposal, setting back Edinburgh's transport policy for years and serving as a warning to other cities.[45]

New Zealand policymakers would do well to take note of these lessons as they consider implementing congestion charging in cities like Auckland and Wellington. While a trial period may not be necessary or feasible, developing an effective communications strategy to sell the benefits of congestion charging is crucial. There has long been hesitancy about infrastructure pricing in New Zealand, so ensuring that road users are well-informed and understand the rationale behind congestion charging will be paramount.

An effective approach may be to lean into the deliberative democracy process, as demonstrated by Auckland Council's recent consultation with 100 Aucklanders on solving the region's transport problems.[46] Drawing on Stockholm's experience, the two-day forum resulted in a significant shift in participants' attitudes towards congestion charging, with nearly 40 percent moving from a negative to a positive stance.[47]

Ultimately, the goal should be to help the public understand and experience the benefits of congestion charging. By focusing on clear, evidence-based communication, targeted engagement and addressing the concerns and priorities of key constituencies, New Zealand

policymakers can build the necessary public support to make congestion charging a reality. If successful, Auckland and Wellington may soon serve as models for other cities tired of endless gridlock.

The Triumph of Tolls: Highways of the Rising Sun

Japan's toll road network is a paragon of success. From its modest post-war beginnings to today's technological sophistication, the story of Japan's expressways offers valuable insights for countries like New Zealand grappling with the challenges of funding and maintaining modern highway infrastructure. Over the decades, Japan has developed an extensive toll road system spanning over 8,500 kilometres that connects all major cities and regions, vastly improving regional and national mobility across the island nation.[48]

The origins of Japan's toll road network can be traced back to the 1950s when the war-ravaged country embarked on an ambitious programme of infrastructure development. With limited resources at hand, the government made an important strategic decision: it would fund the construction of its national expressway through tolls rather than taxes. Thus, in 1956, the Japan Highway Public Corporation (JHPC) was born, charged with the task of building and operating a toll-based highway system that would become the backbone of Japan's post-war economic miracle.[49]

Japan's adoption of road pricing was not always a smooth ride, encountering its fair share of bumps along the way. The concept of paying for roads initially met scepticism from a public accustomed to "free" access. But the JHPC persevered and through a combination of innovative engineering, strategic land acquisition and persuasive public outreach, Japan's first tolled expressways began to take shape. In time, they would transform land transport on the archipelago.

As the network expanded, so too did its sophistication. The JHPC introduced electronic tolling in 2001, long before such systems became commonplace elsewhere. And by the mid-2000's, Japan boasted an extensive web of expressways stretching the length and breadth of the country, all seamlessly connected by a state-of-the-art tolling system.[50]

But the real genius of Japan's approach lay in its embrace of public-private partnerships. In 2005, the JHPC was privatised and split into regional expressway companies, each tasked with managing a portion of the network.[51] This move brought a new level of efficiency and innovation to the system, as the private sector's profit motive was harnessed in service of the public good.

Today, Japan's tolling system is an integral part of the country's sophisticated infrastructure network. With over 90% of expressway users equipped with electronic toll collection devices, the network generates an abundance of data that is used to dynamically manage traffic flow, adjust prices based on congestion levels and inform transport investment decisions. The result is a highway system that is not only financially self-sustaining, but also remarkably efficient and responsive to the needs of its users.

The outcomes are impressive. Japan's expressways are among the most efficient and well-maintained in the world, with high levels of user satisfaction – a stark contrast to New Zealand, which only has three tolls and correspondingly low levels of user satisfaction with the road network.[52]

Japan's early adoption of electronic tolling and continuous refinement of data-driven management techniques have positioned it at the forefront of the global transportation industry. For a small island nation like New Zealand, with its own infrastructure challenges, adopting advanced technologies like electronic tolling and data-driven management techniques could improve network efficiency and responsiveness while

generating substantial revenue for reinvestment in infrastructure development and maintenance.

The example of Japan's high-tech, user-focused approach is one that New Zealand would do well to emulate.

Life in the Fast Lane: American Express Lanes

For decades, transportation authorities across the United States have wrestled with a problem familiar to commuters in New Zealand: worsening traffic congestion in major urban centres. Steadily increasing travel demand, coupled with limited public funds to build new roads, has led to crippling gridlock and unreliable journeys on many of the country's busiest highways. In response, a growing number of states have turned to an innovative market-based solution: managed lanes.[53]

Managed lanes are dedicated highway lanes that use variable tolling and vehicle eligibility restrictions to maintain free-flowing traffic. The idea is simple yet effective. On congested highway corridors, a set of lanes are dynamically and/or variably priced to respond to changing traffic conditions.[54] By managing demand through pricing, this approach makes more efficient use of existing road capacity while offering drivers a reliable travel option.

There are three main types: high-occupancy toll (HOT) lanes, express toll lanes and high-occupancy vehicle (HOV) lanes. HOT lanes allow solo drivers to pay a variable toll to use lanes reserved for high-occupancy vehicles, with prices adjusting based on congestion; express toll lanes charge all vehicles a variable toll, with prices rising during peak hours to maintain free-flowing traffic; HOV lanes, popular since the 1970s, grant priority of access to vehicles with two or more occupants (HOV 2+) or three or more occupants (HOV 3+), encouraging carpooling and optimising road capacity.[55]

The strength of managed lanes is they make more efficient use of limited road space through variable/dynamic pricing, matching demand to available capacity. Solo drivers can opt to pay for a faster and more reliable trip when they need it. Public transport and carpools are rewarded with a congestion-free ride, encouraging mode shift. And revenue generated from tolls can fund the lanes' construction and operation or other mobility improvements.

But it is express toll lanes that have emerged as the most promising form of priced managed lanes in the United States. First introduced on California's SR-91 freeway in Orange County in 1995, express toll lanes have evolved over the past quarter century into a proven and effective congestion management tool. Projects now operate successfully in over a dozen states, from Florida to Texas to Minnesota to Washington.[56] The results have been consistently positive: significant travel time savings, greater trip reliability, increased vehicle and person throughput, reduced congestion and more sustainable funding for infrastructure improvements.

A prime example is the I-394 MnPASS Express Lanes in Minneapolis. Since opening in 2005, MnPASS has increased vehicle throughput by 48% and person throughput by 25% during peak hours compared to the previously underutilised carpool lanes.[57] Speeds in the MnPASS lanes average 64 mph during rush hour versus just 52 mph in the general lanes.[58] A 2009 survey found over 90% of MnPASS customers are satisfied with the lanes, with users citing time savings and reduced stress as the top benefits. The system generates enough toll revenue to fully cover operating costs.[59]

Similar success stories can be found on express lane corridors across the US. For instance, in Los Angeles, the I-110 Express Lanes have saved more than 32 million commuting hours, facilitated more than 100 million trips and generated more than US$480 million in economic benefits to the area.[60] This illustrates how express lanes can

significantly enhance traffic flow and provide substantial economic advantages.

These impressive outcomes hold valuable lessons for Auckland and other New Zealand cities facing similar congestion challenges and constraints. The US experience shows that with careful planning and implementation, public outreach and an emphasis on road user benefits, variably priced express lanes can be a gamechanger – offering drivers a choice, making more efficient use of roads and keeping daily traffic flowing. By adopting this market-based approach on its most gridlocked highways, New Zealand could become a leader in congestion management.

Of course, New Zealand would need to adapt the American model to its own unique context. Building necessary public acceptance and political will in a country less accustomed to highway tolling will require a thoughtful process of engagement, public education and demonstration of benefits. At the same time, striking the right balance between free and priced lanes will be key. Any express lane revenues should be transparently reinvested to create a better road network.

But the core principle from the US is clear and compelling: by harnessing market forces to manage highway demand, we can get more out of the roads we already have in a way that benefits road users, the environment and the economy. As Auckland and other Kiwi urban centres continue to grow, dynamically priced express lanes deserve a hard look as part of a comprehensive transport toolkit. The US experience shows what is possible – if we are bold enough to seize the opportunity.

Germany's Toll-Road Fiasco

Germany's attempt to implement a nationwide tolling system for trucks (HGV) in 2005 is an object lesson in how *not* to approach road pricing. The scheme had a clear rationale: namely, to shift the burden of road maintenance costs on to trucks causing the most wear and tear, while also incentivising more efficient use of the road network.[61]

The toll's bungled roll-out dented public confidence from the start. It was championed as a smart solution to solve traffic congestion, but it was plagued by technical problems and delays. The system relied on GPS tracking and mobile communications to automatically log vehicle movements and charge drivers. However, the technology never worked as planned.[62]

Several factors contributed to the fiasco. First, the German government opted for a highly complex, satellite-based tolling system, which was still relatively untested at the time. This decision was driven in part by a desire to demonstrate German technological prowess and establishing a world-leading tolling solution.[63] Yet, this ambition came at the cost of reliability and ease of implementation.

Second, the government underestimated the challenges of integrating the various technological components, including onboard units, GPS tracking and wireless communication with the central billing system.[64] Compatibility issues between the onboard units and the software led to frequent malfunctions and inaccurate toll calculations.

Third, the rapid rollout of the system across Germany's extensive highway network left insufficient time for thorough testing and troubleshooting. The government was keen to start generating revenue as quickly as possible, leading to a rushed implementation process that compounded the underlying technical issues.

The toll system was developed by Toll Collect, a consortium of DaimlerChrysler, Deutsche Telekom and Cofiroute of France. However, the developers struggled to combine the different software systems, and in the end, the project cost the government more than $10 billion in lost revenue,

according to one estimate.[65] After several years of delays and failed launches, the government finally cancelled the contract with Toll Collect in 2004. The failed project became a cautionary tale, with "Toll Collect" becoming a popular byword among Germans for the country's economic troubles.

This cascading fiasco shredded public trust and support for road pricing in Germany. The toll's technical failures, delayed implementation, and massive financial losses left many Germans sceptical about the feasibility and reliability of such systems. To make matters worse, subsequent political mismanagement of the scheme further eroded public confidence.

In the years following the cancellation of the Toll Collect contract, the German government attempted to revive the beleaguered HGV tolling scheme. However, these efforts were met with fierce opposition from neighbouring countries like Austria and the Netherlands, who argued that the toll unfairly burdened their citizens who frequently transit through Germany. In 2019, after a protracted legal battle, the European Court of Justice ruled that the revised scheme discriminated against foreign drivers, violating EU laws on free movement.[66]

Although New Zealand does not have to contend with the intricacies of cross-border traffic, this example underscores the importance of proper planning, transparent objectives and a gradual, phased approach to implementation. It also highlights the need to build and maintain public trust throughout the process, as a loss of confidence can be difficult to recover from and may jeopardise the long-term success of road pricing initiatives.

Germany's experience is not unique. Indeed, other countries have faced similar challenges when implementing road pricing schemes. In the UK, plans for a nationwide road pricing scheme were abandoned in 2007 after public backlash over privacy concerns and the potential cost to motorists.[67] In the Netherlands, a proposed distance-based pricing system was shelved in 2010 due to political opposition and concerns about the complexity and cost of the technology.[68]

Closer to home, Australia has also encountered major problems with its toll road system, particularly in relation to private contractors and social license.[69] For example, the Cross City Tunnel in Sydney, which opened in 2005, was mired in financial difficulties due to lower-than-expected traffic volumes. The private operator ultimately went into receivership, leading to a protracted legal dispute with the New South Wales government.[70] Similarly, the operator of Brisbane's Clem7 tunnel faced financial collapse just one year after opening in 2010, as traffic volumes were far below forecasts.[71] These cases highlight the risks of relying on overly optimistic traffic projections and the potential for costly disputes with private operators. Public policy settings matter.

Above all, these international examples highlight the importance of public engagement, technological reliability and political consensus when introducing road pricing. As New Zealand updates its own road pricing system, it would do well to heed these cautionary tales. Rigorous pilot testing of the technology is essential before any nationwide rollout of a complex road pricing scheme. At the same time, the system needs to be transparently structured as a clean user charge, not a revenue-raising tool. Finally, public outreach is critical to address privacy concerns and demonstrate the benefits of road pricing, such as reduced congestion and improved transport infrastructure.

Most importantly, New Zealand needs to establish broad political support for road pricing. This will require a clear understanding of how the system aligns with national transport policy goals and how revenue will be allocated. By learning from the pitfalls encountered in Germany and elsewhere, New Zealand can leverage road pricing to create a more efficient and responsive transport network.

CHAPTER 3

A Smarter Way Forward

New Zealand has an opportunity to lead the world in transport funding by transitioning to a comprehensive, distance-based Road User Charge (RUC) system. This innovative funding model, called Smart RUC, would apply to all vehicles and gradually replace fuel excise duty (FED) over a five-year period. Smart RUC, in conjunction with electronic tolling and congestion charging, would shift transport funding to a pure user-pays model. Under this system, road users would be charged based on mileage, time of use, route and vehicle type and weight. But how would it work?

Smart RUC will offer motorists two payment options: an automated "pay-as-you-drive" (PAYD) system with regular billing or pre-paid balance top-ups and the existing pre-purchase RUC license model. Providing both options ensures flexibility for different driver preferences and alleviates concerns about mandatory in-vehicle tracking. This twin-track approach also builds on New Zealand's current RUC and eRUC framework, which already supports electronic pricing and traditional paper licenses.

For the PAYD option, drivers would have an electronic distance recorder installed in their vehicles to automatically track distanced travelled. They would receive regular bills (e.g. monthly) based on their actual road usage, or they could top up a pre-paid RUC card via an app or online portal as needed. This method is similar to how we already pay for electricity and internet, making it a familiar and efficient method for collecting RUC. The convenience of "set and forget" payment would streamline the process for road users, reducing administrative burdens.

For the traditional RUC license model, drivers would purchase distance licenses in advance, similar to the current system used by diesel vehicles and heavy trucks. To purchase a license, road users would need to provide their vehicle details, including the registration number, make, model and current odometer reading. The cost of the license would be based on the vehicle type, weight and the distance purchased.

To facilitate the transition to a fully electronic road pricing system, all new vehicles entering the fleet will require an electronic distance recorder. This requirement would ensure that, over time, an increasing proportion of vehicles on New Zealand's roads are compatible with the PAYD version of Smart RUC. However, to maintain flexibility and accommodate driver preferences, the traditional RUC license would remain available for existing vehicles. This gradual approach allows for a smooth transition, giving drivers time to adapt to the new system while ensuring that the shift towards a more technologically sophisticated model gathers pace over time. As more vehicles become equipped with electronic distance recorders, the Smart RUC system will be able to accommodate more nuanced time-of-use and route-based charging.

All vehicles would have their electronic distance recorders and RUC payment status audited during annual registration checks. This process would help maintain compliance and accurate tracking of road usage.

Under the Smart RUC system, RUC rates would initially be determined in the same way as they are now. Charges would vary based on a variety of factors such as vehicle type, axle configuration, weight and emissions profile. By building on the existing system, we can keep implementation costs low and maintain continuity. As the Smart

RUC system matures, control over rates would ideally transfer from the Minister of Transport to independent road managers, operating under appropriate regulatory oversight. An independent rate-setting process would promote long-term stability and efficiency in the transport funding system.

RUC rates for light vehicles would be set based on the vehicle's weight and emissions characteristics. Vehicles would be classed into weight bands, with heavier vehicles paying higher per-kilometre rates to reflect their greater impact on road wear and tear. Similarly, vehicles with higher emissions (based on engine type, fuel efficiency and pollutant profile) would be charged higher rates to account for their environmental impact.

RUC rates for heavy vehicles, meanwhile, would continue to be based on weight, axle configuration and distance travelled. However, the Smart RUC model would allow for more granular and dynamic charging, with rates potentially varying based on factors such as road type, time of day and real-time traffic conditions.

The Ministry of Transport would determine precise RUC rates for each vehicle category through regular cost allocation studies. These studies assess the relative impact that different vehicle types impose on the network, enabling the Ministry to set rates that ensure equitable distribution of road costs among vehicle classes. NZTA Waka Kotahi would remain responsible for administering and collecting RUC, as well as ensuring compliance.

To incentivise uptake of the PAYD option, Smart RUC would employ targeted pricing signals. PAYD users would benefit from lower per-kilometre rates compared to the traditional RUC licence model, reflecting the reduced administrative and enforcement costs of the automated system. This built-in discount would make the PAYD option an attractive choice for cost-conscious road users.

The government could also consider subsidising the installation of electronic distance recorders for drivers who sign up within a specified timeframe. While this would require an initial investment, it would be offset by the long-term savings generated through a more efficient and targeted transport funding model.

Smart RUC also presents a unique opportunity to collaborate with insurance companies and offer bundled discounts for drivers who adopt the PAYD option.[72] By leveraging the data collected by electronic distance recorders, insurers can develop usage-based insurance programmes that reward safe and efficient driving habits.

For example, detailed trip data could be used for personalised insurance policies based on individual driving patterns. Low-risk drivers who accumulate most of their mileage on motorways during off-peak hours could see significant savings, while those who frequently drive on congested urban streets during rush hour may pay rates that more accurately reflect their actual risk profile. This integration of Smart RUC and usage-based insurance would create a strong incentive for drivers to adopt safer and more efficient habits on the road, leading to reduced accidents and congestion.

In the longer term, the rich data generated by the widespread adoption of the PAYD option could drive significant innovation in the insurance industry. Granular, real-time information on traffic patterns, road conditions and driver behaviour could power advanced predictive models and dynamic risk assessment. Insurers could use these insights to develop proactive safety initiatives, partnering with local authorities and road managers to identify and mitigate high-risk locations.

A contestable market for road pricing services would play a vital role in making Smart RUC efficient and providing road users with options that best serve their needs. In this system,

approved providers such as EROAD and RUC Monkey would collect RUC and then pass the funds on to NZTA Waka Kotahi. Service providers would compete to offer the best product and user experience to road users, who would be free to choose the provider that best meets their preferences and requirements.

Waka Kotahi would set the core requirements and minimum standards for service provision, but beyond that, private firms would be free to develop their product as they saw fit. For example, providers could offer individual drivers personalised trip planning and route advice based on their driving habits and preferred destinations, helping them save money and getting them from A-to-B more efficiently. By tailoring their services to road users' actual needs and preferences, providers would create value over and above mere revenue collection; they would be developing services that road users genuinely wanted to use.

As the Smart RUC system evolves and control over rates shifts to independent road managers, the role of service providers could expand further. In the future, these providers could work directly with road managers, offering tailored services and pricing packages to road users based on their specific needs and usage patterns. This direct relationship between service providers, road managers and users would create a more dynamic and responsive transport funding system, ensuring that costs are allocated efficiently across the network.

Compliance and enforcement are critical aspects of any road pricing system, and the Smart RUC model is no exception. While there will inevitably be some individuals who try to game the system, several practical measures can help maintain high levels of compliance. First, all vehicles would have their electronic distance recorders and RUC payment status audited during annual registration checks. Second, the Road User Charges Act 2012 would be amended to mandate compliance with the Smart RUC system and define clear penalties for evasion. The revised legislation would outline the legal requirements for participation in the Smart RUC system, establish offences for non-compliance and set out fines and other penalties that would apply.

Enforcement of these provisions would be carried out by NZTA Waka Kotahi, which would be responsible for monitoring compliance, conducting audits and pursuing legal action against offenders.

Privacy Safeguards

Since Smart RUC collects sensitive location and driving data, robust privacy safeguards are essential. Waka Kotahi will work closely with the Office of the Privacy Commissioner to ensure that Smart RUC adheres to the information privacy principles set out in the Privacy Act 2020 and that users' personal information is collected, used and disclosed only as necessary for the legitimate purposes of the scheme.

To protect user privacy, Smart RUC will operate on a principle of data minimisation, with private providers collecting only the information strictly necessary for calculating charges and operating the system. Personal data will be anonymised wherever possible, with users identified primarily by a unique account number rather than by name or vehicle registration.[73] Raw location data will be deleted by the providers once charges have been calculated and any data shared with Waka Kotahi for planning or analysis purposes will be aggregated and anonymised to protect individual privacy.

Access to Smart RUC data held by private providers will be tightly controlled and monitored, with only authorised personnel able to view identifiable user information for legitimate purposes such as billing or customer support.

Providers will be required to maintain strong security measures to protect user data from breaches or unauthorised access and will be subject to regular audits by Waka Kotahi and the Privacy Commissioner to ensure compliance.

Users will have the right to access and request corrections to their personal data held by RUC providers and to be informed about how their information is being used. Any use of individual-level data beyond the core purpose of calculating charges, such as for targeted advertising or sale to their parties, will be strictly prohibited without explicit user consent.

To give these privacy safeguards the force of law, the legislation enabling Smart RUC will include specific privacy provisions, setting out users' rights and providers' obligations in relation to personal information. The law will establish clear penalties for privacy breaches or misuse of Smart RUC data, giving users confidence that their personal information is being properly protected.

Implementation

Throughout the design and implementation of Smart RUC, Waka Kotahi and the Ministry of Transport will engage closely with the Privacy Commissioner and other stakeholders to ensure that privacy considerations are embedded at every stage. Public input will also be sought through consultations, focus groups and deliberative democracy forums to understand and address New Zealanders' privacy concerns related to electronic road pricing.

Implementing such a transformative reform of transport funding will require careful planning and nimble execution. The Ministry of Transport, NZTA Waka Kotahi, Treasury and private sector partners will need to work together closely to ensure a smooth rollout that maintains public trust. To this end, the following is a proposed 5-year implementation strategy to transition New Zealand's entire vehicle fleet from fuel excise duty to the Smart RUC system. If implemented successfully, this reform would represent the most significant shift in New Zealand's transport funding model since the introduction of the petrol tax in 1927; it would also position New Zealand as a global leader in transport policy.

Year 1

- Begin gradual increases in RUC rates and decreases in fuel excise duty (FED) to start shifting revenue sources. Target an 80/20 split between FED and RUC by the end of year 1;
- Pass legislation mandating that all new vehicles entering the fleet must have electronic distance recorders installed. Provide subsidies to incentivise retrofitting of existing vehicles;
- Launch a public awareness campaign explaining the changes and benefits of the Smart RUC system;
- Establish partnerships with RUC service providers and develop the IT infrastructure for the pay-as-you-drive (PAYD) billing system.

Year 2

- Continue increasing RUC rates and decreasing FED, aiming for a 60/40 revenue split by the end of year 2. Adjust rates as needed to maintain revenue neutrality during the transition;
- Make the PAYD billing system operational and begin enrolling vehicles. Provide discounts on RUC for PAYD users;
- Expand enforcement to audit vehicles for electronic distance recorders and RUC compliance during annual registration checks;
- Work with insurers to develop bundled discounts and usage-based insurance products for PAYD users.

Year 3

- Accelerate the transition to a 40/60 split between FED and RUC revenue. Fine-tune rates to ensure a smooth transition without revenue shortfalls;

- Enrol the majority of the light vehicle fleet in PAYD billing. Phase out most FED for light vehicles;
- Develop more sophisticated RUC pricing models based on vehicle type, weight, emissions and usage patterns.

Year 4

- Shift to a 20/80 split between FED and RUC revenue. FED remains only for older vehicles and certain exemptions;
- Enrol remaining light vehicles and heavy vehicles in Smart RUC. Traditional RUC licenses remain an option but are priced higher than PAYD;
- Refine enforcement practices and introduce steeper penalties for RUC evasion.

Year 5

- Fully phase out FED and shift to 100% RUC revenue. Fees now fund all road maintenance and improvements in the National Land Transport Fund;
- Integrate real-time congestion and corridor pricing into the RUC model to further optimise road usage and reduce congestion;
- Assess the success of the transition in terms of transport efficiency and revenue stability. Identify areas for further improvement.

The proposed 5-year implementation plan will transition New Zealand's entire vehicle fleet to the SMART RUC system, gradually replacing fuel excise duty with universal road user charges. The plan incentivises the adoption of electronic distance recorders and offers discounted PAYD billing to increase SMART RUC enrolment, prioritising road users' preferences. More sophisticated pricing models will be introduced as the system evolves, culminating in a 100% RUC-funded transport network by the end of the fifth year. Close collaboration with key stakeholders, targeted public awareness campaigns and robust enforcement measures will be critical to the successful implementation of this innovative transport funding reform.

CHAPTER 4

Myths and Misconceptions

If liberty means anything at all, it means the right to tell people what they do not want to hear.[74]
— George Orwell, unused preface to *Animal Farm* (1945)

Road pricing is supported by over two centuries of economic thought and has seen international success in cities from Stockholm to Singapore, yet it remains politically charged and highly emotive. Why is this so? The answer lies in a series of deeply entrenched myths and misconceptions that have clouded public debate and hindered adoption.

One of the most pervasive myths is that road pricing is unfair, penalising low-income drivers who have no choice but to use the roads during peak hours. Another common objection is that road pricing will lead to a loss of privacy, with "Spies in the Skies" tracking our every move. Then there are concerns about the technology itself – will it be reliable, secure and easy to use? And perhaps most fundamentally, many people simply baulk at the idea of paying for something they believe they have already paid for through fuel taxes and other charges.

While these concerns are understandable, they are often rooted in misconception or inaccurate and partial information. In this chapter, I examine each of these objections, separating fact from fiction to provide a clearer understanding of how road pricing can benefit New Zealand.

The road to a more rational transport system is full of potholes and speedbumps. Deep-rooted myths and misconceptions surrounding road pricing will not be easily dislodged. Yet, if we are willing to engage in an honest and evidence-based dialogue about the merits and challenges of road pricing, a smoother, faster and more reliable transport network is there for the taking.

How will road pricing impact social equity? I am concerned that pricing roads will be regressive, penalising those who can least afford it.

One of the most common objections to road pricing is its perceived negative impact on low-income households.

Critics concerned with potential social equity implications of road pricing contend that it disproportionately hurts the most economically disadvantaged, who may struggle to afford toll payments or congestion charges. Moreover, they argue that many low-income workers lack the flexibility to adjust their work hours to avoid these charges. They may also have limited access to reliable public transportation. Advocates call this transport poverty.[75]

While social equity is undoubtedly important, there is abundant evidence to suggest that road pricing can work for everyone. As transport economist Brain Taylor observes, recent road pricing initiatives have "turned equity objections to pricing on their head by presenting pricing as both a way to substantially increase transportation system efficiency *and* to address and correct substantial inequities in our current systems of transportation finance."[76]

In fact, a well-designed road pricing system can be more equitable than our current approach to transport funding, which relies heavily on fuel taxes. Fuel taxes are regressive, disproportionately affecting those with lower incomes. By contrast, road pricing can be structured to promote equity,

ensuring that the costs and benefits are more fairly distributed across all income levels.[77]

The current setup is arguably *more* regressive than universal road pricing. Fuel taxes disproportionately burden low-income individuals because they often drive older, less fuel-efficient vehicles. As a result, they pay higher fuel taxes per kilometre driven than those who can afford newer vehicles. Social equity, in other words, is not served by the status-quo.

At the same time, low-income households are more likely than affluent ones to rely on public transport. And public transport would be less affected by road user charges on a per-passenger basis than private vehicles. Reduced congestion benefits users of public transport as much as users of private vehicles, making journeys faster and more reliable for all. When low-income motorists place a particularly high value on their time, such as making doctor's appointments, they would still reap the benefits from congestion-free roads by opting to travel by car.

There is strong international evidence to suggest that worries about the distributional impacts of road pricing are overblown.[78] For example, a major study of the Stockholm congestion charge found that most road users, including low-income groups, would be better off after the charge was implemented. Affluent men would pay the most in congestion charges – hardly the group of most concern for those worried about social equity.[79]

In any case, the preoccupation with social equity shows a loss of focus. The primary purpose of a transport system is to efficiently move people and goods, not (directly) to address income inequality. Affordability and access are important considerations. But using transport policy as a vehicle to achieve social equity objectives risks compromising the smooth operation and long-term financial sustainability of the network. It is a road to nowhere.

Concerns about the allegedly regressive impact of prices on low-income households are not unique to road pricing. The same logic could be applied to low-income individuals paying market prices for staples like milk and butter. However, it is widely accepted that the prices of those goods should reflect costs and market conditions, with income insufficiency addressed separately through the tax and welfare system.

New Zealand already has income redistribution mechanisms in place to support low-income households' standards of living. Fine-tuning redistributive policies is likely to be a more effective and appropriate way to improve social equity than distorting transport pricing.

While the upfront costs of road pricing may seem daunting, it is important to consider the even higher costs of doing nothing. Traffic congestion already imposes major economic costs in terms of wasted time, fuel and productivity. Aucklanders, for instance, spend an average of five days a year stuck in traffic. These costs are ultimately borne by everyone through higher prices, not to mention the costs of stress and a lower quality of life.

No policy is perfect, but road pricing is a powerful tool for creating a more efficient and rational transport system. With thoughtful design and implementation, road pricing can improve how Kiwis get from A to B. The alternative – endless traffic and an underfunded transportation system – is far worse for social equity in the long run.

I am worried about privacy and what will happen to my data. Should I be concerned about electronic road pricing?

The introduction of an electronic road pricing system like Smart RUC naturally raises questions about privacy and data security. As a road user, it is understandable that you are worried about how your personal travel information will be handled. However, by following international best practice and building on New Zealand's existing

safeguards for road user data, Smart RUC can be implemented to protect your privacy.

International experience demonstrates that privacy and road pricing can work together. In Singapore, which operates the world's most advanced congestion charging scheme, data protection has been a core principle from the outset. Through a combination of data minimisation, anonymisation, encryption and strict access controls, Singapore ensures that personal travel information is only used for the legitimate purposes of operating the system and calculating charges. No individualised travel histories are retained, and data is deleted once it is no longer needed. Singapore's ongoing transition to a satellite-based system incorporates even more sophisticated privacy-enhancing features.

New Zealand can learn from Singapore in designing a privacy-first approach for Smart RUC. Our existing eRUC system for light diesel vehicles and heavy trucks already offers a solid foundation, with strict data security protocols governing the collection, transmission and storage of GPS-tracked road use data by private on-board unit providers. This experience shows that road pricing and privacy protection can be mutually reinforcing when the right regulatory safeguards are in place.

Building on this base, Smart RUC will go even further in safeguarding user privacy. The system will operate on the principle of data minimisation, collecting only the information essential for charge calculation and system operation. Where possible, data will be fully anonymised, with users identified by a unique account number rather than personal details. Any location data will be deleted once the charges have been determined and information shared with NZTA Waka Kotahi and the Ministry of Transport will be aggregated and anonymised to prevent individual tracking.

Strict limits and oversight will govern access to Smart RUC data held by private providers. Only authorised staff will be permitted to view identifiable user information solely for legitimate purposes like billing or customer service. Regular audits by NZTA Waka Kotahi and the Privacy Commissioner will ensure that providers adhere to rigorous standards to prevent breaches or misuse. Users will have the right to check and correct their personal data and any use beyond core Smart RUC functions will require explicit informed consent.

Crucially, these privacy safeguards will be embedded in the enabling legislation for Smart RUC, ensuring they have the force of law. The statute will clearly define users' data rights and providers' obligations, with stiff penalties for any breaches. From the outset, privacy experts and the public will be closely consulted to ensure Smart RUC reflects New Zealanders' expectations and earns their trust.

Is electronic road pricing even feasible? I worry that the technology might not be capable of supporting a universal road pricing system.

Technology is no longer a barrier to the implementation of a road pricing system based on distance, time and location. This is not to say that it will be easy – equipping New Zealand's entire fleet with devices linked to payment accounts will be a significant challenge for the Ministry of Transport, NZTA Waka Kotahi and private providers. However, we are no longer constrained by the technological hurdles that hindered previous generations from adopting universal road pricing.

The rapid advancement of technologies such as satellite navigation systems, automatic number plate recognition and 5G connectivity heralds a new era for road pricing. This digital revolution enables distance-based, dynamic and location-specific charging that was previously impractical or prohibitively expensive; the future is already here.

These technological breakthroughs facilitate the use of affordable, onboard devices that seamlessly collect and process vehicle movement data. This enables flexible congestion pricing that is adjustable in real-time based on location, time and traffic conditions. As the costs of these systems continue to decrease, advanced road pricing becomes increasingly viable, offering new possibilities for demand management and efficient road usage.

If you have recently used Uber, you will know first-hand that intelligent transport systems are shaking up how we move around our urban centres. Ridesharing platforms like Uber already collect travel information at minimal cost to calculate routes and charge users – and few people now yearn for more expensive, traditional taxi services with less sophisticated technology.

New Zealand is at the forefront of this technological revolution. EROAD, headquartered in Auckland, was the first company to implement a cellular-based road pricing solution across an entire country – and it has successfully marketed its product in Australia and North America.[80]

EROAD's electronic road user charge system uses a vehicle's odometer along with GPS to measure distance travelled. For light vehicles, their "smart algorithm" can be calibrated to a vehicle's odometer, allowing automated calculation and purchasing of road usage licenses based on distance.[81] This Kiwi success story shows that the core technology is sound; the challenge lies in rolling out a road pricing system to millions of vehicles.

Given these advancements, New Zealand is well-placed to take advantage of the latest developments in road pricing technology. Since 2010, Electronic Road User Charges (eRUC) have been collected from light-diesel vehicles and trucks. These vehicles are equipped with electronic distance recorders, installed by private companies such as EROAD and RUC Monkey and are connected to a central system managed by NZTA. The eRUC system calculates charges based on distance travelled and vehicle weight, with higher charges for heavier vehicles due to their greater impact on road wear and tear. This system has been highly successful, with over half of all road user charges now collected electronically.

Internationally, we can look to Singapore and Oregon as trailblazers in road pricing technology. Singapore, which already boasts the world's most sophisticated congestion charging system, is currently transitioning to a next-generation, satellite-based platform. This will enable dynamic, distance-based pricing across the entire road network, with charges adjusting in real-time based on traffic conditions.[82] Oregon, meanwhile, has successfully piloted a mileage-based charging system for passenger vehicles, using onboard devices to record distance travelled and calculate charges.[83] These real-world examples demonstrate that the technology for advanced road pricing is not just feasible, but already being implemented in forward-thinking jurisdictions.

The evolution of road pricing technology over the last decade has made universal, distance-based charging a realistic and achievable goal. Indeed, the fundamental components are all in place: accurate vehicle tracking, seamless data processing, automated charge calculation and integration with existing payment systems.

The question, then, is no longer whether the technology for electronic road pricing exists – it clearly does. Instead, the focus now shifts to how we can most effectively implement an efficient, reliable and user-friendly system that works for all New Zealanders.

I already pay for our roads through taxes, so why should I pay more?

Nobody likes the idea of shelling out extra cash, especially when it feels like every time we fill up at the gas station, we are already paying a hefty amount. This is a genuine worry. However, road

pricing offers a fairer and more efficient way to manage our transportation system compared to fuel taxes. Importantly, it is not about paying more, but rather about paying based on actual road use.

Take the current system. A driver who covers 20,000 kilometres a year in a heavy SUV rightly pays more in fuel taxes than someone who drives 5,000 kilometres a year in a small hatchback. Yet the difference in fuel taxes paid does not accurately reflect the actual difference in road use and the associated maintenance costs. Fuel tax is a blunt tool for assessing road usage and impact.

The SUV driver not only contributes more to road wear and tear due to the vehicle's weight, but also derives more benefit from the roads by using them more frequently. The fuel taxes paid by each driver are thus a poor proxy for their actual impact on the roads and the benefits they derive from using them. This disconnect between road use, costs imposed and benefits received creates a fundamental unfairness and is at the heart of our transport funding woes. But road pricing and the principle of user-pays can help fix this.

The principle of user-pays is well-established in other sectors. When you use more electricity or opt for a faster internet plan, you expect to pay more. The same logic should apply to roads. Those who use the roads more and impose the greatest costs on the network should pay more, while those who drive less should pay less. This is not only fairer, but also more efficient, as it sends clear price signals about the true cost of driving.

Unfortunately, New Zealand's current transport funding system is not only unfair, but also unsustainable. The revenue collected from road users through fuel taxes and other charges is no longer sufficient to cover the costs of maintaining and improving the road network – hence the potholes that blight many of our roads. As a result, NZTA Waka Kotahi faces a growing gap between the funds available and the amount needed to keep our roads in good condition and build new infrastructure to meet the demands of a growing population.

This funding gap is compounded by the increasing prevalence of electric and fuel-efficient vehicles. As more people switch to these vehicles, their contribution through fuel taxes decreases despite continued use of the roads. This means that the traditional revenue stream from fuel taxes is no longer sustainable, necessitating a more usage-based and efficient approach to funding our transport infrastructure.

Given these realities, it is clear that New Zealand needs to reform transport funding. Smart RUC offers a promising solution. By charging road users directly for their use of the roads, we can create a fairer, more sustainable system where everyone pays their fair share based on the costs they impose and the benefits they receive.

Some road users may indeed face higher costs, while others may see a drop in what they pay for using the roads. This is because the charges will be directly linked to actual road use and the associated costs imposed on the network. Those who drive more, especially during peak hours and in heavier vehicles that cause more wear and tear, will likely pay more than they do under the current fuel tax system.

On the other hand, those who drive less, travel during off-peak times or use lighter, more efficient vehicles may see a reduction in their costs. This is not about punishing anyone, but rather about ensuring that everyone pays their fair share based on their actual use of the roads. It is a more equitable and transparent approach that aligns the costs and benefits of road use, encouraging more efficient use of our transportation infrastructure.

In the end, we all want the same thing: a transportation system that is effective, safe and reliable. Road pricing can help us get there by ensuring that everyone pays their fair share.

Conclusion

New Zealand's transport system is at a crossroads. Our current transport funding model, heavily reliant on fuel excise duty (FED), is not merely straining under pressure – it is fundamentally broken. Each passing year widens the gap between revenue collected and investment needed to maintain and improve our roads. Congestion worsens, maintenance backlogs grow and the very foundation of our national road network frays a little more.

But these challenges also present an opportunity – an opportunity to not just patch over the cracks, but to rebuild our transport funding system from the ground up. The solution proposed in this report, a comprehensive distance-based road pricing scheme called Smart RUC, represents a bold step towards a more rational, efficient and sustainable transport future. In fact, Smart RUC constitutes the most ambitious reform of transport funding in New Zealand since the introduction of motor taxes in the early 20th century.

Smart RUC is not just about plugging a funding gap. It is about fundamentally rethinking the way we pay for and manage our roads. Under Smart RUC, those who use the roads the most, and cause the greatest wear and tear, would contribute the most towards their upkeep. Those who drive less, or who opt for lighter or more eco-friendly vehicles, would pay less. This is a model grounded in both economic theory and common sense – one that guarantees the costs of our transport infrastructure are borne by those who use it, while incentivising more efficient use of the network.

Crucially, Smart RUC is not a distant pipedream – it is a concrete and achievable plan. As this report has demonstrated, the necessary technology already exists and has been successfully implemented in jurisdictions around the world. There is a wealth of real-world evidence to draw upon. New Zealand, with its existing expertise in RUC and its strong tradition of pragmatic innovation, is ideally positioned to learn from these examples and adapt them to local conditions.

Of course, the transition to Smart RUC will not be without its challenges. Change on this scale never is. There will be concerns about privacy, fairness and technological reliability. But as this report has shown, these potential obstacles are far from insurmountable. Careful planning, close collaboration between government and industry, and a commitment to public engagement and transparency will enable us to navigate these issues.

Perhaps the greatest challenge will be one of political will. Moving to a comprehensive road pricing model will require firm leadership and a willingness to champion a policy that, while in the long-term public interest, may be initially unpopular. It will require a sustained effort to shift the public narrative, to challenge long-held assumptions about the "right" to drive, and build a shared understanding of the need for change.

But the potential rewards are substantial. Smart RUC promises not just a transport network that is adequately funded and efficiently managed, but one that is safer, cleaner and more equitable. By sending clear price signals about the real costs of road use, it can incentivise a shift towards more sustainable transport modes, helping to decarbonise our transport sector and improve air quality in our cities. At the same time, Smart RUC will generate a stable and predictable revenue stream, enabling long-term planning and investment in critical infrastructure.

And by ensuring that everyone pays their fair share, Smart RUC can also rebuild public trust in the transport funding system.

Ultimately, the transition to Smart RUC is about more than just transport policy. It is about the kind of country we want to be. Do we want to cling to a 20th-century funding model, watching our roads slowly crumble as gridlock chokes our cities? Or do we want to embrace the opportunities of the 21st century, harnessing technology and innovation to build a transport system that is truly world-class?

The choice is ours. But one thing is certain: change is coming to transport funding, whether we like it or not. The question is whether we proactively shape that change, or whether we let it happen to us. This report offers a roadmap for the future – a comprehensive road pricing system that is safer, more efficient and better equipped to meet the needs of all Kiwis. It is a smarter way forward.

New Zealand's current land transport policies have us on a road to nowhere. By implementing a more robust road pricing system, we can change course and build a network that benefits everyone. The time for action is now.

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