



Transportation Association of Canada

Road Pricing in Canada: Opportunities and Challenges

June 2024



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Author(s) Mara Bullock, P.Eng. Nour Elnawawi David Ungemah Hannah van Amelsfort Nico Dogterom		Performing Agency Name and Address WSP Canada Inc. 6925 Century Avenue Mississauga, ON, Canada L5N 0E3
Abstract Road pricing is a form of mobility pricing that includes four main tools: road or bridge tolls (point charges), cordon charges, distance-based charges and area-based (zonal) charges. Road pricing could enable transformative changes that Canadian governments have set as policy goals but struggle to achieve with current tools. However, the only meaningful examples of road pricing implementation in Canada have been road or bridge tolls, and there are complex but very real concerns around the public acceptability and equity impacts of other forms of road pricing. This report explores practical issues related to the use of road pricing to generate revenue, manage congestion, or improve the environmental, economic and social outcomes of transportation systems in Canada. Major consideration is given to the following aspects of road pricing: <ul style="list-style-type: none"> • Program development • Coordination with other forms of mobility pricing • Charge rates • Geographical coverage • Revenue use • Equity • Public engagement and support • Technology and data 		Keywords Traffic Control <ul style="list-style-type: none"> • Economics of transport • Mobility (personal) • Policy • Road pricing • Sustainability • Toll road • Traffic relief
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Project Steering Committee

- Fearghal King, TransLink (Chair)
- John Calimente, City of Vancouver
- Sundar Damodaran, Ontario Ministry of Transportation
- Brian Hollingworth, City of Hamilton
- Eliza Jackson, Halifax Regional Municipality
- Raymond Kan, City of Vancouver
- Bob Leore, Transport Canada
- Rémy Lévesque, Ministère des Transports et de la Mobilité durable du Québec
- Éric Martel-Poliquin, Ministère des Transports et de la Mobilité durable du Québec
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The project was managed by Romaine Morrison, Program Manager, Transportation Association of Canada.

Project Consultants

- Mara Bullock, WSP (Project Manager)
- Nour Elnawawi, WSP
- David Ungemah, WSP
- Hannah van Amelsfort, Goudappel
- Nico Dogterom, Goudappel

Executive summary

Introduction

In cities around the globe, road pricing has proven to be an effective approach to generating transportation revenue and incentivizing preferred travel behaviours. It includes four main tools:

- **Tolls (point charges).** These put a price on the use of a specific road or bridge and are likely the most familiar form of road pricing.
- **Cordon charges.** These are imposed on vehicles when they cross a ring or line of charge points, and typically (though not exclusively) have been implemented to improve congestion and air quality.
- **Distance-based charges.** These “pay-as-you-go” measures charge drivers based on their distance travelled, based on detailed vehicle tracking or on trips made between zones or on specific road segments.
- **Area-based (zonal) charges.** These are similar to cordon charges but instead are a fee for movements between multiple zones, typically charging vehicles for each entry.

Within Canada, road pricing could create new, diversified and sustainable transportation revenue streams while providing governments a tool to influence mobility behaviours and outcomes. By doing so, it could enable transformative changes that governments have set as policy goals but struggle to achieve with current tools. However, the only examples of road pricing implementation in Canada have been fairly conventional road or bridge tolls, and there are complex but very real concerns around the public acceptability and equity impacts of other forms of road pricing.

This report begins with a consideration of the major transportation challenges facing governments today (e.g. urban growth and congestion, climate change, equity and affordability, infrastructure funding, municipal revenue streams, fuel tax revenues), then goes on to explore important practical issues related to the use of road pricing to generate revenue, manage congestion, or improve the environmental, economic and social outcomes of transportation systems in Canada.

Key messages

Road pricing can support key Canadian public policy goals. There is evidence that road pricing can support a range of priority policy goals of Canada’s federal, provincial, territorial and municipal governments. These include raising transportation revenues, recovering capital costs, managing congestion, reducing emissions, encouraging modal shift, influencing vehicle purchase and usage decisions, and supporting equity, fairness and affordability.

Clear communication around objectives is essential. Consideration of road pricing by a jurisdiction necessitates clarity of thought and communication around overall objectives. Road pricing is typically proposed as a means of changing behaviour, raising revenues, and/or promoting fairness and equity – but these goals are connected by synergies and tensions in ways that are not always obvious. Thorough engagement and scenario testing are essential to understanding how adjustments to various road

pricing “levers” may yield different outcomes. Methodical analysis can inform (and likely moderate) aspirational messages like “This road pricing plan will reduce congestion by X% and generate \$Y billion in revenue”, to avoid unrealistic promises that can erode public trust and support.

The broader mobility pricing context matters. The synergies and tensions between existing forms of mobility pricing and any new road pricing application are important to acknowledge and understand. There are inevitable interactions between road pricing tools and parking charges, fuel and carbon taxes, existing tolls, and vehicle registration fees – and the planning process would need to address concerns about equity, affordability and accountability. The various roles and authorities of different orders of government can complicate the search for balanced solution, particularly where the best path (for example) is to offset road pricing revenues to one government by reducing taxation by another government.

Road pricing requires governmental coordination. Collaboration among governments is needed to identify and resolve the mobility pricing interactions described in the previous paragraph; in addition, municipalities seeking authority to implement road pricing may require enabling provincial legislation, which in turn requires political alignment. There are also other reasons for governments to partner on strategies in support of shared objectives, and on analyses that fully recognize the transformative potential of road pricing. For example, optimizing the equity outcomes of a municipal road pricing strategy could involve offsets, rebates or credits delivered through changes to provincial programs (e.g. income tax, fuel tax, sales tax, registration fees, insurance premiums).

Rates, coverage and revenue use offer flexibility. Variations in geography, urban form, travel patterns, and political and fiscal environments mean that road pricing cannot be a one-size-fits-all solution. During the planning and design of a strategy that supports local goals, three of the most important road pricing “levers” to be tested are the rates charged, the coverage area, and how revenues are used. In doing so, stakeholder engagement is an important addition to methodical modelling.

Equity is a vital consideration. Road pricing is neither inherently equitable nor inequitable, neither fair nor unfair – like almost all public policy choices, it can lead to both positive and negative outcomes. Equity is always a prominent consideration in road pricing (and, increasingly, is also a key goal) and the realities around any proposal will inevitably be complex and nuanced, defying both simplistic accusations and assurances. Stakeholder concerns about equity, fairness and affordability outcomes may be grounded in reality and/or used as political wedges to impede progress; regardless, they deserve to be understood and explored. Equity concerns are best identified, assessed and addressed in a transparent manner, taking advantage of caps, rebates, exemptions, discounts and subsidies to minimize unintended consequences.

Building public acceptance and political support is essential but complex. The early involvement of experts in stakeholder engagement is a wise part of any road pricing study, and the audiences to include are both numerous and varied. The time required to move from concept to implementation affords an opportunity to engage with groups and individuals, overcome distrust, build relationships, and create alliances that support both effective analysis and responsible decision making. Many lessons can be learned by examining the mistakes and successes of other jurisdictions.

New technologies bring new opportunities. Long-proven technologies enable many forms of road pricing. While technology innovations are likely to open new doors to more dynamic pricing applications, their early adopters will be closely watched. From a practical perspective, the most likely

barriers associated with new road pricing technologies include cost, administrative complexity, privacy and security.

Further work

There are still many uncertainties around the issue of road pricing in a Canadian context. Additional research in the following areas would be constructive:

- Modelling and assessment of the price elasticity of travel demands and the potential impacts of additional pricing signals on emissions and congestion, especially in areas with limited mobility options and a high degree of reliance on automobiles.
- Canadian mobility trends since the COVID-19 pandemic, reflecting ongoing shifts in hybrid work and online activities.
- The projected market uptake of electric vehicles among consumers, and the associated impacts on fuel tax revenues.
- The impacts of road pricing on freight carriers, shippers and fleet managers, and their possible responses in terms of business location, shipping mode and route decisions.
- Understanding the relationship between road pricing, transport poverty and equity, especially in the context of small and medium-sized communities.
- Emerging technologies in road pricing, and best practices to harness their potential while mitigating risks.

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1. Introduction

1.1 Background

The Canadian transportation landscape has seen dramatic changes in recent years, stimulated by new technologies and shifts in demand for both passenger travel and goods movement. All orders of governments are grappling with revenue gaps, funding pressures, vehicle electrification, climate change, aging infrastructure, congestion, and residual impacts of the COVID-19 pandemic.

The need for long-term change seems both necessary and inevitable – and a wide range of tools that put a price on various aspects of multimodal mobility could play a role in this transformation. Road pricing is one such approach – and while highway and bridge tolls are well established types of road pricing, shifting priorities and advancing technologies are driving interest in more sophisticated and comprehensive approaches.

Around the globe, road pricing is understood to be an effective tool for generating transportation revenue and incentivizing preferred travel behaviours. However, in a Canadian context there are few examples of non-conventional road pricing having been considered, let alone implemented – and there are complex but very real concerns around its public acceptability and equity impacts.

This report explores important practical issues related to the use of road pricing in a Canadian context as a tool to generate revenue, combat congestion, or manage the environmental, economic, or social outcomes of transportation systems.

1.2 Key issues shaping mobility in Canada

Several issues provide important context for any possible change to how mobility is managed in Canada.

COVID-19 pandemic. The pandemic may have accelerated pre-existing trends such as remote work, e-commerce, suburbanization, and rising housing costs that are impacting mobility patterns in communities of all sizes, but particularly those with large downtowns¹. It also illustrated the vulnerability of municipal and regional transport authorities to economic shocks; as a result, some governments have begun to develop sustainable financial frameworks, with Toronto and Vancouver undertaking reviews of their municipal revenue sources^{2,3}.

Urban growth patterns. Canadian cities are growing, with international immigration and internal migration being major factors⁴. Over 70% of Canadians live in cities, a proportion that continues to increase, and 80% of metropolitan Toronto's population is housed in suburban areas. These realities impact rates of motor vehicle ownership and use, the potential for shifts to transit and active transportation, and the urgency of reducing travel's environmental impacts.

Congestion. Major urban centres in Canada experience heavy levels of congestion, with resulting economic costs of about \$7 billion in the Greater Toronto area, \$1.7 billion in the Greater Montreal area, and \$1.4 billion in the Metro Vancouver area⁵. Congestion has well documented negative impacts on individual access to opportunity, equity, health, and economic productivity.

Climate change mitigation. Canada ranks among the top ten countries in terms of both per capita and total emissions – and in 2020, emissions from Canada’s transportation sector were 24% of our national total, second only to the oil and gas sector. Climate action is a priority area for all levels of the Canadian government, with 2030 and 2050 targets set by federal, provincial, and municipal governments. In 2021, the federal government passed the *Canadian Net Zero Emissions Accountability Act*, which established 2050 carbon emission targets. Provincial governments have established their own targets in line with the federal goals; British Columbia, for example, has set greenhouse gas emission reduction targets for 2030, 2040 and 2050 of 40%, 60% and 80% relative to 2007 greenhouse gas emission levels, respectively⁶. Furthermore, between 2019 and 2022 around 650 municipal governments declared climate emergencies.

Equity and affordability. Transport equity – or the distributive impact of transportation policies across geographies and populations – is becoming a priority for many jurisdictions that recognize the strong correlation between access to opportunity and socioeconomic health. A total of 1.3 million Canadians, including 5% of people in our largest cities, are living in transport poverty – a state that reflects both low income and low transport accessibility⁷. Linkages between housing affordability and transport are exacerbating equity concerns, with rising housing costs in urban centres causing people to move to suburban and rural areas where fewer transportation options exist. While Canadian governments have invested heavily in public transit infrastructure in recent years, there remains a great need to address transport poverty through future mobility strategies.

Fairness. Whereas equity is concerned with the distribution of costs and benefits among vulnerable individuals and other groups, the concept of fairness revolves around the possible perception of paying more than once for a given service. Transparency and clarity of communication around goals, principles and mechanisms are critical to effectively addressing fairness in program delivery.

Infrastructure funding. For several years there has been an underinvestment in maintaining the state of good repair of urban transportation infrastructure⁸. The *Canadian Infrastructure Report Card* for 2019 identified substantial risks and called for significant re-investment in coming decades. It found that the about 40% of roads and bridges were in fair or worse condition, and that 80% were more than 20 years old. The *State of Infrastructure in Canada* revealed that in 2020 a total depreciation of \$69 billion was just below total investment levels of \$82 billion^{9,10,11}. Infrastructure maintenance is a cost borne by municipal and provincial governments, which must finance these activities even as assets deteriorate and expansion needs continue.

Municipal revenue streams. Canadian municipalities manage about 60% of the public infrastructure that drives economic activity, but they receive only 10% of Canadian tax revenues. They also have a limited set of revenue tools and depend heavily on property taxes. Increasing property taxes is never popular among the public, and cities have limited options – meaning that their practical ability to finance services is susceptible to shocks. Both Vancouver and Toronto have begun reviews of their existing suite of revenue tools, in coordination with their respective provincial governments, to identify new opportunities for sustainable funding^{12,13}.

Fuel tax revenue. Fuel taxes on the sale of gasoline, diesel and propane generate revenue for senior orders of government, with federal revenues directed to the Canada Community-Building Fund (formerly known as the Gas Tax Fund). Federal gas taxes have decreased in recent decades due to improvements in fuel efficiency and the transition to electric vehicles^{14,15}. Regional fuel taxes also exist in British Columbia and Quebec; TransLink estimates that fuel taxes will account for only 13% of its

operating revenue by 2031, down from 24% today¹⁶. Similar trends are occurring in the United States and European countries, and could constrain the ability of many jurisdictions to fund infrastructure improvements.

1.3 About this report

The purpose of this report is to support a practical assessment of road pricing opportunities and challenges by interested jurisdictions. Chapters 2 through 4 draw on both domestic and international experience, with a view to the key issues identified in the previous section:

- **Chapter 2 – Pricing mobility: An overview** outlines the broad range of tools and rationales for placing a price on mobility and distinguishes between mobility pricing and road pricing.
- **Chapter 3 – Considerations for road pricing in Canada** briefly identifies the historical extent of road pricing consideration and application in Canada, then provides more in-depth consideration of the major issues that would need to be addressed by any consideration of road pricing in a Canadian context.
- **Chapter 4 – Summary** identifies eight key messages for readers based on the information presented and identifies some valuable areas of additional research.

2. Pricing mobility: An overview

This chapter introduces the subject of why and how governments and service providers put a price on various dimensions of mobility:

- **Section 2.1** discusses five common goals of transportation authorities and how mobility pricing can support them.
- **Section 2.2** illustrates typical approaches to mobility pricing in Canada and internationally.
- **Section 2.3** explains the distinction between the broad field of mobility pricing and a narrower set of road pricing applications.

2.1 Rationales for pricing mobility

The following subsections discuss five key reasons that governments and transportation authorities put a price on various aspects of mobility for people and goods.

2.1.1 To increase and diversify revenue

Mobility pricing allows jurisdictions to generate revenue by charging for the use of transportation services and infrastructure; the many different forms of such pricing include vehicle purchase levies, vehicle registration fees, gas taxes, road tolls, parking charges, transit fares, and taxi fare surcharges. Some of the funds raised may be segregated to support transportation-specific expenses, while others simply end up as part of general government revenues.

2.1.2 To reduce greenhouse gas emissions

Transformation towards low-carbon mobility is complex, but the required actions can be distilled into three types¹⁷:

- Improving vehicle fuel efficiency
- Shifting to low-carbon fuels
- Influencing travel behaviour

Vehicle fuel efficiency is largely being addressed by technology trends and government mandates, but mobility pricing can have an impact on consumers' vehicle purchasing decisions (e.g. via fuel taxes in Canada, or in some countries via vehicle registration fees that are tied to vehicle size or efficiency).

Pricing vehicle-miles travelled in the United States

In the United States, odometer-tracking programs in Oregon, Virginia, Utah and Hawaii allow drivers to pay a vehicle-miles travelled fee that would replace lost revenues from fuel taxes. Hawaii and Virginia offer electric vehicle owners a vehicle-miles travelled fee option instead of paying a user fee, whereas Oregon and Utah offer that option instead of the fuel tax.

Mobility pricing can play an important role in consumer decisions around electric vehicles. Examples include programs to subsidize electric vehicle purchases, reduce annual registration fees for electric vehicles, or encourage scrapping of inefficient vehicles. Such mechanisms are well established in Europe and have proven to be highly effective. Canada’s federal Incentives for Zero-Emission Vehicles (iZEV) Program offers rebates up to \$5,000 (in 2023) for vehicles that meet specific requirements, and provincial incentives exist for the purchase of electric vehicles and installation of home charging infrastructure.

Mobility pricing can also support objectives to reduce greenhouse gas emissions from the use of motor vehicles – and those objectives can be ambitious, with (for example) the City of Ottawa estimating a 58% reduction in daily car trips would be needed to achieve its 2030 targets for greenhouse gas emissions¹⁸. Setting higher prices for driving or parking, and lower prices for public transit, are common pricing strategies; these approaches can be more dynamic (i.e. varied by time or place) than charges related to vehicle or fuel purchases.

2.1.3 To manage congestion

The scale and intensity of congestion varies among Canadian cities. It can be found in downtown areas, arterial roads and highways, bridges and other natural bottlenecks, and in suburban town centres. It can occur in different locations at different times of day, and in different directions of travel. It can be the result of regular commuting patterns, special events, collisions or construction. Its impacts include delay, lost productivity, costs to business, stress, collisions and pollution; at greater levels, it can reduce personal opportunity for employment and education¹⁹.

While conventional pricing tools like fuel taxes are neither effective nor efficient measures to address congestion, there is ample evidence to suggest that mobility pricing can be effective in reducing congestion by charging drivers to use roads at certain times and locations. Raising the incremental costs of driving “there rather than here,” or “later rather than now,” will induce some drivers to change their behaviour – whether that means travelling at a different time, choosing a different destination, taking a different route, choosing a different mode, or making a trip less frequently. Research has shown that changing the behaviour of only a small proportion of road users can have a proportionally greater impact in terms of congestion reduction.

2.1.4 To encourage modal shift

Private cars remain the dominant mode for commuting in Canadian cities, with a typical mode share of more than 70%²⁰, and many communities have made modal shift a strategic priority in their long-range transportation plans. The City of Edmonton has stated that “Encouraging fewer single-occupant vehicle trips reduces the pressure on the roadway system and reduces the need for increased roadway investment. Moving more people in proportionately fewer vehicles adds to overall transportation system efficiency, minimizes environmental impacts and maximizes the effectiveness of financial investments in the transportation system. It also increases the efficiency of goods movement²¹.”

Pricing high-occupancy vehicle lanes in Ontario

In Ontario, vehicles with “green” license plates (i.e. electric or plug-in hybrid vehicles) are permitted to travel in high-occupancy vehicle lanes regardless of how many people are in the car. Other drivers may purchase a three-month sticker for \$180 that allows them to drive a single-occupant vehicle in high-occupancy vehicle lanes on the Queen Elizabeth Way, Highway 403 and Highway 410.

Price is not the only factor that plays into travel decisions, but it is a significant one. A range of mobility pricing measures can support modal shift away from automobiles by establishing financial disincentives for car use or financial incentives for travel by other modes. Such measures tend to be more effective when the facilities and services for non-car modes are attractive, and the use of mobility pricing revenues to improve travel choices is a common strategy. Transit is a major option in many communities, but far from the only one – others include carpooling, active transportation, micromobility, or remote work²².

Comparing travel costs by car and transit

LA Metro's traffic reduction program benchmarks the distance-based cost of car travel against the equivalent transit fare to ensure that there is always a cheaper alternative to private vehicle use.

2.1.5 To promote equity and affordability

Transportation decisions are typically made with an eye toward the expected impacts on different aspects of system performance such as travel speeds, traffic volumes, vehicle-kilometres travelled, transit ridership, costs and revenues²³. More qualitative issues such as those related to the experience of customers, or to the way that impacts are distributed among different groups, receive less attention. Because of this, transportation systems typically feature an inequitable distribution of transport access and opportunity among individuals²⁴.

In recent years, social equity has been a subject of growing interest to transportation practitioners and decision makers in North America, who are increasingly exploring how transportation benefits and burdens are distributed, and how an 'equity lens' can help plan a better system. Benefits and burdens of a transportation system include things like access to opportunities (jobs, health care, recreation, education), travel time, congestion, exposure to noise and air pollution, and out-of-pocket costs. An equity lens might consider how any proposed transportation policy or investment could impact outcomes for equity-deserving groups compared to the general population. Equitable design in transportation policy is aimed at identifying and reducing disparities across system users²⁵; as one example, TransLink has used social equity as one of three strategic lenses (alongside reconciliation and resilience) to guide and shape its long-range planning strategies.

Mobility pricing can promote equity and affordability in three distinct ways:

- **Using pricing to target existing inequities.** Many transportation-related challenges facing societies today fall disproportionately on equity-deserving groups. Indigenous and racialized communities, low-income communities, and persons with disabilities can be more vulnerable to traffic congestion, noise and air pollution, collisions, and climate change impacts. Pricing can address and mitigate these inequities, such as by applying user charges to highways running through or adjacent to low-income neighborhoods.
- **Mitigating possible inequities of pricing measures through caps, rebates, exemptions, discounts and subsidies (known as CREDS).** Concerns that mobility pricing is inequitable, unfair and unaffordable can be addressed through program design and tools such as caps on daily fees, rebates for different vehicle types, exemptions or discounts for low-income communities or people with disabilities, and subsidies for people living inside cordon areas.
- **Allocating revenues to support investments or tax shifts.** The revenues that can be generated from mobility pricing provide an opportunity either to offset existing charges (such as sales, fuel, parking, property or income taxes) for equity-deserving groups, or to invest in transit or active transportation options that benefit them.

2.2 Approaches to pricing mobility

Just as mobility pricing has several possible rationales, it also takes different forms:

- Payments to use or access a service (e.g. transit) or facility (e.g. highway or parking lot), by trip or by unit of distance
- Payments applied to vehicles by occupancy such as single-occupant, 2+ occupants, 3+ occupants or (potentially, with automated vehicles) zero occupants
- Payments applied to different vehicle types such as electric vehicles, internal combustion engine vehicles, commercial vehicles, heavy vehicles, loud vehicles or motorcycles
- Payments applied at fuel points such as gas pumps or electric vehicle charging stations

Pricing can also vary by location, time of day, or vehicle type. These dimensions can be combined – for example, an annual vehicle registration fee could include a premium for older, inefficient vehicles to encourage their retirement; or a bridge toll could augment a per-trip fee (to recover capital costs) with a time-of-day fee (to discourage peak period congestion).

In Canada, the most likely practical applications of mobility pricing are:

- **Fuel or carbon taxes.** These are applied to each unit of fuel by federal and provincial governments. Fuel taxes typically represent a general revenue mechanism to offset transportation system costs. Carbon taxes consider a fuel's hydrocarbon intensity, and are intended to account for the environmental damage imposed by carbon emissions and influence decisions by consumers and businesses.
- **Vehicle registration fees.** These are charges to register a vehicle to a driver or household, usually paid annually. In Quebec, vehicle registration fees are based on engine capacity and the number of cylinders²⁶.
- **Vehicle use fees.** These are typically applied as a surcharge on a vehicle registration fee, notably for electric vehicles to recapture lost fuel taxes. Saskatchewan is the only Canadian jurisdiction to apply a vehicle use fee on electric vehicles, and uses the revenue for road and highway maintenance²⁷. One limitation of this example application is that it does not account for a vehicle's actual impact on the road as a result of its size or usage²⁸.
- **Point-based road fees.** These are typically applied at a single point of entry and/or exit of a facility, such as a toll on a bridge or highway. They also include fees for areas defined by a congestion cordon or low-emission zone.
- **Distance-based road fees** are applied on a per-kilometre basis or segment/zone basis (e.g. travel between adjacent interchanges). They can be layered with additional charges to reflect the external impacts of a trip, such as emissions or delay to other road users, as a function of actual conditions.
- **Parking fees.** These are charges for the use of on-street or off-street parking spaces. While Canadian governments typically only control fees for on-street or off-street spaces that they own, they could apply a per-space levy on private parking facilities or a surcharge on private parking transactions.
- **Area permit fees.** These are charged to register a vehicle and allow its operator to access or park in a particular area. They are usually collected annually.

- **On-demand mobility fees.** These are charges to individuals for their use of shared mobility services (e.g. taxis, ridehailing, carsharing, bikesharing, shared e-scooters). These services are usually operated by private companies and governmental control over fees may be limited.
- **Curbside access fees.** These are an emerging practice and are typically charged to commercial vehicles using designated spaces in congested areas for short time periods (e.g. allowing delivery vehicles to load or unload without inefficient circulating or parking illegally). They can be part of a curbside space reservation process, and could be extended to shared ride providers or members of the public (e.g. at airports).
- **Transit fares.** These are charged for use of public transit infrastructure and services. They may vary by time or distance, and concession fares can benefit users in certain age or income groups.
- **Distance-based insurance costs.** These insurance premiums reflect the distances actually driven by consumers, with higher usage leading to higher premiums. In Canada, the Canadian Automobile Association's MyPace insurance program measures distance using a small wireless device that plugs into a vehicle's on-board diagnostics port, and bills motorists for each 1,000 kilometres driven.

Putting a price on mobility creates the opportunity to change traveller behaviour – not only by charging for something that might previously have been free or less expensive, but by opening the door to waiving or reducing fees as a way of inducing preferred behaviours (e.g. curbside access fees can be waived for electric vehicles). Such inducements can be coordinated and amplified through integrated pricing platforms (sometimes called mobility-as-a-service) that can bundle and discount prices for single trips that require several modes (e.g. ridehail plus transit plus bikeshare). Governments could use mobility-as-a-service platforms to offer dynamic, individualized pricing that makes alternatives to driving more competitive.

2.3 Distinguishing between mobility pricing and road pricing

Whereas “mobility pricing” covers all aspects of how people and vehicles move around, the narrower term “road pricing” references ways that motor vehicle users can be charged directly for their use of road facilities.

The remainder of this report focuses on the challenges and opportunities that road pricing mechanisms present in a Canadian context. The decision to focus this project on road pricing specifically, rather than on mobility pricing more generally, reflects the following objectives:

- **To inform discussions on road pricing in Canada.** Many conventional mobility pricing mechanisms are well established and understood in Canada (e.g. fuel taxes, vehicle registration fees, parking charges). In contrast, road pricing mechanisms are evolving quickly in other countries and have not received the same exposure within a Canadian context. This report is an opportunity to examine recent international experiences in road pricing, including several that have been transformative, through a Canadian lens.
- **To recognize the potential alignment of road pricing with a variety of public policy goals.** Road pricing mechanisms have been demonstrated to offer effective support for each of the major policy challenges that Canadian governments are grappling with, as discussed in Section 2.1.

- **To recognize the flexibility of road pricing applications.** Road pricing measures are more scalable, targeted and dynamic than other “blunt” forms of mobility pricing. They can:
 - Be tested and applied at many geographic scales.
 - Vary charges by time or context.
 - Address the use of certain vehicle types.
 - Address equity concerns through caps, rebates, exemptions, discounts or subsidies.

3. Considerations for road pricing in Canada

This chapter addresses several considerations for road pricing applications in a Canadian context:

- **Section 3.1** introduces the four main categories of road pricing tools.
- **Section 3.2** reviews historical experiences with road pricing across Canada.
- **Section 3.3** addresses the process of developing a road pricing program.
- **Section 3.4** explores the interactions between road pricing and other forms of mobility pricing.
- **Sections 3.5 to 3.7** address rate setting, geographical coverage and revenue use, which are the main tactical parameters of road pricing programs.
- **Section 3.8** discusses equity concerns, equitable program design, and equity measurement.
- **Section 3.9** explores stakeholder engagement, communications, public acceptance and political support.
- **Section 3.10** reviews issues related to technology and data.

3.1 Tools for road pricing

The four main categories of road pricing tools are:

- **Tolls (point charges).** These put a price on the use of a specific road or bridge and are likely the most familiar form of road pricing. Tolls can generate funding for infrastructure and support efforts to reduce congestion. Specialized forms of tolling include high-occupancy toll lanes, which incentivize carpooling.
- **Cordon charges.** These are imposed on vehicles when they cross a ring or line of charge points, and typically (though not exclusively) have been implemented to improve congestion and air quality. One well known example is the London, U.K. congestion charge which is a daily fee to enter the cordon area. Low-emission zones or zero-emission areas are similar applications of cordon-type systems.
- **Distance-based charges.** These “pay-as-you-go” measures charge drivers based on their distance travelled, based on detailed vehicle tracking or on trips made between zones or on specific road segments. Distance-based charges can complement other tools such as bridge or highway tolls. Distance-based charges have been used for freight in Austria, Switzerland and Germany to account for the impact of trucks on road conditions and the environment. Oregon’s OReGO program applies a distance-based charge for use of the state’s highway network.
- **Area-based (zonal) charges.** These are similar to cordon charges but instead are a fee for movements between multiple zones, typically charging vehicles for each entry.

Within the realm of mobility pricing, these tools are particularly powerful because they can directly influence a traveller’s choice of destination, mode and timing on a trip-by-trip basis.

3.2 Canadian experiences with road pricing

British Columbia

- Vancouver's Lions Gate Bridge opened in 1939 as a toll bridge, but the toll was removed in 1963.
- Provincial tolls on the Coquihalla Highway were applied in the 1980s and removed in 2008 once the costs of construction had been recovered.
- Comprehensive road pricing approaches were first proposed in *Transport 2021*, the long-range regional transportation strategy adopted by the Greater Vancouver Regional District in 1993.
- The only implementation of road pricing in British Columbia was on the Golden Ears and Port Mann bridges, which were both tolled for revenue generation and cost recovery purposes. The tolls were removed by the provincial government after an election in 2017.
- A study by the Mobility Pricing Independent Commission was initiated in 2017 to explore "decongestion charging" in Metro Vancouver. The study found that a regional point-based or distance-based pricing system could substantially reduce congestion, raise significant revenues and potentially address concerns about equity and fairness.
- In 2020, the City of Vancouver's Climate Emergency Action Plan deemed "transport pricing" to be integral to the plan's success. However, the City abandoned any plans after municipal elections in 2023.

Alberta

- In 2020, the Province of Alberta introduced Bill 43, which involved replacement of a ferry service across the Peace River with a bridge to be financed by a toll²⁹.
- The City of Calgary is proposing to study road pricing as a possible way of mitigating a decline in fuel tax revenues³⁰.

Ontario

- The Burlington Bay Skyway and Garden City Skyway were tolled until 1973.
- Highway 407 is a limited-access freeway across the Greater Toronto Area that has been tolled since the late 1990s. Most of the highway is leased by the Province of Ontario to the 407ETR Concession Company Limited, which operates the facility as the 407 Express Toll Route (407ETR). A small portion (known as Highway 407 East) is operated by the Province with tolls set by the government and collected by the concession company before being sent to provincial coffers. Highway 407 tolls are charged per kilometre of travel, with the rate varying by type of vehicle, direction of travel, time of day, day of the week, and location³¹; the toll system is all-electronic, using vehicle transponders and license plate video detection. By increasing the rate during peak demand periods, the operator strives to maintain free-flow conditions on the highway. While high tolls for commercial vehicles may have discouraged its use by trucks, studies show that Highway 407 saved an annual average of 23 million hours for commuter vehicles and almost 8 million hours for commercial vehicles, from 1999 to 2017³².
- Highway 412 and Highway 418 were tolled as part of Highway 407 East until 2022, when the Province removed the tolls.
- In 2015, the City of Toronto asked the Province of Ontario for authority to implement tolls on the Don Valley Parkway and Gardiner Expressway, in order to combat congestion and generate

funds for rehabilitating those roads. The City's analysis of tolling options considered flat and distanced-based fee structures over alternative cost-recovery periods of 10 and 30 years. The request was rejected by the provincial government on the basis that the proposed tolls would impose high costs on households without adequate travel alternatives being available^{33 34}.

- The Ministry of Transportation of Ontario has operated a sticker-based high-occupancy toll pilot project on parts of the HOV lanes on the Queen Elizabeth Way since 2016, and on Highway 403 and Highway 410 since 2021. Single-occupant vehicles that bear a purchased sticker can travel in the high-occupancy vehicle lane. In 2016 the Ministry announced that high-occupancy toll lanes would also open on Highway 427; an all-electronic tolling system with dynamic pricing was developed, but when the project opened in 2021 it only included regular high-occupancy vehicle lanes.
- Several international crossings from Canada to the United States are tolled.

Quebec

- Historical tolls on several major facilities have been discontinued, including the Champlain Bridge (tolled until 1990) and the Jacques Cartier Bridge (tolled until 1962).
- The Olivier-Charbonneau Bridge between Montreal and Laval was delivered in 2011 through a concession contract, with an all-electronic toll system that charges by time of day and vehicle height. Through a program of the Quebec government, the bridge is free for electric vehicles.
- Autoroute 30 Express was delivered in 2012 through a 30-year concession contract, and completed A30 between Chateauguay and Vaudreuil-Dorion. A bridge across the St. Lawrence River is tolled based on vehicle height and number of axles. Similar to the Olivier-Charbonneau Bridge, the Quebec government has implemented free crossings for electric vehicles.

New Brunswick

- The Saint John Harbour Bridge was tolled until 2010.

Nova Scotia

- The Angus L. Macdonald Bridge and A. Murray MacKay Bridge across Halifax Harbour have been tolled since the Macdonald bridge opened in 1955. Rates are currently based on a vehicle's number of axles and the presence of dual rear wheels.
- Cobequid Pass is a 45-km tolled section of Highway 104, which was delivered through a public-private partnership. Since 2022, only passenger and commercial vehicles registered outside Nova Scotia must pay a toll; the rate for commercial vehicles is based on axle count.

Prince Edward Island

- The Confederation Bridge is a 12.9-km toll bridge that has connected New Brunswick and Prince Edward Island since 1997. Users leaving Prince Edward Island pay a toll based on their vehicle's axle count.

3.3 Road pricing program development

The process of planning, designing, piloting, and implementing a road pricing program can involve multiple government agencies and stakeholders, public engagement, and user testing. It is non-linear and requires both iteration and nuance; the need for consensus is also vital, as a lack of political and

public acceptance has led to the cancellation of various projects. Figure 1 illustrates a conceptual roadmap for road pricing program development, adapted from an American jurisdiction.

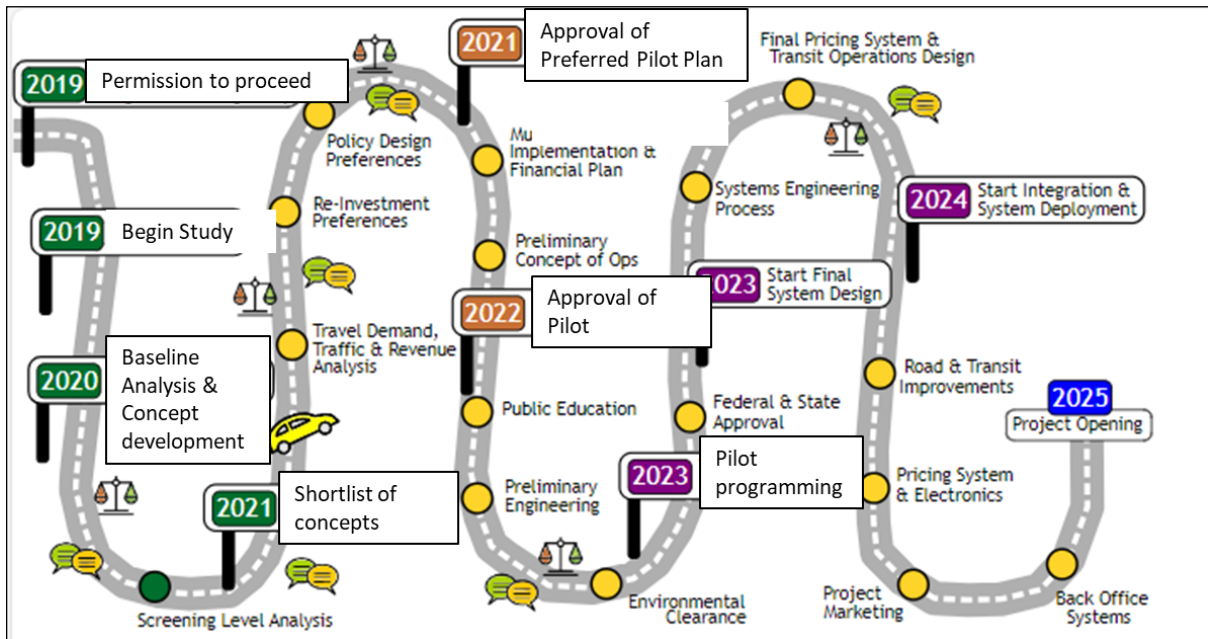
The following paragraphs describe several fundamentally important aspects of road pricing program development, leading up to implementation.

Definition of the problem. A jurisdiction must first frame its problems and needs in the larger context of its mobility system. This can involve questions such as “What challenges do we face?”, “What are their implications over the next 10 to 30 years?”, and “How do we prioritize them?” An understanding of the relationship between priority challenges and pricing is an important part of the groundwork for policy design, and serves to anchor feasibility studies that test various options. Problem definition is also an opportunity for early public engagement by inviting a discussion of public concerns and building a human-centred baseline. For example, early public engagement in Seattle’s congestion pricing study led to analysis of an equitable mobility program³⁵.

Definition of key objectives, outcomes and indicators. Having clear objectives helps programs to effectively and consistently rationale and other key messages to stakeholders. An evidence-based and problem-based list of intended outcomes, key objectives and measurable indicators will support testing of various options, whether through simulation or pilots. It will also allow for clearer follow through of technical and feasibility analysis, and ensure that program validation can be benchmarked against those goals and performance indicators.

Feasibility, functional and technical studies. A variety of studies are needed to understand if a road pricing program can address priority challenges, how it might be designed, and what important legislative, political, social, and technological considerations exist. Feasibility studies may provide an early “proof of concept” through high-level scenario testing that engages the public, and offer an opportunity to integrate lessons learned from other projects across Canada or around the world. Functional or technical studies allow an exploration of how a road pricing program could support key objectives by developing scenarios that apply different levers (e.g. who and what is priced, what the boundaries are, how revenue is used) with adjustments to one having an impacting on the others (see Sections 3.5 to 3.7); the transportation models used in these studies offer insight into possible outcomes, but cannot provide all the answers and do not account for political realities. This work is often iterative, may need multiple phases of analysis, and timelines can be greatly affected by both the extent of public engagement and the need for legislative change.

Legislative constraints. Municipal governments in Canada require provincial approval to generate revenue outside of predetermined channels. They do have authority to enact “(1) a charge for a publicly provided good or service, (2) where the revenues from the fee are solely used to offset the costs of providing the good or service, and (3) the size of fee is dictated by the cost of providing the good or service³⁶”. One example of such a user fee would be the charge for occupying an on-street parking space; no Canadian municipality has attempted to implement distance-based road user fees through this mechanism. Provincial implementation of road pricing would also require legislative or regulatory changes. For example, the *Financing Alberta’s Strategic Transportation Act* (Bill 43) allows government tolls to recover the cost of new or expanded roads and bridges; and in Ontario the removal of tolls from Highway 412 and 418 required changes to the *Highway 407 East Act*.

Figure 1: Conceptual process for developing a road pricing program


3.4 Coordination between road pricing and other forms of mobility pricing

As discussed in Section 3.2, road pricing applications in Canada are currently limited to highway and bridge tolls and high-occupancy toll lanes. In contrast, a wider range of mobility pricing applications are in use, including:

- Fuel and carbon taxes
- Parking fees
- Transit fares
- Vehicle insurance costs
- Annual vehicle levies

Jurisdictions considering road pricing must weigh how road pricing measures could align with or detract from other forms of mobility pricing. They will examine what transportation system users already pay for, how different tools might interact, and what the impacts of any changes to the overall pricing system might be. It is necessary to consider how a tool controlled by one agency could impact other jurisdictions – for example, federal and provincial governments are responsible for fuel and carbon taxes, while vehicle registration is usually facilitated by the province, and parking and local road maintenance are municipal mandates. It is important to understand the degree to which different pricing policies are coordinated and aligned with one another to support regional, provincial, or federal goals and objectives.

Beyond the need for alignment and coordination, the Metro Vancouver Mobility Pricing Independent Commission also anticipated and heard stakeholder concerns around “double taxation” and a desire for low charge rates. The key to navigating these conversations is to understand the purpose and

effectiveness of existing mobility pricing measures, evaluate the impacts of applying additional road pricing measures, and apply a robust and strategic communication strategy.

3.4.1 Fuel and carbon taxes

Fuel taxes in Canada are a main source of public funding for transportation infrastructure. A portion of federal fuel taxes are used to fund infrastructure projects through the Canada Community-Building Fund (formerly the Gas Tax Fund) and provincial fuel taxes are used for infrastructure maintenance and rehabilitation. Transportation authorities in the Montreal, Victoria and Vancouver regions also levy their own fuel tax in addition to provincial fuel taxes.

Carbon taxes are based on a fuel's carbon intensity and put a cost on carbon pollution, and are collected in most provinces and territories. The revenue is returned directly to the province or territory where it was collected in the form of Canada Carbon Rebates (formerly Climate Action Incentive Payments) to households, businesses, farmers and Indigenous groups. Provinces and territories not participating in the federal program are implementing their own pricing systems, for example British Columbia's carbon tax³⁷ and Quebec's cap-and-trade system³⁸.

The primary purpose of road pricing programs is typically to influence transportation system outcomes such as congestion and emissions. However, Vancouver's Mobility Pricing study showed that the revenue-raising potential of road pricing can be substantial – this is because of the level of pricing that would be required to shift individual transportation behaviours. The Mobility Pricing Independent Commission heard public concerns that the proposed price levels were too high; as an alternative approach, the concept of charging one dollar for each major bridge crossing in the region was studied but analysis showed it would be too low a charge to have a meaningful impact on congestion. The Mobility Pricing Independent Commission proposed that concerns about “double taxation” could be addressed by reducing existing fuel or carbon taxes to offset any new road pricing revenues. A key message conveyed by the Mobility Pricing Independent Commission is that mobility pricing could be about *paying differently* rather than *paying more*.

Finally, both road pricing programs and fuel and carbon taxes can have unequal impacts on urban and rural populations. Travellers in urban and peri-urban areas are more sensitive to changes in the cost of driving because they have better alternatives and many can find a different way to travel. In contrast, rural dwellers are more likely to bear any increase in driving costs simply because they have little choice³⁹. Road pricing programs can account for these equity considerations by including exemptions, discounts, or subsidies on fuel taxes or registration fees (e.g. Oregon's OReGO system⁴⁰). Further, it is important to note that fuel tax revenues are trending downward and are susceptible to external shocks related to the cost of oil and gasoline, with some provinces such as Alberta pausing fuel tax collection to support households⁴¹.

3.4.2 Parking fees

The introduction of road pricing measures in areas where parking fees are the norm can lead to questions about policy alignment, double taxation, and unintended consequences.

There are several possible rationales for parking fees: to generate revenue, to recover the cost of providing parking spaces, or to influence travel choices. In Amsterdam, where about half of all car trips are made by non-residents, increases in the hourly rate of on-street parking led to a reduction of citywide car trips of 2.5% and a 2-3% improvement in daily traffic flow⁴². In the United Kingdom, the City

of Nottingham charged employers a tax on parking provided to employees; revenues were used to fund electrification of transit fleets, and also reduced congestion in the city by 47% over a decade⁴³. In both Amsterdam and Nottingham, initial congestion levels were largely the product of non-residents commuting into the urban area.

How to address perceptions of “double taxation” arising from the addition of road pricing measures to parking fees will depend on an area’s travel patterns and the program’s objectives. Unlike road pricing, changes to parking fees will do little to affect congestion that is caused by traffic passing through an area⁴⁴. For this reason, parking policy and road pricing can be complementary tools offering support to multiple objectives. For example, in tandem with its parking fee structure Amsterdam is establishing and expanding low-emission zones as part of its *Clean Air Action Plan* that aims to make the city emission-free by 2030⁴⁵.

3.4.3 Transit fares

Road pricing programs are often intended to promote a shift from automobile use to other travel modes (e.g. transit or active transportation) through a combination of incentives and disincentives. In many regions, transit is the principal alternative to driving for most trips. Transit fare regimes can be complex, and may vary by time of day and distance travelled, and for different groups such as youth, seniors or low-income households. The development of a road pricing program should give due consideration to the availability and cost of other choices available to motor vehicle users, and where congestion reduction and modal shift are objectives of a road pricing measure then the relationship to transit fares will be an issue to consider.

A user’s decision to take transit rather than drive reflects variables beyond cost – such as the convenience, reliability and speed of transit service. For this reason, road pricing programs often feature integral investments to improve the attractiveness of transit. In general, road pricing measures are more likely to be effective in shifting demand when they affect trips in corridors that feature good existing transit access and strategic transit improvements⁴⁶.

3.4.4 Vehicle insurance costs

Distance-based vehicle insurance policies are currently available through the Canadian Automobile Association. Synergies related to in-car or mobile app technologies, administration and operations could create future opportunities related to road pricing initiatives.

3.4.5 Annual vehicle levies

Annual vehicle levies, registration fees and vehicle-use fees are different names for similar charges that are typically intended to generate revenue for governments. In areas where an annual vehicle levy is collected, the development of road pricing should consider whether and how the two types of charges could be managed to avoid the perception of “double charging”.

Infrastructure maintenance requires a dependable revenue stream, and the recent pandemic showed that use-based fees may not be dependable; in addition, it could be argued that vehicle levies are a justifiable charge for the opportunity to use road infrastructure, regardless of the actual level of use. For these reasons, a balanced approach including both annual vehicle levies and use-based charges could make good sense; the two forms of pricing can also work synergistically, such as by raising the costs of both owning and driving vehicles that are fuel-inefficient.

3.4.6 Bridge and highway tolls

Developing a road pricing program in an area with existing tolls creates many opportunities. Motorists who are familiar with tolling will inherently understand the concept of paying for road use, but they may also be more knowledgeable about (or may assume) negative aspects. As a result, consultation will be different and questions around how these systems will work together can be expected:

- Ease of use will be important – for example, it is unlikely that users would want to purchase and install a second transponder when transponders are used on the existing system.
- The cost of deployment and operation could be reduced by integrating systems such as customer service, billings and collections.
- Legislation and regulation would already be in place to support tolling, but changes would likely be required.

3.4.7 High-occupancy toll lanes

Implementation of road pricing in an area with existing high-occupancy toll lanes should consider similar issues to those identified in the previous section. In areas like Ontario where high-occupancy toll permit technology is basic (i.e. windshield stickers) there could be opportunities to upgrade to a technology-based solution that can respond dynamically to changes in congestion levels or time of day.

3.5 Charge rates

Road pricing charges are set as a function of strategic goals and the socioeconomic and built environment context, and with regard to the need to achieve public and political support. Broadly speaking, the three main considerations with respect to charge rates are: How much is charged? When are users charged? And which users are charged?

Charge rates influence traveller behaviour and revenue generation, and need to be orchestrated with both geographical coverage (see Section 3.6) and revenue use (see Section 3.7). The extent of geographical coverage also has implications for both revenue generation and the use of program revenues.

3.5.1 Setting rates

Charge rates strongly influence the degree to which road users adjust their travel patterns, as well as the amount of revenue generated. However, in a given area or corridor the charge rate that maximizes revenue will not be the same as the charge rate that maximizes congestion reduction or any other transportation system outcome. At some point, any increase in charges will start to reduce demand by an amount that diminishes overall revenue generated⁴⁷. For these reasons, trade-offs will be encountered when pursuing road pricing for the simultaneous purposes of revenue generation and congestion management⁴⁸.

Aligning charge rates with the program goals is important. The City of Toronto's study of tolling on the Don Valley Parkway and Gardiner Expressway used payback periods to evaluate different charge rates, and found that toll rates associated with a payback period of less than 10 years would be so high as to cause drivers to seek alternative routes, with consequential impacts on revenue⁴⁹.

The setting of charge rates must consider the existing cost of travel and the sensitivity of road users to price changes. Price sensitivity (or the price elasticity of demand, in economic terms) refers to the estimated change in road usage resulting from a change in price. It will depend on users' value of time, ability to pay and access to alternative modes, as well as the attractiveness of different travel options; these factors are likely to differ between different users, trip purposes and times of day. Freight trips may be less sensitive to price changes than commuters due to the higher inherent costs and time-sensitive nature of goods movement. However, there is evidence from Vancouver's mobility pricing study that freight trips can be quite sensitive to price changes when free alternative routes are available⁵⁰.

Charge rates are challenging to model accurately, with contextual realities leading to differences between economic theory and practical implementation. Behavioural studies have shown that the change in demand for goods and services is not the same when pricing is applied through different instruments⁵¹. Across Canada, the demand for gasoline consumption is affected more by increases in taxation than by similar increases in supplier price. Households in urban areas are more responsive to changes in fuel costs than those in rural areas, due to factors such as trip length, the availability of alternative modes, and socioeconomic variables such as job requirements⁵².

The Mobility Pricing Independent Commission study⁵³ in Metro Vancouver made the interesting observation that there is often a strong negative public response to proposed pricing policies – but paradoxically, lower charge rates can lead to more opposition. Specifically, the study found that to build support, charge rates should be set at a level that can unlock the potential benefits of reduced congestion and more efficient mobility.

3.5.2 Varying rates by time

One of the strengths of road pricing applications can be their flexibility in when charges are applied, to better meet program objectives. Higher charges during periods of high demand can provide an incentive for travellers to change their mode, travel time or destination⁵⁴, thereby moderating traffic volumes and allowing faster and more reliable travel times for the remaining vehicles.

In terms of temporal variation, charge rates can take three forms:

- **Static pricing** does not change, so users know what to expect. Static rates may vary by class of vehicle, and generate revenue in direct proportion to traffic volumes. They are generally designed to generate revenue⁵⁵.
- **Variable pricing** changes charge rates by time of day, but with variations that typically stay constant over periods of time. Variable pricing is more effective than static pricing at managing outcomes such as congestion^{56,57}, and has been shown to improve equity as users can manage their costs by choosing when and how to travel. 407ETR uses variable rates that make it more expensive to travel during peak periods, as a way to maintain free-flow conditions. However, variable pricing programs can lead to peak shifting or other unintended consequences that may require additional consideration⁵⁸.
- **Dynamic pricing** changes charge rates as a function of real-time conditions. It has been used by ride-hailing and parking services, but to date it has only been used in road pricing programs for single corridors rather than entire networks. Theoretically, dynamically priced charge rates could be programmed to optimize achievement of a desired objective; however, such variations could confuse drivers and also expose them to large, unexpected fluctuations in travel cost with

no practical ability to opt out⁵⁹. Planning work done for priced-managed lanes by Ontario's Ministry of Transportation considered dynamic variable pricing, where charges for single-occupant vehicles to use a high-occupancy vehicle lane would increase with traffic volumes, with the goal of maintaining free-flow conditions in the HOV lane.

A challenge in establishing charge rates is finding a balance between the theoretically optimum price and the projected change in demand through time. If congestion reduction is a key objective, then it is important to understand how congestion varies through the day. In practice, there are multiple ways to analytically determine an optimal charge structure – however, small-scale pilot programs have proven successful in testing charge rates to be applied at a broader scale.

3.5.3 Varying rates by user

Charge rates can be set in a way that changes who pays (or not), or who pays more (or less) relative to other road users. Rates can vary by type of vehicle (e.g. passenger vehicle, light or heavy-duty truck), vehicle propulsion (e.g. electric or internal combustion engine), vehicle occupancy, location of registration, or user characteristics in order to improve equitable outcomes.

Jurisdictions today face the issue of whether and how much to apply pricing to electric vehicles. There are arguments to include electric vehicles in charging programs to reflect their road use, imposed wear and tear, and congestion impacts. There are also arguments to exempt electric vehicles as an incentive to vehicle purchasers. Electric vehicles are already likely to be exempt from emissions-based fees; they could receive further exemptions or subsidies toward road pricing charges.

Many tolled roads differentiate between vehicle type, and some offer discounts to users from adjacent areas. Some pricing programs with a geographic focus (e.g. cordon charges or low-emission zones) may provide exemptions for equity-deserving groups, electric vehicles, taxis or buses.

Freight vehicles are often charged a higher rate due to their greater physical impact on road infrastructure⁶⁰. Some road pricing programs developed to manage freight, such as Germany's heavy goods vehicle distance-based tolling system, apply charge rates that vary by vehicle weight, emission standard, number of axles and vehicle-kilometres travelled to account for the impact these vehicles have on roads and the environment⁶¹.

3.6 Geographical coverage

The geography and jurisdictional boundaries of a city or region play a critical role in road pricing, with the potential to act as barriers or opportunities. The shape and application of the program coverage depends on the nature and scale of the area, and the location and alignment of the facility(-ies) or corridor being considered. The preliminary road pricing system considered by the City of Vancouver was largely determined by the city's geography, with the peninsula's shape creating natural boundaries for point charges and zones.

A clear understanding of the desired program objectives is a key determinant when determining road pricing coverage. The range of options can be narrow (e.g. individual corridors or specific lanes) or broad (e.g. entire areas or zones). Pricing programs with wider coverage (e.g. applying cordon or area-based charges) tend to be more effective at reducing congestion and addressing external factors and outcomes⁶²; this is partly because they can prevent users from simply diverting to unpriced routes.

Narrower road pricing tools, such as bridge tolls, can have a relatively greater capacity for revenue generation because the payment gives users the benefit of time savings⁶³.

The nature of congestion would likely influence the type of charge applied at a geographic boundary throughout the day. For example, if congestion is focused on main arterial roads entering or exiting an urban or peri-urban area, then cordon or point-based schemes could be effective. In contrast, areas with more general interzonal congestion, such as London, may benefit from area-based charges because charges apply to all movements between zones⁶⁴. Vancouver's analysis of a multi-zone distance-based charge showed that it would reduce congestion by 20-25% (the same as a point charge system) and improve travel time by 18-23% (compared to the 17-20% for point charges). A significant uncertainty associated with a multi-zone system was the possibility of higher costs for both operations and the offsetting of equity imbalances.

Distance-based charging, which accounts for movement through a corridor or within a zone, could address the added expenses of area-based charges but still poses practical challenges around the capture of data on distances travelled. Distance-based systems with zones could require more intensive technological deployment to capture how far each vehicle has moved within or between zones, as not all zones would necessarily be priced the same⁶⁵.

3.7 Revenue use

It is clear that road pricing can generate substantial revenues:

- Tolling of bridges and highways for the purpose of paying off capital costs has proven effective in a Canadian context; the Coquihalla Highway in British Columbia and the Burlington Skyway and Garden City Skyway in Ontario are three examples where tolls were removed once capital costs had been recovered.
- 407ETR, which features distance-based tolling, reported a net income of \$435.3 million for 2022⁶⁶. The facility was privatized in 1999 through a 99-year lease agreement, with revenues supporting highway operation and improvements as well as corporate profit.
- A 2015 study by the Pembina Institute titled *Fare Driving* estimated that pricing Toronto's Gardiner Expressway and Don Valley Parkway could have generated annual revenue of almost \$500 million by 2025 (in 2015 dollars)⁶⁷. The City of Toronto estimated that its pricing proposal could target total revenue of \$5.7 billion over 30 years to pay for maintenance and rehabilitation of the tolled roads⁶⁸.
- Metro Vancouver's mobility pricing study found that regional pricing systems could generate up to \$1.6 billion in annual net revenue, an amount equivalent to TransLink's annual operating budget at the time.

As with any infrastructure financing, gross revenues would be directed first to service debt and bank fees, and then to operations, maintenance and administration. The net revenues remaining can then be directed to serve the strategic goals of the road pricing program or the greater mobility system it contributes to.

The use of net road pricing revenues is typically guided by enabling legislation and regulation, with four common options:

- **Invest in alternatives to personal vehicle use.** This could include transit infrastructure or operations, transit fare subsidies, cycling and walking facilities, or shared micromobility programs.
- **Reduce existing taxes.** This could include reductions in fuel taxes, parking taxes, property taxes, sales or income taxes.
- **Invest in road infrastructure.** This could include capital improvements to roads and bridges, or enhanced highway operations and maintenance (e.g. snow removal, incident response).
- **Make direct transfers to households.** This could include incentive payments such as the federal Canada Carbon Rebate⁶⁹.

An understanding of any jurisdictional restrictions on how revenue may be used (e.g. whether funds can/must be earmarked for specific purposes), and an examination of how revenues could support the road pricing program objectives, are both fundamental to the identification and assessment of options. Revenue use, diversion and investment are dependent on legislation, which determines whether it can be used to fund infrastructure or be directed to other governmental operations; legislative or regulatory changes may be desirable. Regardless of any eventual decision, transparency with the public is critical with regard to the use of revenues.

Metro Vancouver's Mobility Pricing Independent Commission found that one of the best ways to address concerns about the equity, fairness and affordability of road pricing was through the use of revenue, including public transit investments and a well designed framework for caps, rebates, exemptions, discounts and subsidies. Other opportunities to address fairness-related concerns include offsetting existing taxes and charges such as fuel taxes, or even sales or income taxes.

Governments aiming for a revenue-neutral road pricing system could either direct revenues to municipal budgets as a way of reducing property or land-based taxes, or redistribute them as direct transfers to households. Using revenues to reduce property taxes would require coordination between the government agencies responsible for road pricing and property tax collection.

3.8 Equity

Transportation policies have historically focused on quantitative system outcomes including level of service, safety and travel times. Now, there is a growing desire to understand how those policies impact different population groups in a qualitative sense. Considerations of a household's ability to pay for mobility services, their resilience to change including access to transportation alternatives, the benefits they receive, their existing reliance on driving, and their resulting capacity to participate in society all play into the consideration of whether a pricing policy is fair, equitable and affordable.

Transportation (or mobility) equity refers to how transportation systems impact different people and allow them to meet their needs, across different groups defined by income, race or ethnicity, gender, disability, or location of residence. Special consideration is often given to vulnerable or marginalized populations, and to how they are identified in different contexts. Transportation equity should not be confused with transportation equality, which would seek to give each person the same transport resources and the same ability to access opportunity⁷⁰.

Within the field of equity, mobility or transport poverty reflects the dual condition of having both low income and low transport access; some mobility programs have begun to leverage access improvements as a way to reduce poverty. Those programs rely, in part, on equitable design considerations by analyzing how transport decisions impact the livelihoods of households and exacerbate or mitigate negative outcomes⁷¹.

The following sections will outline why equity matters in road pricing programs, what can be done to address equity and how can equity be assessed.

3.8.1 Equity concerns in road pricing

Equity is an important consideration in any road pricing program, and can be considered from two perspectives:

- **Horizontal equity.** This is the extent to which mobility services and impacts are distributed among different user groups.
- **Vertical equity.** This is the extent to which an intervention or policy affects people disproportionately based on their income or other socioeconomic characteristics.

It is important to consider the needs of equity-deserving populations early in consultation, as these groups likely face mobility-related barriers. Jurisdictions are commonly concerned with affordability and household access to services, and providing economic opportunity through connectivity and access. Ottawa's Transportation Master Plan applies an "equity lens" to consider the mobility needs and constraints of BIPOC communities, women, children, older adults, and people living in poverty⁷². As another example, Figure 2 illustrates the key elements of Portland's equitable mobility framework.

Generally, there is a perception that road pricing proposals would disadvantage equity-deserving groups (e.g. low-income households, people of colour, Indigenous communities, seniors, youth and people with disabilities) to a greater extent than the general population⁷³. When road pricing is considered by jurisdictions, equity is often the main objection raised by stakeholders (and is often conflated with concerns about fairness and affordability). Failure to address equity concerns in road pricing programs can lead to lack of public support, and successfully addressing equity concerns relies on an understanding of how the following typical concerns might affect different groups:

- Low-income and/or middle-class households could be unable to afford to pay the proposed charges.
- There are existing mobility pricing measures such as fuel taxes and parking fees, so the proposed charges could represent a "tax grab".
- Suburban areas could suffer from poor mobility options including transit service or active transportation networks.
- Some road users are reliant on driving for practical reasons, and would be unable to change their behaviour.
- People that travel greater distances could have to pay more, and are already penalized by higher fuel costs.

Despite the reality of these equity concerns in an immediate sense, road pricing may accelerate the long-term process of making mobility systems more broadly equitable – an evolution that also involves reducing car dependency, urban sprawl, and housing costs in urban areas. However, there is likely to be

a transition phase where travel costs increase while car dependency continues – which represents a potentially inequitable situation that warrants action to mitigate.

Figure 2: Framework for pricing options for equitable mobility in Portland, Oregon⁷⁴



3.8.2 Strategies for achieving equity

An equitable framework for road pricing would be unique to any jurisdiction, but Seattle and Portland have demonstrated some basic steps to assess equity impacts. Those steps begin with the definition of equitable mobility, identification of equity disparities, and identification of new policies that could help equity-deserving groups, and are outlined briefly below⁷⁵:

- Identify equity-deserving populations to be considered, as well as proposed mechanisms for program evaluation. In Canada, special consideration should be given to Indigenous communities and organizations.
- Determine benefits and disbenefits for impacted communities with respect to affordability, accessibility and health.
- Consider tools to improve transportation equity for deserving groups including goals and policies to increase opportunity and minimize impacts. Potential road pricing issues include impacts on household income, access to mobility options, and non-driver benefits.
- Reduce unequal burdens of technology to ensure vulnerable communities are not excluded. Payment systems can support those with limited access to bank accounts through the use of prepaid debit cards or pay-as-you go smart cards, and can include strong privacy and cybersecurity protections. The location of payment systems and the use of automated enforcement mechanisms could be assessed to reduce impacts on vulnerable communities. Finally, fines for non-compliance could consider household income to mitigate inequities.
- Monitor and evaluate programs from an equity perspective and adjust them when needed. Monitoring could include continued community engagement. London, U.K. continues to conduct regular analysis of the equity impacts of its congestion charging scheme.

Recent road pricing initiatives have placed equity at the forefront in two ways: identifying mobility equity as an overall program goal, and integrating equity into the design methodology. Road pricing design has the potential to be either progressive or regressive, with regressive programs exacerbating the financial burden of car ownership and reliance for households that have limited resources⁷⁶.

Conversely, road pricing tools can support regenerative measures if their levers are designed to be protective or proactive. Equitable distribution of road pricing outcomes depends on both pricing strategy and revenue use. For example, flat rates without reinvestment in travel alternatives are generally considered less equitable, as costs are borne by all households; dynamic pricing can have more equitable outcomes, as shown by studies in Vancouver and Portland⁷⁷. The inclusion of caps, rebates, exemptions, discounts and subsidies for different socioeconomic groups can improve equity outcomes. Lastly, programs that reinvest revenue in expanding options for non-drivers can improve equity. Road infrastructure has traditionally dominated mobility budgets, and road pricing offers a way to influence this imbalance; however, in a Canadian context doing so could require collaboration among different orders of government to enable the diversion of revenues from roads to (for example) transit infrastructure.

3.8.3 Measuring equity

Assessing the equity impacts of road pricing is important but challenging, and there are several ways to approach the task. To provide a sense of affordability and fairness, user costs per trip or per day can be compared among different household income groups, average costs for equity-deserving groups can be compared to the general population, and costs per trip can also be estimated for different home locations and overlaid with the quality of transport alternatives. Costs borne by those that drive more than average could also be compared to their income levels and their access to travel alternatives. And as the costs of road pricing are assessed for different groups, the benefits should also be explored; those may include travel time savings or local reductions in noise or air pollution. Finally, it is worth comparing costs and benefits for groups of interest.

In California, the TransForm initiative applied an equity lens around process and outcome; process equity is ensuring that all populations have participated and been consulted as part of planning and development, while outcome equity is measured in terms of indicators such as affordability, access to opportunity, and community health. The Greenlining Institute has also developed a three-step mobility equity framework that applies 12 mobility indicators for vulnerable, equity-deserving populations⁷⁸.

Metro Vancouver's mobility pricing study evaluated equity (termed "fairness") using four criteria⁷⁹:

- **Consistency in the application of charges.** This assesses whether those who pay more benefit more, and whether users pay proportionally to their use.
- **Availability of transportation choices.** This assesses the accessibility and connectivity of transit.
- **Household charges.** This measures affordability by evaluating charges at the household level.
- **Income equity.** This assesses the proportionality of charges to household income, and the amount of redistribution revenue required to mitigate imbalances.

It can be tempting for jurisdictions to offer numerous discounts and exemptions to improve levels of acceptance and support (e.g. 120 different groups asked New York City for exemptions from its new congestion pricing program), but too many exemptions can impact the efficacy of any road pricing program. It is important clearly define who is deserving of caps, rebates, exemptions, discounts or subsidies, and to set principles that guide the level of any discount.

3.9 Public engagement and support

It would be ideal for road pricing programs to enjoy broad public support and acceptance, but most experience meaningful opposition during their development stages. Road pricing is often perceived as another form of taxation, and stakeholders are often skeptical of the ability of governments to manage revenues effectively⁸⁰. The process of building acceptance is nuanced and non-linear, and retaining the assistance of skilled professionals who are familiar with local issues and stakeholders is highly recommended.

3.9.1 Engaging with stakeholders

Stakeholders that have a role to play in road pricing, or that may be impacted by it, can include elected officials, municipal and provincial agencies, businesses, interest groups, and individual members of the public. The purpose of engaging with stakeholders is to provide information, support knowledge sharing,

gain support, build consensus, and ensure that they have an opportunity to voice concerns and express their needs.

A meaningful engagement process is one where stakeholder input contributes to the final outcome. Assuring decision makers that stakeholder issues have been considered, and explaining whether and how they have been actively addressed, can make that outcome more acceptable⁸¹. Early, meaningful engagement and communication in the development process has been shown to improve the perception of road pricing programs because it allows users to influence decisions that impact them.

Effective engagement programs address a variety of stakeholders, particularly populations that may be affected by or are less supportive of the program. More than 400 stakeholders were engaged during the initial development of London's congestion charging program, with their input leading to several modifications⁸².

Different forms of engagement may be needed for different stakeholders. For example, meetings or workshops during business hours are typically used to engage with public or private organizations. In contrast, in-person or virtual open houses, print and social media, and websites are typically used to engage with the general public.

3.9.2 Communication, messaging and education

Aligning messaging with public values is important when engaging stakeholders. A common barrier to public acceptance of road pricing is simply the "newness" of applying a cost to something that is currently free⁸³. To overcome this challenge, several jurisdictions (e.g. Seattle, Oregon, London, Stockholm) have used goal-based and solution-based messaging to clearly communicate benefits to the public.

Messaging can also align with pro-social values held by stakeholders, even prioritizing them over quantitative benefits like travel time. In engaging with lower-income residents, persons with disabilities, multilingual or displaced people, and individuals who identify as Indigenous or racialized, the City of Portland focused messaging around inclusivity, accessibility and opportunities for public involvement and equity; it also plans to show how staff are learning from conversations and building on feedback⁸⁴.

Environmental messaging is another useful pro-social perspective. Some agencies, such as Amsterdam, position road pricing tools as part of a larger sustainable transport and clean air strategy, highlighting environmental benefits and emission reductions⁸⁵. Communication about the use of road pricing revenues to support program goals can build transparency, preventing the perception of a "tax grab" and allowing stakeholders to understand the links to equitable outcomes.

Using tools aimed at diverse audiences can help build support and acceptance by explaining program goals, and can also ensure the public's understanding of how to use the system and what impacts they can expect. The City of Vancouver used targeted social and print media campaigns to keep stakeholders informed, while OReGO promotes use of the optional system by communicating user benefits and other positive impacts⁸⁶.

The purpose of educating stakeholders is to give them a better understanding of the nature of road pricing as well as the specifics of the road pricing program, its levers and design components. Communicating how revenues will be used to support the program goals and benefits, for example, is important to establish transparency and avoid the perception of a "tax grab." Stakeholder involvement can even guide the use of revenues to improve equity of program outcomes. In Sweden, Gothenburg's

road pricing program was publicly positioned as an environmental and congestion reduction measure; however, public awareness of the actual main goal – generating funds for infrastructure projects – limited public acceptance of the program⁸⁷.

3.9.3 Acceptance, support and timing

The concepts of acceptance and support are often used interchangeably in discussions on road pricing, but this section addresses two distinct ideas:

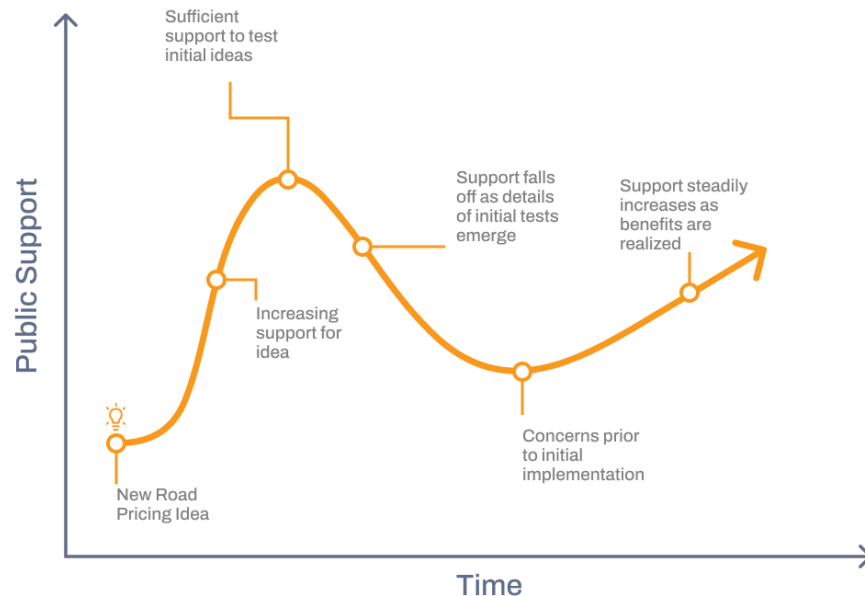
- **Public acceptance** – the overall public attitude with respect to the case for road pricing
- **Political support** – the level of buy-in by elected officials in the relevant jurisdiction(s)

While road pricing proposals generally meet with resistance, complete public acceptance is not usually required for successful implementation. Gothenburg implemented a charge in 2013 that had broad political support but limited public acceptance (it had been rejected in a public referendum that was largely ignored). Stockholm and London both faced public acceptance ratings that were low before pilot testing (21% and 39% respectively) but increased after the concept was shown to be effective⁸⁸. The first iteration of New York's road pricing program received wide public acceptance in 2008 (59% in favour vs. 38% opposed) but it failed to gain political support in the New York State Assembly that largely represented outer boroughs⁸⁹. Work continued, and federal approval was received in 2023 with charging expected to begin in 2024⁹⁰.

One lesson learned from these experiences is that the timing of definitive public input matters. Manchester and Edinburgh held referendums before their pilot tests, meaning that voters could not see potential impacts. Public support in Stockholm grew from 21% to 67% after the initial phases of implementation⁹¹. Public acceptance can be expected to decrease ahead of pilot or final implementation, then rise afterward as the benefits become visible, people adapt behaviours to avoid costs, and early negative projections do not come to pass (see Figure 3). Studies have shown that the public support will grow if individuals perceive charging to benefit them personally⁹².

Another lesson is the advantages of phased implementation, which allows the development of complementary actions and benefits⁹³. Pilot phases can demonstrate positive impacts and help ensure that the program design is scalable. Another example is “shadow toll” programs that allow individuals to opt in and see what they would pay through a charging program as opposed to a fuel or vehicle use tax, without incurring any actual financial risk.

Political support can be challenging, especially since road pricing development typically spans several years, over which time elections take place and new governments may follow policy directions they developed when in opposition. In the face of this risk, setting clear goals and providing transparency on the use of revenues used, along with building public support, are the best ways to maximize program viability. A strategy used in Metro Vancouver was the use of a citizens panel (the Mobility Pricing Independent Commission) to conduct studies independently of the political arena.

Figure 3: Road pricing support curve ⁹⁴


3.10 Technology and data

Almost all road pricing programs rely heavily on technology. Schemes with more varied charges generally require more complex hardware and software, and present greater challenges around data management. For example, a dynamic, distance-based pricing project will be technologically much more complicated than a flat-fee, single-point toll system.

3.10.1 Technology

While the established technologies behind road pricing programs are proven, new technologies continue to emerge that create new opportunities. Two areas of technology are most important:

- Hardware in the field or in vehicles will identify when a specific vehicle passes a fixed point(s) along the transportation network, where and when a vehicle travels, and even its occupancy; additional communications hardware is needed to connect to central systems. Redundant systems may be desirable, which can increase accuracy and reliability but adds additional cost.
- Central systems (software and hardware) include a back-office function that determines charges to each user, generates bills and manages payments, non-payments and reconciliations. They also include a customer service function that manages customer calls, inquiries and complaints and provides reporting, as well as a clearinghouse function that manages transactions between multiple systems and interoperability with other road pricing programs.

Field hardware for point charges, cordon, zone, or area-based schemes typically consists of equipment to detect vehicles and trigger image capture (typically laser-based), and radio frequency identification (RFID) readers or cameras that use video processing and artificial intelligence for automatic number plate recognition (ANPR). This equipment is mounted on gantries over the road, or on poles beside the road. The use of dynamic rates as a function of congestion would require additional sensors to track

traffic speeds and volumes, and variable message display systems to communicate rates to users. RFID readers require vehicle-mounted transponder tags, stickers, or smart plates, and ANPR is used by all major systems to date as either the main form of vehicle identification or for enforcement purposes. The 407ETR uses in-vehicle RFID transponders for subscribers, and vehicles without transponders are charged using ANPR⁹⁵. Users of the OReGO system are offered several options for data collection including manual reporting, odometer photos, or transponders that are detected through gantries or tracked using global positioning systems (GPS)⁹⁶.

In-vehicle hardware for advanced pricing systems (e.g. those that track and charge trucks for travel on highway networks in Germany, Slovakia, Poland and Switzerland) gather and transmit data based on global navigation satellite systems or GPS.

3.10.2 Data

Data storage, sharing, privacy and security are major concerns for governments, citizens and businesses. Road pricing systems are data-rich, and use sensitive private information such as where a person has travelled, where they live, their credit cards or bank accounts, and sometimes images of the vehicle (and possibly the driver and/or passengers) as it passes a gantry. Safeguards for personal information include proprietary internal identifiers, encryption, and anonymized/aggregated geodata that make GPS data inaccessible to other parties. The separation of back-office and customer service functions can help protect data.

Data privacy in Canada is governed by federal and provincial laws. The federal *Personal Information Protection and Electronic Documents Act* guides privacy for private-sector organizations and federal programs. It sets out the ground rules for how businesses handle personal information in the course of their commercial activity. Provincial privacy laws in Alberta, Quebec and British Columbia override the federal act, so it is important to understand which privacy laws a pricing system must conform to⁹⁷. It is also common for provinces and territories to require all data to be stored in Canada or within their own boundaries, which is an important consideration for cloud-based systems. Further, legislation can be enacted as part of road pricing programs to ensure stringent privacy protection methods and protocols; for example, Oregon legislation requires that user data be destroyed within 30 days of payment processing.

4. Summary

By changing how Canadians pay to move around their communities, road pricing measures have the potential to influence travel behaviours while creating diversified and sustainable transportation revenue streams. Ultimately, road pricing could support the achievement of social, environmental and economic outcomes that Canadian governments have set as policy goals but are struggling to achieve with current tools.

At the same time, the practical implementation of road pricing poses considerable challenges. Concerns about equity and affordability must be understood, validated and addressed through proper design. Building public acceptance and political support for road pricing is a requirement without meaningful Canadian precedent. The intergovernmental coordination required to create supportive legislation and pursue a shared long-term vision would be a sensitive and complex task. And not least of all, a thoughtful strategy to guide communication and engagement would entail difficult public conversations around both the rationale for road pricing and the means of implementing it.

Section 4.1 of this chapter summarizes the key messages of this report. **Section 4.2** offers some constructive suggestions for future work.

4.1 Key messages

Road pricing can support key Canadian public policy goals. There is evidence that road pricing can support a range of priority policy goals of Canada’s federal, provincial, territorial and municipal governments. These include raising transportation revenues, recovering capital costs, managing congestion, reducing emissions, encouraging modal shift, influencing vehicle purchase and usage decisions, and supporting equity, fairness and affordability.

Clear communication around objectives is essential. Consideration of road pricing by a jurisdiction necessitates clarity of thought and communication around overall objectives. Road pricing is typically proposed as a means of changing behaviour, raising revenues, and/or promoting fairness and equity – but these goals are connected by synergies and tensions in ways that are not always obvious. Thorough engagement and scenario testing are essential to understanding how adjustments to various road pricing “levers” may yield different outcomes. Methodical analysis can inform (and likely moderate) aspirational messages like “This road pricing plan will reduce congestion by X% and generate \$Y billion in revenue,” to avoid unrealistic promises that can erode public trust and support.

The broader mobility pricing context matters. The synergies and tensions between existing forms of mobility pricing and any new road pricing application are important to acknowledge and understand. There are inevitable interactions between road pricing tools and parking charges, fuel and carbon taxes, existing tolls, and vehicle registration fees – and the planning process would need to address concerns about equity, affordability and accountability. The various roles and authorities of different orders of government can complicate the search for balanced solution, particularly where the best path (for example) is to offset road pricing revenues to one government by reducing taxation by another government.

Road pricing requires governmental coordination. Collaboration among governments is needed to identify and resolve the mobility pricing interactions described in the previous paragraph; in addition,

municipalities seeking authority to implement road pricing may require enabling provincial legislation, which in turn requires political alignment. There are also other reasons for governments to partner on strategies in support of shared objectives, and on analyses that fully recognize the transformative potential of road pricing. For example, optimizing the equity outcomes of a municipal road pricing strategy could involve offsets, rebates or credits delivered through changes to provincial programs (e.g. income tax, fuel tax, sales tax, registration fees, insurance premiums).

Rates, coverage and revenue use offer flexibility. Variations in geography, urban form, travel patterns, and political and fiscal environments mean that road pricing cannot be a one-size-fits-all solution. During the planning and design of a strategy that supports local goals, three of the most important road pricing “levers” to be tested are the rates charged, the coverage area, and how revenues are used. In doing so, stakeholder engagement is an important addition to methodical modelling.

Equity is a vital consideration. Road pricing is neither inherently equitable nor inequitable, neither fair nor unfair – like almost all public policy choices, it can lead to both positive and negative outcomes. Equity is always a prominent consideration in road pricing (and, increasingly, is also a key goal) and the realities around any proposal will inevitably be complex and nuanced, defying both simplistic accusations and assurances. Stakeholder concerns about equity, fairness and affordability outcomes may be grounded in reality and/or used as political wedges to impede progress; regardless, they deserve to be understood and explored. Equity concerns are best identified, assessed and addressed in a transparent manner, taking advantage of caps, rebates, exemptions, discounts and subsidies to minimize unintended consequences.

Building public acceptance and political support is essential but complex. The early involvement of experts in stakeholder engagement is a wise part of any road pricing study, and the audiences to include are both numerous and varied. The time required to move from concept to implementation affords an opportunity to engage with groups and individuals, overcome distrust, build relationships, and create alliances that support both effective analysis and responsible decision making. Many lessons can be learned by examining the mistakes and successes of other jurisdictions.

New technologies bring new opportunities. Long-proven technologies enable many forms of road pricing. While technology innovations are likely to open new doors to more dynamic pricing applications, their early adopters will be closely watched. From a practical perspective, the most likely barriers associated with new road pricing technologies include cost, administrative complexity, privacy and security.

4.2 Further work

There are still many uncertainties around the issue of road pricing in a Canadian context, and additional research in the following areas would be constructive:

- Modelling and assessment of the price elasticity of travel demands and the potential impacts of additional pricing signals on emissions and congestion, especially in areas with limited mobility options and a high degree of reliance on automobiles.
- Canadian mobility trends since the COVID-19 pandemic, reflecting ongoing shifts in hybrid work and online activities.

- The projected market uptake of electric vehicles among consumers, and the associated impacts on fuel tax revenues.
- The impacts of road pricing on freight carriers, shippers and fleet managers, and their possible responses in terms of business location, shipping mode and route decisions.
- Understanding the relationship between road pricing, transport poverty and equity, especially in the context of small and medium-sized communities.
- Emerging technologies in road pricing, and best practices to harness their potential while mitigating risks.

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Transportation Association of Canada

401–1111 Prince of Wales Drive, Ottawa, ON K2C 3T2
(613) 736-1350 secretariat@tac-atc.ca

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and its activities, products and services, visit www.tac-atc.ca.