Western Road Usage Charge Consortium

Roadmap for Considerations of a Road Usage Charge System

Final Report and Best Practices Guide

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Preface

Elected officials often look to transportation agencies for guidance, analysis, and recommendations regarding alternative funding mechanisms that can supplement or replace the gas tax. A handful of states have convened task forces, stakeholder panels, and commissioned other work exploring or testing a RUC system; each state seems to have taken a slightly different approach. There is no known compendium or synthesis of these prior efforts, their effectiveness, the different governance and transportation philosophies underpinning those efforts, and lessons to be learned from around the U.S. and internationally. As a result, state DOTs have not fully capitalized on the earlier work of others, which may result in repeating the mistakes of others and duplicating efforts.

This report synthesizes RUC policy development approaches and processes used in U.S. states and internationally, along with a high-level decision matrix that state planners and policy makers can utilize to guide the development of RUC policies.

Executive Summary

Economists, policy experts, and academics have long promoted road usage charging (RUC, also known as road charge, road user fees, vehicle miles traveled fees, or mileage-based user fees)—assessing a fee based on distance driven on all public roads within a jurisdiction—and other forms of direct road pricing. RUC is seen as a promising approach to road funding, either as a replacement for or complement to other tax policies such as fuel taxes, tolls, and registration fees. Today, based on the number of U.S. states and other jurisdictions engaged in studies or pilot tests, RUC interest is at a peak. Yet implementation remains rare, with light vehicle RUC programs in place for revenue collection only in New Zealand and (since July 1, 2015) Oregon, and heavy vehicle RUC only in New Zealand, several European countries, and four U.S. states. All other RUC programs are in research, pilot, or testing phases. This leads to several questions:

- If RUC is a desirable policy concept from an analytic standpoint, what has hampered its widespread adoption?
- What can we learn from both successful and unsuccessful attempts to implement RUC around the world?
- What are the critical success factors for beginning an inquiry into, analyzing, and/or implementing RUC?

Fundamentally, these are very difficult, unpredictable questions that depend on *politics*. It is difficult to know what argument or operational approach will politically move a jurisdiction toward RUC. Policy formulation is nebulous and frequently changing, and it should be a precedent to *system* definition (e.g., operational concepts and technology). Despite this ambiguity, policy formulation is not merely the art of the possible ("nurture policy champions") or the result of random chance ("muddling through"). It is a process that can be enhanced by applying proven analytical frameworks and insights from best practices.

This report combines the public sector "strategy triangle" framework pioneered by Professor Mark Moore of the Harvard Kennedy School with trends gleaned from worldwide case studies. The result is an actionable set of decision support insights (best practices and common pitfalls) accompanied by an illustrative visual roadmap suited to each of the RUC West members participating in this project. The three pillars of the public sector strategy triangle are: articulate public value, establish legitimacy and support, and assess organizational capability. The results-in-brief of this analysis of best practices are provided below for each pillar:

- Best practices for articulating public value of RUC
  - Define the problem(s) clearly
  - Articulate and prioritize objectives
  - Compare alternatives for addressing problem(s) and fulfilling objectives
  - Conduct a jurisdiction-specific feasibility study of RUC
  - Establish clear principles to guide policy
  - Consider RUC as part of wider strategy for system funding or management.
- Best practices for establishing legitimacy and support
  - Provide feedback on legislative efforts authorizing RUC studies
  - Convene a stakeholder committee to analyze public value in collaboration with the agency
  - Develop public communications protocols for consistency of messages across stakeholders, agencies, and policy makers

  - Engage local agencies
- Best practices in assessing operational capabilities
  - Inventory organizational assets, processes, and expertise within and beyond DOT and conduct gap analysis
  - Study organizational roles and develop recommendations to meet scope of project
  - Begin some organizational reforms in advance of full implementation of a RUC system

The list below captures common pitfalls for each pillar of the strategy triangle:

- Common pitfalls in articulating the public value of RUC
  - Fail to set objectives and evaluate policy alternatives
  - Jumping to technology or operational solutions without first setting RUC policy parameters
  - Discuss rates, including discounts and exemptions, too early in the process
  - Focus on gross revenues, which neglects the importance of collection costs and evasion
  - Fail to analyze impacts on sufficiently wide range of users
  - Fail to communicate with the public and incorporate feedback
  - Change objectives, which disorients any analysis or testing
  - Allow RUC to evolve into a conversation about spending
- Common pitfalls in attempting to establish legitimacy and support
  - Declare an approach (technology or operational) that precludes policy alternatives or upsets key stakeholders
  - Undertake technology development or operational efforts before ready to progress from a policy standpoint
  - Let opponents or skeptics dominate public/media narrative with misinformation
  - Neglect key issues or questions that may generate growth in doubt
  - Evaluating RUC against a hypothetically perfect revenue system instead of on its own merits or in comparison to what it would replace (e.g., fuel tax system)
  - Fail to train spokespersons or stakeholders to present consistent messages to the news or media
  - Raise the gas tax or equivalent source of new transportation revenue and declare the problem solved
- Common pitfalls in assessing operational capabilities
  - Commit to an organizational design too early in the process
  - Allow lack of clarity of responsibilities to generate rivalries between divisions or agencies
  - Place responsibility for RUC with an existing organization by default
  - Ignore incentives in developing appropriate organizational design
  - Neglect key tools required for effective enforcement
  - Fail to identify and engage with the full range of partner agencies whose involvement or cooperation is required for implementation of RUC

In applying best practices and common pitfalls to RUC West states, we observe great variability. To address this variability, we created four distinct “starting points.” Each starting point attempts to characterize the policy appetite of various states, summarized as follows in order of increasing ambition:

- Monitor revenue risks and policy developments

- Anticipate revenue risks and policy developments
- Respond to legislative or executive interest (Governor or within DOT)
- Spur interest or initiate action within DOT, Legislature, or Governor

Regardless of the starting point, RUC is a new policy that represents a profound departure from current practice for policy makers, the public, and administering agencies alike. Navigating any policy change of this magnitude requires a combination of talents, resources, and prudent decisions sustained over a long period of time. Many jurisdictions have confronted the challenges of innovation in transportation funding, and this report attempts to document the many lessons learned from the extensive experiences of others. No roadmap can capture precisely all of the steps, actions, or decisions that will result in successful policy transformation. The process is not strictly repeatable from one jurisdiction to another, nor is it linear. But, the likelihood of success increases when agencies display the following characteristics and capabilities:

- Flexibility to respond to changing policy preferences and circumstances in order to sustain the legitimacy and support for progress in investigating, testing, or implementing RUC
- Latitude to analyze and articulate the public value of RUC as a prospective policy, especially as the value may change with changing objectives and policy preferences
- Ability to conceptually realize the needs of RUC policy, as it is successively defined more precisely, with evolving marketplace services, technologies, and agency capabilities

In short, the recipe for successful consideration of RUC cannot be defined as a generic manual or handbook. Each jurisdiction must confront unique local problems, needs, and constraints; understand their values and preferences; and identify and define the opportunities for policy innovation. The lessons learned from others who have attempted or implemented RUC can serve as a valuable input for pursuing common success factors and to avoid common mistakes. And, as the global body of knowledge and quantity of experience with RUC policy grow larger, the roadmap to its consideration will contrarily grow shorter.

1. Introduction

Economists, policy experts, and academics have long promoted road usage charging (RUC, also known as road charge, road user fees, vehicle miles traveled fees, or mileage-based user fees)—assessing a fee based on distance driven on all public roads within a jurisdiction—and other forms of direct road pricing. RUC is seen as a potentially viable approach to road funding, either as a replacement for or complement to other policies such as fuel taxes, tolls, and registration fees. Today, based on the number of U.S. states and other jurisdictions engaged in studies or pilot tests, RUC interest is at a peak. Yet implementation remains rare, with light vehicle RUC only in New Zealand and (since July 1, 2015) Oregon and heavy vehicle RUC only in New Zealand, several European countries, and four U.S. states. This leads to several questions:

- If RUC is a desirable policy concept from an academic standpoint, what has hampered its widespread adoption?
- What can we learn from both successful and unsuccessful attempts to implement RUC around the world?
- What are critical success factors for beginning an inquiry into, studying, and/or implementing RUC?

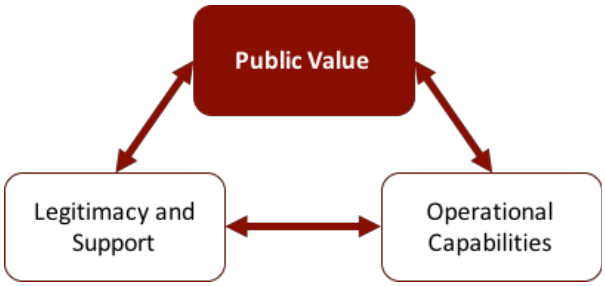
This report provides information that addresses the above questions using a rigorous framework for policy innovation: the public sector strategy triangle pioneered by Prof. Mark Moore of the Harvard Kennedy School, illustrated at right and described below (see, e.g., Creating Public Value: Strategic Management in Government, Harvard Univ. Press, Cambridge, 1995.). Using the lens of the strategy triangle provides a coherent, useful, and robust way to identify best practices and diagnose common pitfalls from other jurisdictions that have studied or pursued RUC. This report also recognizes that each state is unique and seeks to classify findings in a way that is flexible and configurable for each jurisdiction.

- **Articulate public value**. The underlying motivation to pursue a policy innovation such as RUC stems from the ability to identify, measure, and articulate its public value (both quantitatively and qualitatively), which may evolve over time as new benefits and/or costs emerge, as well as new policy preferences and priorities. This is discussed in Chapter 2.
- **Establish legitimacy and support**. In order to realize the public value of a policy innovation like RUC, a favorable authorizing environment must be present to sustain it. This element of the strategy triangle is gained through engagement with the executive, legislative, and other stakeholders who exercise authority, enhance legitimacy, and give or withhold critical support to the policy innovation. This is discussed in Chapter 3.
- **Operational capabilities**. This third element refers to the ability of agencies to deliver on a policy proposal through human and intellectual capital and financial and organizational resources. Analysis of this factor in past RUC efforts is covered in Chapter 4.

These analyses form a strong foundation for the best practices guide and common pitfalls, presented in Chapter 5. Chapter 6 augments these practices with key public communications elements, while Chapter 7 identifies gaps for future research in this area. Finally, Chapter 8 describes the decision tool, which is delivered separately from this document. The Appendix contains a comprehensive review of global RUC case studies that served as inputs to the formulation of the rest of this report.

2. Public Value of Road Usage Charge Systems

RUC systems are only introduced if they can produce "public value." Public value is a measurable *outcome*, such as economic, social, or environmental benefits, net of the costs of introducing and operating a RUC system. Demonstration of public value is the basis for consideration of RUC as a policy tool and a key contributor toward legitimacy and support (see Section 4) and can only be realized with operational capabilities (see Section 5). The chart at right depicts these three elements of the "strategy triangle." This section summarizes the key ways that RUC, when implemented, has generated public value, by reference to the case studies in Section 2. It then describes the policy contexts that have generally been behind the implementation of RUC, and finally the key enablers and factors that helped RUC generate these public value outcomes.



2.1. How Can RUC Create Public Value?

A RUC system charges directly for the use of road space based on distance traveled or duration of use of a network. The fundamental public value of RUC is to generate sustainable net revenue for the upkeep of the transportation system, but there may be secondary values as well, such as improvements in tax fairness; improvements in infrastructure maintenance, operations, and capital investments; and improvements in economic efficiency and environmental performance.

A. Primary public value: ability to sustainably generate net revenue for the upkeep of the transportation system. RUC systems exist primarily to generate net revenues efficiently and effectively for transportation purposes. Successful RUC systems in Europe and New Zealand have proven able to sustainably generate substantial net revenues above operating costs. Systems that were considered unable to generate sufficient net revenues compared to indirect forms of charging did not proceed (e.g. Denmark, UK Lorry Road User Charging). Key measures of this public value arise from the amount of net revenue generated (if charging previously uncharged road users) or in comparison to existing sources such as fuel taxes over the longer term. An important element of net revenue is the administrative costs of RUC. Choices of appropriate RUC systems will significantly influence revenue generating potential, capital costs, and operating costs. Notably, New Zealand has found that RUC revenues vary with economic activity as a direct reflection of road use, and have not been affected by fuel efficiency.

B. Secondary public values:

B.1. Ability to generate revenue in fair proportion to costs: RUC can more equitably charge for road use and the costs that road users generate from using roads, than by other means of taxation. In political terms, this means all road users are treated equally based on the amount of road use they consume and not based on other factors, more closely approximating market-based pricing or a utility mechanism. In economic terms, this can mean reduced costs for some transport and non-transport economic activities, increasing investment, employment and economic growth in those areas. Increasing costs for activities that may currently be indirectly cross-subsidized will result in less consumption of transport for those activities. The net impacts of reducing distortions from existing motoring charges may be

considerable (a study in Australia estimated benefits of around $687 million per annum could be generated by replacing existing motoring taxes with a simple distance and vehicle class based RUC system).[1]

B.2. Improve efficiency and stability of infrastructure investment: Public value is further gained by the ability to use net RUC revenues for infrastructure maintenance and improvements. With an opaque, invisible tax such as fuel taxes, tax diversions are more common. However, a direct charge such as RUC functions more like a utility and, with greater awareness, the public tends to enforce the use of RUC revenues in the transportation domain. Fuel taxes in many countries, including Australia and across Europe, are used to support the general fund. In the U.S., federal fuel taxes are hypothecated to transportation, as are most state taxes, with some exceptions. However, there is often pressure to use fuel taxes for other purposes. For example, the first U.S. federal fuel tax was for deficit reduction; likewise, an increase in federal gas taxes in the 1990s was temporarily devoted to deficit reduction. Many states divert fuel tax revenue for other purposes such as education and law enforcement. This is certainly the case in New Zealand and in the U.S. on toll roads, currently the widespread visible example of direct charging.

B.3. Improve economic efficiency and environmental performance: Because most roads are not subject to a direct charge (the key exception being tolled roads), road users frequently perceive their consumption of road space to be “free of charge”, even if they indirectly pay a tax on fuel to use that road. Introducing RUC (a direct, transparent charge) may increase economic efficiency by exposing road users more directly to the costs of providing the road, or by charging to reflect scarcity of road space or to incentivize use of more environmentally friendly vehicles. It is important to note that RUC efforts in the U.S. have not pursued or emphasized this potential public value and have instead emphasized simpler charging schemes focused on fair, sustainable revenue. However, some RUC programs abroad have been designed to directly influence user behavior, such as congestion pricing programs in Singapore, London, and Stockholm. Singapore’s road pricing system, for example, ensures average speeds on charged roads do not drop below targets, such as 28mph on expressways. The main public value from this typically comes from changing the route, time of day, or mode of travel to reduce demand at times of peak congestion, reducing congestion costs, encouraging use of other modes (and travel times or travel routes); depending on the policy, it may also incentivize use of more environmentally friendly vehicles, more appropriate routes for heavy vehicles, and more “road-friendly” heavy vehicle configurations.

2.2. Policy Scenarios

The above list of public values has also served as the four principal policy scenarios (or policy objectives) under which RUC has been implemented globally, although in most cases there is some overlap. These scenarios are listed below and each is treated separately:

- Revenue sustainability (or new generation of revenue)
- Equity of revenue generation

[1] NSW Financial Audit 2011, NSW Treasury, Sydney, Australia.

- Improvements in the allocation of road investments
- Behavior change to improve economic efficiencies and reduce externalities;

2.2.1. Revenue sustainability

The primary policy goal of the Oregon Ore*GO* light vehicle RUC system and the California Road Charge Pilot Program is to establish a revenue source that is more sustainable and fair than fuel taxation. In Oregon, Ore*GO* has been set up as an alternative to the gas tax to provide a source of revenue that is not linked to the motive power of a road vehicle, but rather on its usage of the network.[2] Regardless of fuel efficiency or the type of energy used to power a vehicle, the vehicle is charged for road usage. This is also the intent of the California Road Charge Pilot Program.[3] In both cases, gas tax revenues are in decline because vehicles are using less fuel on average due to the rise of hybrids, electric vehicles, and general improvements in fleet fuel economy. This trend is likely to continue, creating challenges in raising revenue to pay to maintain and upgrade roads. Public policy objectives of reducing pollution and CO2 emissions, and more generally reducing usage of fossil fuels means gas tax as a source of revenue is under challenge.

Many states (including Oregon, California, Washington, and Utah) have all forecasted declines in gas tax revenue due to fuel efficiency and increased take-up of hybrid, electric and other alternatively fueled vehicles. By contrast, New Zealand has found that the introduction of RUC has meant that fuel efficiency of diesel vehicles has not impacted net revenues.

Similarly, RUC may be an opportunity to generate new revenue from road users that was not otherwise obtainable, because it may charge road users for activities that they were not previously charged for or adequately charged for. If it is assumed that the revenue is used for purposes that generate net public value (i.e. on projects with economic returns higher than their costs), then new revenue generation from RUC can be said to have created public value.

The ORe*GO* program is, in part, about generating revenue from vehicles that are not currently charged for road use (e.g., electric vehicles) and those that are charged significantly less than others (e.g., hybrids). Similarly, in Europe all of the national heavy and light vehicle RUC systems are in part justified in public value due to them earning revenue from foreign road users that were paying little or nothing towards the roads in their countries. For example, in Hungary 49% of revenue from its heavy vehicle RUC system and x% of revenue from its light vehicle RUC system comes from foreign users.

2.2.2. Equity of revenue generation

The three main means[4] of generating revenue for road infrastructure spending across the world are:

- Fuel taxation,
- Motor vehicle registration/licensing fees, and
- General taxation.

[2] Source: http://www.myorego.org/frequently-asked-questions/
[3] Source: http://www.californiaroadchargepilot.com/about/
[4] There are also tire taxes and taxes on the sale of motor vehicles, but these are much less common.

The main types of road expenditure necessary to maintain and optimize the public value of the network may be classified as:

- *Fixed costs of road maintenance and renewal*. These costs that are independent of road usage and are attributable to the influence of the environment, specifically the effects of the sun, precipitation and geological movement. These exist independent of the volume of traffic on a road.
- *Marginal costs of road maintenance and renewal.* These costs that are attributable to wear and tear due to road use. This is primarily a function of ESA (Equivalent Standard Axle) weight and frequency of passage over a section of road.
- *Capital improvements*. These costs generate net public value to road users primarily due to reductions in travel time and vehicle operating costs, reductions in injuries, fatalities and property damage or reductions in externalities. These costs are a function of decisions to enhance the value of the network to improve safety, reduce congestion or travel times, or otherwise improve mobility.

The principle of user pays is generally accepted as optimal for equity in revenue generation, assuming that users pay for expenditures attributable to them. Under that principle, those imposing the highest marginal costs of road maintenance and renewal should pay reflecting those costs; conversely, those imposing relatively low marginal costs should pay less. The fixed costs of road use are not dependent on usage, but the greatest beneficiaries of expenditure on those costs are those that use the road network the most, so it is arguable that these costs may also be attributable based on usage.

Of the three main means of generating revenue, only fuel tax provides any sort of relationship between road use and the amount paid to use the roads. The greater the road use (whether by time or distance traveled), the greater the fuel use. However, the relationship between fuel consumption and marginal costs generated by vehicle weight is increasingly poor for heavier vehicles.[5] However, the use of electric vehicles generates no revenue from fuel tax, and hybrid and the most fuel-efficient new vehicles also use significantly less fuel than the average of the vehicle fleet. Given that such vehicles are almost always the newest vehicles available, they are likely to be used by people with higher than average incomes, meaning those who remain with older, less fuel-efficient vehicles are paying a higher proportion of road expenditure than those with newer, more fuel-efficient vehicles.

In Europe, both heavy and light vehicle RUC systems were introduced because much foreign transit traffic across European countries (particularly those in central Europe such as Switzerland, Austria and the Czech Republic) may drive across their road networks without refueling (and without paying local registration fees). This is seen as inequitable for countries with high volumes of such traffic (particularly heavy vehicle traffic which generates significantly higher marginal costs of road wear and tear) to pay to maintain their roads without revenue from foreign road users. Heavy vehicle RUC systems charging by distance and vehicle weight/size (e.g. in Switzerland, Hungary, Austria and Germany) directly charge for any use on a network, and are imposed upon both domestic and foreign road users. This creates equity in recovering road related costs. Light vehicle RUC systems in Europe charge by number of days in advance of usage of their national highway

[5] "Optimal User Charges and Cost Recovery for Roads in Developing Countries", Ian G Heggie and Vincy Fon, World Bank, 1991.

networks (e.g. in Austria, Hungary, Romania and Slovenia). These time-based access charges mean foreign light vehicle users pay to use these networks similarly to domestic users.

In New Zealand, RUC was introduced in part to be a more equitable means of generating revenue from heavy vehicles compared to fuel tax. The equity came in part because it developed a RUC system based on a cost recovery approach to charge heavy vehicles an economically calculated proportion of road expenditure attributable to those vehicles based on weight and axle configuration. Around 90% of the marginal infrastructure costs of road use in New Zealand are attributable to heavy vehicles. These costs, along with a general road use proportion of fixed costs and the proportionate cost of capital projects that benefit heavy vehicles, are recovered from heavy vehicles through RUC. An independent review of the system found this to be more equitable than any alternative involving fuel tax.[6] Oregon's weight-mile tax, although the proportions differ, follows a similar methodology and has been determined to be an appropriate balance of charges on light vs. heavy vehicles.

In Australia, one purpose of the Heavy Vehicle Road Reform program is to improve equity among road users in recovering road related expenditure. Although not always applicable, there is some acceptance among transport economists that increased ESA (Equivalent Single Axle) weight loads impose proportionately higher wear and tear upon roads.[7] Heavy vehicle RUC systems in Oregon, New Zealand, and Europe all justify their charge rates on this basis (instead of charging such road use by fuel tax or time based charges).

Of other forms of revenue generation, vehicle licensing/registration taxes bear no relationship to road usage. However, such taxes may be used as a way of recovering fixed costs.[8] Yet they have also come into criticism because of the deadweight costs such taxes impose by charging regardless of road use, particularly for vehicles that may be idle for considerable periods (and which do not benefit from expenditure on the fixed costs of an entire road network).[9]

General taxation of course is charged upon a wide tax base including those that do not own motor vehicles or use them, so does not have any relationship at all with most road related expenditure.

2.2.3. Improvements in the allocation of road investments

RUC for heavy vehicles is sometimes introduced to improve the relative competitiveness of rail freight compared to road freight by ensuring that heavy trucks pay a more appropriate share of the costs they impose on the road network. As railroad operators typically to have to recover all of the capital and operating costs of their networks (as all those costs are internalized and not paid for by taxes), failure to charge truck operators an appropriate share of those costs of highways may be an advantage that such operators have over railroads. In New Zealand, it was decided to introduce market-oriented reforms allowing competition between road and rail freight, but in parallel to introduce RUC based on weight/distance and axle configuration so that there could

[6] "An Independent Review of the New Zealand Road User Charging System", Road User Charges Review Group, Wellington, New Zealand, 2009.
[7] Source: http://www.pavementinteractive.org/article/equivalent-single-axle-load/
[8] "Commercial Management and Financing of Roads" World Bank Technical Paper No. 409, Ian G Heggie, Piers Vickers, The World Bank, Washington D.C., 1998.
[9] Ibid footnote 1.

be better modal neutrality and fairer competition between modes. The result was that the rail freight sector concentrated more of its investments and operations on servicing train-loads of bulk and containerized freight mostly over distances of over 100 miles, whereas sufficient funds were raised from heavy vehicles to ensure the state highway network was at low risk of having deferred maintenance over extended periods because of budgetary restraint. The net impact has been to secure the future of rail freight services in the advent of competition from road freight, where rail can be competitive.

RUC systems in Switzerland and Germany have also had secondary goals of improving the relative competitiveness of rail freight over road freight, primarily by the introduction of better pricing to recover the infrastructure costs associated with heavy trucks using the highway networks. In both cases, they are seen as having contributed to the growth of rail freight usage for long-haul freight in and through those countries.

2.2.4. Behavior change to reduce externalities

Several RUC systems have been introduced in primarily or in part to reduce externalities, typically congestion and/or emissions. Sweden's two urban congestion tax systems are designed to reduce congestion, and have achieved notable results, with the Gothenburg system reducing peak time traffic volumes by 20%[10] and Stockholm's system estimated to generate around $74m in annual travel time and trip reliability benefits.[11] London and Singapore's congestion charge and electronic road pricing systems respectively have also successfully reduced private car traffic at the times and locations these systems operate.

The Swiss heavy vehicle RUC system was in part implemented to reduce truck traffic through the Alps, particularly foreign transit traffic. concern about the environmental impacts of unconstrained growth in such traffic (in part because some trucks sought to use Switzerland to bypass toll roads in France) has meant that the Swiss rate schedule includes discounts for the most environmentally friendly heavy vehicles and much higher rates for those with poor environmental ratings. The impact of this has been to change the profile of trucks using Swiss roads towards those with lower emissions. As a result, all European heavy vehicle RUC systems offer differential rates based on environmental ratings of vehicle engines (through the EURO rating system of major pollutants). In Germany this has resulted in a significant shift towards lower emission vehicles, so much that the rate schedule has had to be reformed to increase charges for lower emission vehicles. In 2005, only 2% of charged trucks had a EURO 4 emissions rating[12] or better; by 2014, 88% did.[13] The introduction of RUC in Germany is seen to be a significant contributor towards incentivizing such a change and means that growth in road freight traffic has not seen a parallel increase in noxious emissions.

2.3. Enablers of Public Value for RUC

Demonstration of public value must occur before, during, and after RUC implementation.

[10] Source: http://www.eltis.org/discover/news/gothenburg-congestion-charge-fulfils-expectations-sweden-0
[11] Source: "The Stockholm congestion charges: an overview", CTS Working Paper 2014;7, Jonas Eliasson, Stockholm.
[12] European Union environmental standard for emissions with a maximum of 0.02 PM (g/KWh), 3.5NOx (g/KWh), 1.5CO (g/KWh), 0.46HC (g/KWh).
[13] Source: "Ten years truck toll in Germany", Edith Buss, Federal Ministry of Transport and Digital Infrastructure, Berlin, Germany, 2015.

- Before RUC implementation, public value can only be demonstrated through comparative analysis of RUC and alternatives for achieving a public purpose.
- While implementing RUC, public value can be demonstrated by continued analysis and the implementation of system evaluation to actually measure value.
- After RUC implementation, public value must be measured through ongoing evaluation of various kinds, including direct evaluation of the success or value of the RUC program itself (e.g., cost of collection, administrative efficiency) or of its outcomes (net revenue, allocative efficiency).

This section discusses the two types of analysis and evaluation that are central to being able to demonstrate the public value of RUC:

- Net revenue analysis is the most important analysis for addressing the fundamental public value (sustainable revenue).
- Transport economic impacts and externalities analysis is critical if there is a need to address secondary public values such as allocative efficiency and environmental improvements.

2.3.1. Net revenues

Net revenues are core to the success of a RUC system. The key elements that determine net revenues are:

- Scale of charge (range of vehicles subject to the charge, geographical and temporal scope of operation);
- Type of charge (network distance charge, network time charge, or point based charging);
- Charge rates, demand levels and elasticity of demand response to charge rates;
- Discounts, exemptions, surcharges;
- Capital costs of deployment and renewal; and
- Operating costs.

The most successful charged networks in terms of net revenues are those that have access to high volumes of traffic across wide networks that charge both heavy and light vehicles. Of the case studies considered, Austria has the highest revenue per mile because it charges both heavy and light vehicles, has a simple operating model of products and services operated on a commercial basis, and has relatively high average charge rates.

All values in US$	Oregon WMT	NZ[14]	Swiss[15]	Germany[15]	Austria	Czech	Slovakia	Hungary
Gross revenue	308	780	1,470	5,200	2,000	522	238	666
Operating costs	14	16	22	590	186	66	55	45
Net revenue	294	764	1,448	4,610	1,814	456	183	621

[14] Gasoline powered vehicles exempt
[15] Heavy vehicles only

Charged network	73,479	58,775	44,739	8,700	1,356	808	1,491	4,047
Revenue per mile	4,003	12,999	32,365	529,885	1,337,758	564,356	122,736	153,447
Rate range[16]	0.05-0.23	0.03-0.40	0.11-0.19	0.14-0.38	0.27-0.77	0.05-0.77	0.03-0.43	0.11-0.77

2.3.2. Transport economic impacts and externalities

The key impacts that RUC systems may have are on behavior changes that may reduce congestion and so improve travel times and reduce vehicle-operating costs (primarily fuel consumption).

- The Stockholm congestion tax's primary impact was to reduce numbers of vehicles at peak times by 22%, and reducing peak delays by 30%. A 2009 study of the impacts[17] showed benefits of around US$74 million per annum in travel time savings and improved trip reliability, with environmental and safety impacts of around US$25 million per annum (although in strict economic terms these were offset by the payments of the charge by users, the net revenues were available for high quality transport infrastructure improvements).
- The German RUC system for heavy vehicles increased the efficiency of freight movement, with one survey[18] indicating changes in operation for 23% of the vehicles subject to RUC. 19% engaged in fewer empty runs and greater consolidation of freight trips, and 4% changed modes to rail, coastal shipping and inland waterways.
- A key objective of the reform effort in Australia is to improve economic impacts. A shift from vehicle licensing fees and fuel tax to distance, weight based RUC in one state is estimated to generate annual economic benefits of $687 million per year, with the introduction of time of day and location based targeting of congestion generating benefits of over $5 billion per annum.[19] Given estimates that the economic cost of congestion in Australia is around $12 billion per year (and to more than double in 15 years)[20], it is believed that these costs could be halved through the introduction of RUC to replace fuel and registration fees.

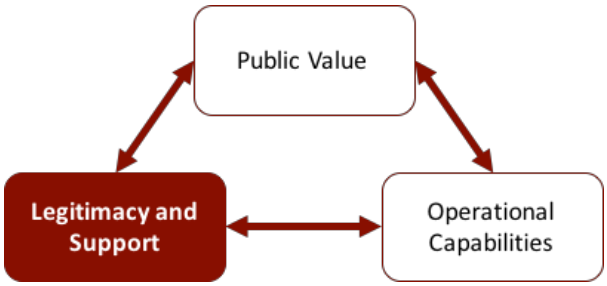
To determine the economic impacts of RUC requires strategic modeling of various RUC options upon groups of vehicles and networks as to demand elasticity and the likely distribution of impacts among road users. This should also take into account the impacts of countervailing reductions in other taxes, and any changes in public spending that are directly related to the existence of RUC (at the very least the costs of establishing and collecting RUC, and the benefits from projects undertaken if there are any net revenues that are raised *because* RUC has been introduced). Studies undertaken in many countries have indicated that the introduction of RUC systems carefully designed to target policy objectives around reducing congestion and

[16] Distance charges only.
[17] Eliasson, J. (2009). A cost-benefit analysis of the Stockholm congestion charging system. Transportation Research Part A: Policy and Practice, 43(4), 468–480.
[18] BME Umfrage, 2005. Bundesverband Materialwirtschaft, Einkauf und :Logistik e.V, BME Umfrage Wer Zahlt wie viel in Sachen Maut, 2005.
[19] Ibid footnote 1.
[20] Source: http://bitre.gov.au/publications/2015/is_074.aspx

emissions are able to do so, but that some alternative system designs may have limited impacts or could worsen congestion (e.g. the Auckland Road Pricing Evaluation Study in New Zealand indicated that a motorway only congestion charge would *worsen* city wide congestion and pollution by diverting traffic onto parallel local residential streets). This indicates that the public value for RUC is dependent on careful selection of charging concepts and design of the geography, charging rates, time and scope of operation to meet public value objectives, rather than to reflect engineering or design inputs that may seem attractive.

3. Establishing Legitimacy and Support: Creating and Sustaining a Favorable Authorizing Environment

Section 3 focused on the need to identify, demonstrate, and articulate the public value proposition for transitioning to RUC. This section focuses on creating the political, social, and organizational conditions necessary to support a fundamental change in transportation funding architecture.



For RUC initiatives to progress from a valuable concept to becoming an actual tax collection mechanism, those who hold power to approve RUC must be convinced of the public value proposition. In all states, these decision-makers include the Governor; the Legislature; the Courts (limited); and in states with active public referenda/initiative powers, the Voters.

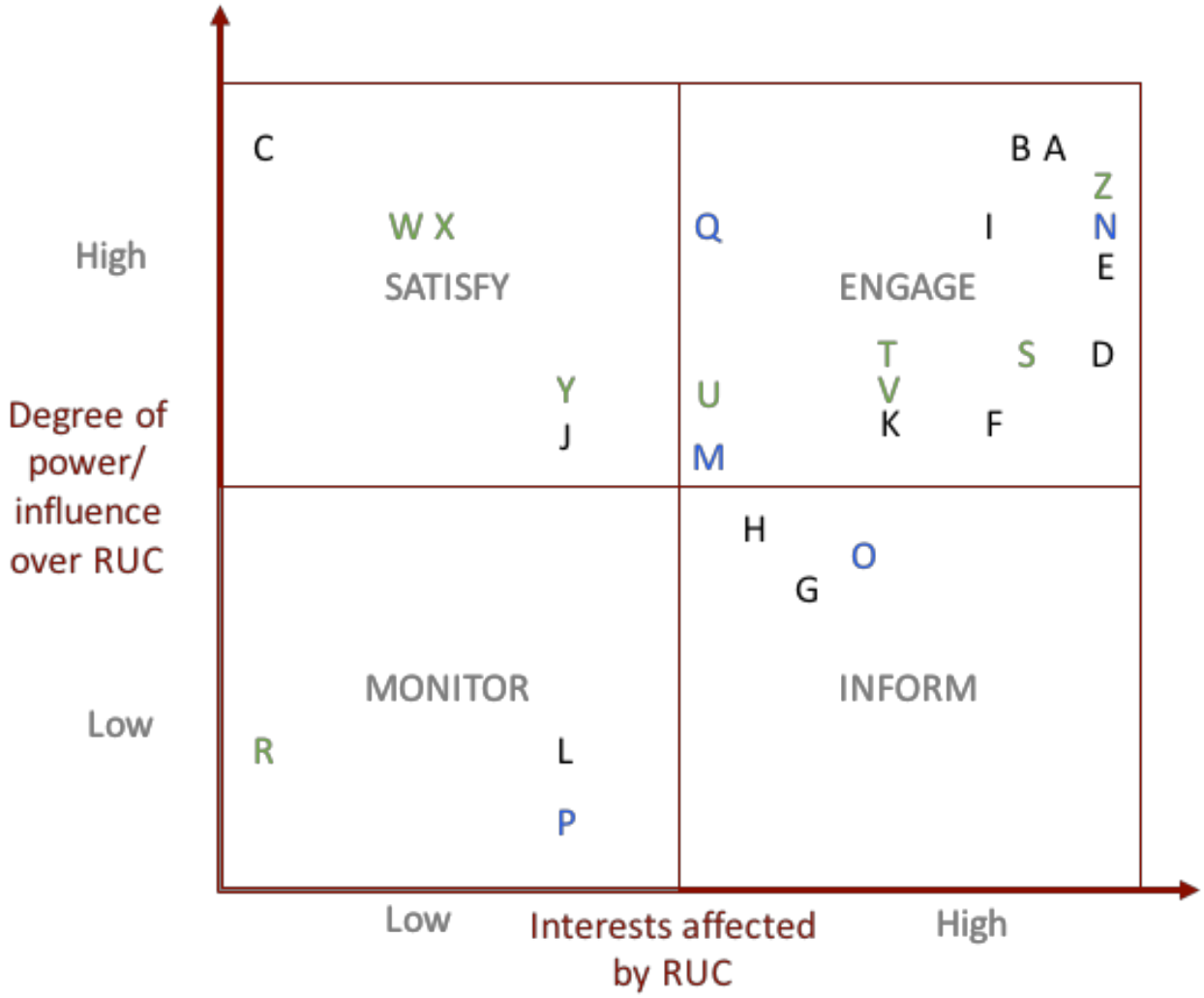
Each of these actors has some degree of formal legal authority to enact (or limit) RUC; they are the ultimate deciders of whether RUC initiatives will be implemented. However, the *authorizing environment* that RUC proponents such as DOTs encounter is much broader than just those actors from whom formal authorization is needed. Within the context of transportation tax policymaking, dozens of other persons and organizations hold *informal power* by wielding influence over the formal decision-makers. Collectively, all of these entities constitute the RUC authorizing environment (see Figure 1).

The actors in this broad and diverse group form opinions and take positions that will influence the outcome of a RUC initiative. Therefore, it is essential that these influencers understand and agree with the public value proposition of RUC so that they can provide their support for the initiative (advocacy, endorsement, resources, assistance, administrative approvals, etc.).

The main objective of this section is to examine how DOTs can position their RUC initiatives in this complex, dynamic authorizing environment in ways that can enhance legitimacy and gain support. First, a model Stakeholder Analysis Map is provided to visually portray the full authorizing environment that a DOT must operate within. Next, specific strategies for enhancing the legitimacy of a RUC initiative are discussed in detail, specifically drawing from the case studies presented in Section 2. Finally, dozens of strategies for gaining and maintaining the support of stakeholders are identified and briefly described. The special topic of general public support is addressed in a future section.

Figure 1: Stakeholders in the RUC Authorizing Environment

Public Sector	Private Sector	Social/Civil Society
A. Governor	M. Automotive OEMs	R. Universities
B. Legislature	N. Trucking industry	S. Transportation advocates
C. Courts	O. Shipping industry/ports	T. Consumer/driver advocates
D. Transportation Commissions	P. Technology providers	U. Environmental advocates
E. DOT Director	Q. Business associations	V. Privacy advocates
F. DMV Director		W. Print media
G. Agency civil servants		X. Broadcast media
H. Tax agency		Y. Social media
I. State Treasury		Z. Public
J. Fiscal analysis office		
K. Local government officials		
L. Federal agencies		



3.1. Stakeholder Analysis

To provide more insight into the RUC authorizing environment, a stakeholder analysis map is provided above in Figure 1. The purpose of this map is to identify actors likely to affect or be affected by a RUC initiative, and assesses the potential impact of their influence. The various actors are plotted based on the collective experience drawn from the RUC case studies presented in Section 0. However, each DOT considering a RUC initiative should develop its own stakeholder map based on the unique circumstances found in their state. Below are descriptions of the four quadrants:

- **Satisfy (upper left)**: Stakeholders in this quadrant may be highly influential, but their interests in a RUC initiative are not strong because they will not be uniquely affected. Because of their role within government, industry, or civil society, stakeholders in this quadrant tend to be influential but mostly impartial actors. The general goal is to keep them satisfied in their information requests.
- **Engage (upper right)**: Stakeholders in this quadrant are key to the success of RUC and should be actively engaged, as they are both strong influencers and have a specific interest in the outcome of the initiative. Actors in this quadrant may hold strong initial opinions. For a majority of these actors, the goal of active engagement is to gain their support for exploring and assessing the public value proposition of RUC. However, some of the actors in this quadrant may be predisposed against RUC; in this case, the goal of active engagement is to hear their concerns, and if possible, address those concerns through a public value proposition policy analysis that considers varying policy parameters, organizational designs, or RUC operational scenarios.
- **Monitor (lower left):** Stakeholders in this quadrant are in the authorizing environment landscape, but have neither a unique interest in the outcome of RUC or much influence over state-level decisions regarding RUC initiatives. Nonetheless, monitoring their activity will help identify any emerging issues or information that could affect a RUC initiative. One of these actors may develop a stronger interest or new role in RUC in the future, which may move them into a new stakeholder quadrant and require a different type of interaction.
- **Inform (lower right)**: Stakeholders in this quadrant have an interest in the progress and outcome of the RUC initiative, but their influence is diminished compared to other RUC stakeholders. The goal is to actively inform these stakeholders and use their input and feedback to strengthen the RUC public value proposition analysis.

3.2. Strategies for Enhancing Legitimacy

Some entities hold a unique role or position in the stakeholder landscape, and through their review or validation, can enhance the *legitimacy* of RUC as a potential policy initiative. Organizations that conduct independent and impartial analysis, are non-partisan, or that represent the broad interests of the public are often viewed as objective, trustworthy sources of information. To the extent that their work or positions echo those put forward in a RUC initiative, legitimacy is enhanced.

Another approach to enhancing legitimacy is when certain stakeholders who are typically skeptical of RUC (or tax measures generally) instead endorse or make statements in favor of RUC. In these instances, legitimacy is enhanced because these stakeholders are supporting RUC in spite of their own pecuniary interest or historical positions.

Below is a summary of activities that can enhance legitimacy:

- *External validation of the public value proposition by independent analysis*. Since DOTs are often sponsors and beneficiaries of a RUC system, the public value analysis conducted under their direction, though essential, may be viewed with suspicion. Independent examination of the issues presented can greatly enhance the legitimacy of the RUC proposal because the analysis is perceived as more objective. Examples include the following:
  - The Congressional Budget Office conducted a comprehensive analysis of the federal gas tax, and a potential mileage-based fee system (or RUC). The analysis found that a RUC is worth further exploration as a potential alternative to the diminishing returns from the gas tax.
  - Fitch, Moody's and Standard and Poor's ratings agencies all conduct analysis and ratings for publicly issued bonds. When one (or more) of these firms cite the erosion of the motor fuel tax as a problem that must be addressed in the future, legitimacy of state-level forecasts of this same problem are enhanced.

- *Inclusive, deliberative information-gathering and decision-making process.* The credibility of the process for investigating and developing RUC as a funding mechanism is critical. If stakeholders feel that decisions about RUC were made in the absence of fact-finding, or without opportunity for meaningful input, any resulting RUC initiative will be tainted. Many advantages of establishing a task force, advisory committee, or similar stakeholder committee are discussed more fully in Section 3.3 below. If the process is administered with integrity, it can enhance the legitimacy of the RUC initiative itself. Examples include the following:
  - **California's** Road Charge Technical Advisory Committee held monthly meetings throughout the state, allowing interested persons from different regions to attend and comment. Meetings were publicized in the local media, proceedings were broadcast on public access TV, and all materials were made publicly available on the Internet.
  - **Washington's** Road Usage Charge Steering Committee consists of a wide array of stakeholders and decision-makers, including several legislators. The Steering Committee has been very methodical in their examination of RUC and development of related policy approaches. As witnesses to this process, legislative members are able to vouch for the credibility of the decision-making to their legislative colleagues, enhancing the legitimacy of the RUC initiative.
  - An important lesson can be learned from **Minnesota**. Their Task Force either did not develop or enforce common ground rules aimed at maintaining the integrity of their process. As a result, some Task Force members initiated their own report, introducing new and untested information, drawing conclusions and taking stances at odds with the Task Force's official report.

- *Endorsement by public interest organizations*. Support for RUC initiatives by organizations with the reputation of representing the general public interest can uniquely enhance legitimacy.
  - In **Washington**, their Steering Committee must include a consumer advocacy organization. The committee member filling this position has served as Board Chair for Consumers Union (publishers of Consumer Reports) and is a noted expert in consumer protection issues.
  - In **Oregon**, **California**, and **Washington,** the local chapters of the Automobile Clubs of America – better known as AAA – are represented on the stakeholder committees in each of these states. Although some of the chapters have not yet taken final positions in favor of RUC, their presence and active involvement enhance the legitimacy of the process and outcomes.

- *Endorsement by organizations against their usual interests*. As noted above, a RUC initiative can gain greater legitimacy when stakeholders who ordinarily might be opposed to a specific tax measure instead provide their endorsement or support.
  - Although **Utah** is still in the initial RUC research and exploration stage, in late 2014 the Utah Taxpayers Association pushed for consideration of mileage-based user fees as an alternative to the existing gas tax. This added legitimacy to RUC, since the Taxpayers Association's purpose is to scrutinize tax programs and the "proliferation of questionable government acts" – generally not favorable to government tax proposals.
  - The 3,000-member Seattle Electric Vehicle Association (SEVA) has been an active proponent for RUC, in spite of the fact that EV owners would pay about $25 more per 1,000 miles driven under the most recent **Washington** RUC test proposal, relative to what they pay in gas taxes. SEVA's continued support for RUC has enhanced the credibility of the RUC proposal.
  - Through active engagement (as suggested in Figure 1) and subsequent negotiations, **Oregon** DOT was able to obtain the consent of the local chapter of the American Civil Liberties Union (ACLU) for the state's implementation of a RUC. The agreement reached with the ACLU is often cited as proof of legitimacy of Oregon's privacy protections in their RUC program.

- *Establish direct linkages between the taxable event (road use), the tax rate (repair and replacement costs) and the use of tax proceeds (roadway upkeep)*. The tighter the connections between these elements, the less susceptible RUC is to claims of unfair taxation, arbitrary increases, diversion of tax revenue for other purposes, or general misuse of public funds. These direct linkages also mirror the business practices of other public utilities, such as water, electricity and waste disposal.
  - In **New Zealand**, heavy and light vehicle RUC rates are reviewed annually based on the application of its Cost Allocation Model (CAM). The CAM calculates charge rates based on revenue required to meet maintenance and capital spending in the NZ Transport Agency's ten-year financial forecast, and forecasts of future traffic demand (by distance) of vehicle categories. The model applies economic principles to classify costs as being fixed (common), weight related, road space related or vehicle type specific, and produces recommended charge rates as a result. Although rate setting is ultimately a decision of Cabinet, because it is directly informed by economic modeling (and is undertaken annually), it has largely de-politicized the debate about rate setting.
  - Every two years, **Oregon** DOT publishes its Cost Allocation Model that calculates the costs to the roadway system imposed by different categories of users, and then recommends calibration of roadway taxes and fees according to the identified cost responsibilities.

3.3. Strategies for Gaining and Maintaining Support

To create a favorable authorizing environment for a RUC initiative, it is essential to build support among stakeholders, but especially among those shown in the upper right quadrant of the stakeholder map (see Figure 1), because their opinions and actions will have the greatest impact on the ultimate success of a RUC initiative.

First, stakeholder *strategies* and *tactics* must be distinguished. For the purposes of this report, strategies are defined as pre-planned, high-level, generic approaches expected to help create a favorable authorizing environment; meanwhile, tactics are the specific methods used and actions taken to further the strategies. For example, one strategy for gaining critical support for a RUC initiative is to identify and deploy legislative leaders that are willing to serve as a RUC champion, and who have enough clout to guide a transportation tax reform measure through the legislative process. A tactic, on the other hand, would be to cultivate a relationship with the Senate Transportation Committee Chairperson as means of implementing the strategy. In the material provided below, we are only identifying successful *strategies*. Tactics are much more dependent on the individual circumstances, current conditions and unique personalities within a state DOT's stakeholder landscape. A tactic that might be effective in one state may be counter-productive in another state due to differences in legislative process, executive branch structures, powerful personalities, etc.

Strategies that apply across the entire stakeholder landscape ("overarching strategies") are listed first. Strategies more tailored to specific types of stakeholders or to specific actors are grouped below by stakeholder quadrant.

3.3.1. Overarching Strategies

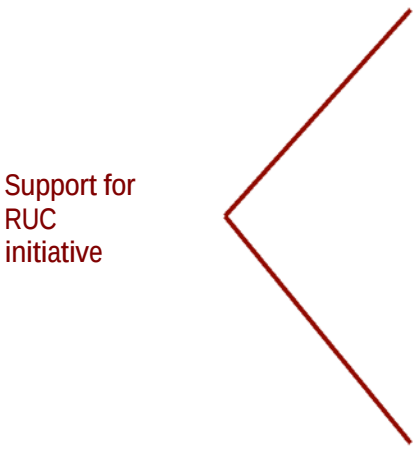
Below are several overarching strategies for building support for study, testing, or implementation of RUC.

- *Clearly establish the public value proposition*. Although all states are heavily reliant on the gas tax as a source of transportation funding, every state is different in the degree of reliance, tax mix and structure, how revenues are used, and the potential consequences of inaction. A financial evaluation can be conducted specific to each state to illustrate the benefits of RUC as a potential replacement for gas taxes. In addition, laws and policy priorities differ from state to state. Conducting a feasibility analysis of RUC will identify the unique issues in each state that must be addressed for a RUC initiative to succeed. Together, these two actions will help to clarify the public value of RUC. Stakeholders, decision-makers, and the public will all want to examine this supporting evidence if they are to support RUC.

- *Keep the primary purpose to be served by RUC – providing sustainable transportation funding – as the "North Star".* The experience in other states has shown that a diverse group of stakeholders can be united behind a RUC initiative. However, the groups often put forth divergent justifications for supporting RUC. These differences are not crucial in the initial stages of RUC investigation and preparation (feasibility analysis, business case evaluation, etc.). But as RUC policy development moves into more advanced stages, "different values can thread fault lines through the basic coalition" supporting RUC.[21] As RUC implementation details are considered, apparent conflicts, policy contradictions and required tradeoffs may emerge. When this happens, the original and primary purpose for considering a RUC

[21] Moore, *Creating Public Value*, Harvard University Press (1995), at page 59.

initiative must serve as "true north" to keep the stakeholders unified. Although an initial RUC system may not be able to immediately deliver all of the hoped-for benefits desired by every single stakeholder, establishing a basic RUC system designed to stabilize transportation revenue is the first evolutionary step. Without accomplishing this primary purpose, the secondary purposes cannot materialize later. The graphic below illustrates examples of stakeholders, secondary purposes that may motivate their support of RUC, and corresponding "fault lines" that may translate their secondary motivations into issues.



Stakeholder	Motivations / Secondary Purposes	Fault lines (latent issues)
Transportation industry	Sustainable transportation revenue	… replacement for existing gas tax?
State Treasurer	Additional source of revenue to bolster credit rating	… addition to existing gas tax?
State AAA chapter	Dedicated revenues for roadways	… restricted use of revenue?
Social justice advocates	More equitable tax method than gas tax	… discounted rates for low-income?
Local governments	Peak pricing to manage congestion	… higher rates in during commutes?
Energy/environmental advocates	Reduce gasoline consumption	… lower rates for high MPG vehicles?
Electric vehicle drivers	User fee instead of EV ownership fee (registration surcharge for EVs)	… lower rates for alt fuel vehicles?

- *Policy objectives should drive decisions; technology should not limit or dictate policy*. Most of the initial attention paid to RUC by the media, general public, and even policymakers is focused on technologies and devices for how mileage will be recorded and reported. Because the rate of change in the technology industry is much greater than the rate of change for transportation policy, it is important to monitor emerging technologies and approaches for improvements in ease of use by consumers, accuracy and security of mileage data collection and transmission, and improvements in capital and operating costs. However, basing the state's transportation funding policy to fit within the available technologies can lead to a mismatch between the end goal – for example, a sustainable transportation revenue collection system – and what governors, legislatures, and public are willing to support. The best practice is for states to begin with the policy objectives and establish policy principles first, as the foundation for a RUC initiative. Focusing on the means (technologies for reporting mileage) can lead to unacceptable public policies, as well as technology lock-in, where the state's tax policies are constrained by a technology approach that was adopted years or even decades ago.
  - Legislative proposals for newer methods of transportation taxation, such as vehicle fees that vary by MPG, fuel source, or principal residence are not possible in many states due to the vehicle licensing databases that were adopted 30 or 40 years ago and cannot accommodate these changes.
  - Designing a RUC system and tax policy around one technology approach – a GPS-based OBD-II port device, for example – constrains the public policies that a state may wish to adopt. Privacy concerns regarding GPS devices, inability of older vehicles to pay RUC with technology,

and difficulty taking advantage of emerging, evolving technology such as in-vehicle telematics could constrain tax policy decisions, if a state builds its tax system around a chosen technology.

- **California** and **Washington** are two states that most recently established their policy preferences, parameters and guiding principles first, before settling on the various method or methods for collecting a RUC. Only after these policy parameters were established did the states move forward with identifying the technologies for implementing a RUC.
- Similarly, **Oregon** moved from a single-technology approach (piloted in 2006-2007) to an open system that is technology agnostic from the second pilot in 2012 to the current system.
- **New Zealand** began with a manual approach based on paper distance licenses before technology was available that could handle RUC efficiently. Once technology became available, the agency transitioned to an open system that allows for any qualifying technology or service provider to collect RUC on behalf of road users.
- **Europe**'s earlier RUC systems for trucks relied on single technology approaches, largely DSRC or a combination of DSRC and GPS. Such lock-in has prevented new policy considerations such as extending charges beyond motorway networks and onto secondary and tertiary roads, due to the cost of such expansion

Beyond these overarching strategies, individual strategies that are geared for different groups of stakeholders are presented below.

3.3.2. Strategies tailored to the "engage" stakeholder quadrant (high influence/authority, high interest)

- *Create a special committee (Task Force, Advisory Committee, Policy Committee, Steering Committee, etc.) that includes high-impact stakeholders*. Creating a forum for introducing and examining information, drawing conclusions and making recommendations about a future RUC system will lead to more well-rounded public policy recommendations and greater buy-in by diverse stakeholders.
- *Identify and cultivate well-positioned legislative champions*. With a limited number of days and hours during legislative sessions to make critical policy, budget and tax decisions, the vast majority of legislators do not have the time to become experts in RUC. Instead, they tend to rely on their legislative colleagues and look to them for guidance on complex tax policy measures. Having a well-respected legislative champion who has enough clout to gain support from his or her peers will be critical in gaining legislative approvals for RUC.
- *Illustrate the mutual benefits of RUC and environmental/energy policy*. Transportation and environmental advocates are often presumed to be at odds over the best long-term course of action for moving people and goods without damaging the environment. Modeling and limited testing has shown that direct user fees (such as RUC) not only provide fairer and more stable transportation funding, but that they may cause drivers to be more conscious of their driving habits, reducing unnecessary mileage.
- *Incorporate consumer choice into RUC policy*. Because there are so many alternative methods of reporting and paying for RUC, the design of this new funding system can accommodate the choice of consumers in the method they find most trustworthy and convenient. Allowing personal choice among multiple options for RUC enhances public and stakeholder acceptance and support.
- *Allow accommodations for those who distrust technology and/or the government (but do not design the entire system to accommodate this perspective)*. Privacy advocates are often suspicious of data collection activities by government, particularly the collection and retention of personally-identifying information. New technologies such as automated, high-resolution cameras, GPS-based tracking

devices, etc. further generate concerns about government-mandated technologies and data collection. As **Oregon** has proven, a RUC system can work and be more acceptable to the public when low-tech alternatives are provided for reporting mileage.

- *The public value proposition should factor in the statewide economic cost of deteriorating roadways caused by the lack of reinvestment in the system.* A financial analysis can show the declining revenue that will be available for transportation if states remain reliant on gas taxes in the coming decade. However, the fact that government would have less money available does not adequately capture the potential consequences of under-investment in the system. Businesses – particularly those depending upon ground transportation systems – are interested in understanding the local and regional economic impact and effects of a transportation system that no longer functions well.
- *Consider RUC approaches that are compatible with future technologies, policies and applications of interest to local governments.* Local governments tend to be interested in mitigating congestion in their cities and urban corridors. Tolling is the current method for managing congested corridors, but in the future when all vehicles are equipped with advanced telematics systems and pay-by-the-mile is the primary funding mechanism, the local agencies may want to leverage the RUC system to apply their own peak pricing policies. In the initial stages of RUC introduction to the public, these policies and the required technologies are a significant drag on public support. However, these capabilities should not be completely ruled out in the future. Local governments are more likely to support a RUC system that allows for this future compatibility.
- *Make sure other agencies – and especially DMVs – are included in the deliberations and design of a RUC system.* DMVs around the nation are under tremendous pressure to find ways to collect new information and apply new types of taxes on vehicles and drivers, even though their IT systems are generally antiquated. Since a state RUC will have some interdependencies with the state's motor vehicle database, DMVs may be skeptical about the possibility of accommodating an entirely new tax method within their resources. RUC initiatives (and especially pilot projects) can be presented as an opportunity for experimentation, rather than as a threat. Active collaboration with DMV administrators, and joint development of new delivery platforms and service channels for RUC can be mutually beneficial, particularly if RUC can serve as a catalyst for drawing state or federal investment in IT system upgrades. **Washington** has successfully worked with its Department of Licensing (whose Director is a member of the RUC Steering Committee) to identify issues that IT limitations raise for RUC, discuss appropriate timing of any testing or implementation around IT modernization, and explore a range of possible agreeable resolutions.
- *Leverage the role and reach of state Transportation Commissions to lead or support policy development and communications.* Although it varies by state, many Transportation Commissions have latitude to research, explore and recommend innovative projects, programs, and policies. Commissioners tend to be civic and/or elected leaders and command respect within their communities and industries. As trustees of the statewide system, to be managed for the benefit of the entire state, Transportation Commissions can play a powerful role in leading or supporting the introduction of RUC initiatives. Their influence should be utilized wherever possible.
- *DOT Directors can tap their Research offices to provide political cover, resources, and support*. In many instances, the Governor, Legislature or Transportation Commission has not directed DOTs to explore RUC; yet the Directors understand better than anyone the risk to the transportation system from chronic underinvestment and diminishing revenues; consequently, many wish to pursue RUC. In situations where no external directive or authorization has been provided, DOTs can use their Research Offices and

research funding to undertake initial investigation of RUC as a revenue mechanism, as part of their usual research activities.

- *Consider the perspectives and obligations of the state's treasurer or bond-issuing agency, and address their concerns with legally and financially viable alternatives for RUC*. The overriding concern for many state treasurers is achieving and maintaining the highest credit ratings possible so that the state can issue debt at the lowest possible cost. Changing from a well-proven, 100-year old, historically predictable revenue source – the gas tax – to a new, unproven revenue source often strikes state treasurers as a risky proposition. However, there are many alternatives for transitioning from the gas tax to a RUC, including methods that can not only retain a state's strong credit rating, but potentially enhance it. Bringing the interests of the state's treasurer to the table during the policy and economic discussions can help in identifying legal and financially viable approaches for moving forward with a RUC system.
- *Lean on the federal CAFE standards and 2025 deadline for compliance to underscore the need for a revenue plan.* This will help frame RUC as a *response* to federal regulations, rather than stepping too far out in front of the looming gas tax revenue problem. Citing the impending federal CAFE standards, which principally affect light vehicles, may also alleviate some of the concerns in the heavy truck industry that they are targets for mileage-based taxes.
- *Cite work in other states, particularly where state legislatures have taken action*. This can help elected officials feel more comfortable that other states are exploring RUC as the preferred solution as well.
- *Refer to work conducted by the National Conference of State Legislatures, Congressional Research Services, the Council of State Governments, and other legislative-branch professional research organizations.* Similar to the strategy above, this can provide legislators with comfort knowing that the issue is widespread enough that their own research organizations and industry associations are examining the problem and recommending RUC.

3.3.3. Strategies tailored to the "satisfy" stakeholder quadrant (high influence/authority, lower interest)

- *Develop a proactive media outreach strategy*. The goal for this stakeholder group is to make sure they have factual information, before they begin their coverage, reporting, and opinion editorials. Rather than waiting for a story to be published, the better strategy is to seek out the transportation reporters and editorial boards, and ask to meet with them to inform them of the forthcoming RUC exploration and give them the facts. This will reduce the instances of factual mistakes appearing in news stories.
- *Identify and train designated spokespersons, so they can rapidly respond to media inquiries*. Reporters often need to speak with someone immediately (on the record or live broadcast), about RUC. Having a few designated spokespersons can ensure that the media is provided with the best spokesperson possible for laying out the facts and case for RUC.
- *Anticipate the need for basic information and develop materials in advance*. It is very helpful to the media (and especially television) when factual information can be presented in visual, easy-to-understand formats. Having pre-recorded B-Roll video clips, high-resolution graphics and charts, or even concise answers to Frequently Asked Questions all help keep the media informed.

3.3.4. Strategies tailored to the "inform" stakeholder quadrant (lower influence/authority, high interest)

- *Pay special attention to the needs and concerns of operating agencies and entities*. It is important to retain the support of co-workers, colleagues in other agencies, and even key vendors and suppliers that

may end up playing a role in a future RUC system. Periodic emails, brown-bag briefing sessions, and meeting invitations can all help ensure that the divisions of a DOT and partner agencies do not object when their support, cooperation, or assistance is needed.

- *Keep revenue and tax collection agencies informed of developments*. To the extent these agencies are not already involved in transportation revenue collection (e.g., fuel taxes), they have specialized expertise in tax collection as a whole, particularly in compliance and enforcement. Even if these agencies will not have a formal role in a future RUC system, it is wise to draw on their knowledge, insight and experience for the benefit of the initiative, but also to earn their support for RUC.

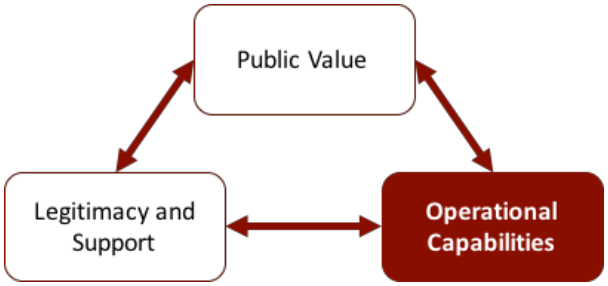
3.3.5. Strategies for the "monitor" stakeholder quadrant (lower influence/authority, lower interest)

- *Encourage consideration and support of RUC at the federal level – especially at U.S. DOT and within Congress*. Until the passage of the FAST Act, the federal government had not actively supported development of a RUC system nationally, leaving this issue up to the states. However, recent state and industry efforts to gain federal support for RUC research and testing has resulted in the FAST Act, which provided $95 million in grants to states to test alternative revenue systems such as RUC over five years. Continued support at the federal level also improves the authorizing environment in the states, providing increased legitimacy to RUC as a potential solution.
- *Monitor relevant research conducted by universities, and consider tapping UTCs for discrete research activities related to RUC*. Research universities can help improve the overall authorizing environment by conducting research into topics that are overlooked or ill-suited to be researched by DOTs. One excellent example is a comprehensive synthesis report on Public Attitudes and Perceptions of Mileage Based User Fees, conducted by the Mineta Transportation Institute at San Jose State University[22]. Public opinion research is just one area that universities can be tapped to conduct research that otherwise may not be conducted by DOTs.

[22] Cite to A. Agrawal Weinstein, Public Acceptance and Perceptions of Mileage Based User Fees, NCHRP Report No. ---, 2016.

4. Operational Capabilities to Deliver the Public Value Proposition and Validate Support

The third pillar of the "strategy triangle" for consideration of RUC is operational capabilities, or how well a jurisdiction's public agencies can implement and administer RUC in furtherance or delivery of the public value proposition (see Section 3).



Operational capabilities are challenging to develop, since RUC is often an entirely new concept with little if any agency or jurisdictional precedent. Although some elements required for RUC exist in most states (e.g., departments of motor vehicles register individual vehicles, license individual drivers, and conduct transactions; state and local policy enforce registration and licensing regulations), combining these with mileage reporting in a simple, low-cost, enforceable way can be challenging. In addition, there are critical cross-cutting support functions for each of the three fundamental functions, such as communications and IT, that must be enhanced to support RUC.

This section explores how to address operational capabilities as a key element of the roadmap toward consideration of RUC for any jurisdiction, drawing on the case studies in Section 2. The discussion covers three aspects of demonstrating operational capabilities:

- **Operational structure of RUC** can vary widely depending on the type of RUC program and the public value it is attempting to realize. Policy and design choices impacting the operational structure of RUC impact the ability of agencies to demonstrate operational capabilities.
- **RUC technology** likewise can vary widely, thus impacting an agency's capabilities to deliver and manage them.
- **Administrative and legal mechanisms** may already be in place that can be repurposed or reorganized to support RUC, but in many cases new mechanisms need to be created. These include agency regulations, processes, and procedures.

The ability of agencies to demonstrate operational capabilities, specifically the above three dimensions, reinforces the public value proposition of RUC. As the case studies throughout this section illustrate, the most successful RUC efforts have relied on partnerships with the private sector and other agencies to deliver the most efficient possible combination of operational capabilities while still protecting the public sector's obligation to deliver RUC with integrity.

4.1. Operational Structure of RUC

Regardless of the extent to which secondary public values are pursued, RUC can be broken down into three high-level operational functions:

- Road use reporting or detection
- Fee calculation, collection, and accounting
- Enforcement

For each of these high-level functions, there is both a driver perspective and an agency perspective. From the user perspective, acceptance is driven by minimal disruption of normal routines, transactional friction such as time and cost of reporting and paying the fee, and generally positive customer experiences. It is possible to provide these experiences without sacrificing the fundamental public value of generating net revenue or even secondary values such as exposing road users to the costs of driving. However, doing so requires agencies to have capabilities to provide each of these functions in a way that maximizes customer acceptance. The sections below describe each operational function in turn.

Regardless of the particular operational concept(s) chosen for road use reporting or detection, fee calculation, and enforcement, it is critical for implementing agencies to build operational understanding of the full range of approaches for implementing the concept and identify the competencies needed (whether in house, outsourced, or most likely some combination) to deliver.

4.1.1. Road use reporting or detection

Since the basis of a road use charge is *road use*, it is essential for agencies to build the capability either to detect or have users report their road use. As discussed in Section 4, the particular selection of road use reporting or detection concepts or methods may vary based on the policy considerations of a given local; in the end, however, whatever methods are agreed must be implementable. Around the world, varying locales have pursued varying approaches.

- Open systems, user choice, and automation were policy parameters that generated support in Oregon in the period following the initial pilot test using in-house technology. Therefore, **Oregon** DOT had to develop capabilities to provide those characteristics. Oregon benefited from the existence of an Innovative Partnerships division, which had the contracting flexibility to procure mileage reporting technology and account management vendors using an open system framework (a form of a public-private partnership).
- **New Zealand**'s original policy imperative was to generate revenue for road investment. Benefitting from its island geography, an entirely manual system was possible, so New Zealand designed and implemented a manual approach to reporting mileage from the outset of its RUC program in 1978.
- In **Europe**, tolling systems were common and familiar, so early RUC programs resembled tolling, with detection by a series of physical gantries rather than reporting by autonomous technology such as in Oregon or manually by road users such as in New Zealand.
- RUC systems that feature an element of congestion pricing are intended to address secondary public values and so constrain road use reporting into other solutions, typically technology-based solutions, in order to be administratively feasible. **Singapore**, for example, uses a dense network of tolling gantries, while **London** uses video detection in the charged area.

4.1.2. Fee calculation, collection, and account management

The second high-level function of RUC is the calculation of the fee or charge, collection of the fee (which includes moving the funds into the Treasury), and customer account management. There are numerous options for implementing or at least demonstration the capability to implement this set of functions. Hundreds of millions of transactions take place across the U.S. every day, involving numerous private companies and public agencies. Competency to calculate fees, collect funds, and manage accounts is widespread and

evolving with technology such as smartphone apps, near field communications (NFC), peer-to-peer payment networks, and distributed ledgers.

- **Oregon** and **California** RUC programs are both relying on commercial account managers and outsourced state account managers (who act on behalf of the agency) to calculate fees, collect funds (simulated in the case of California; real in the case of Oregon), and manage customer accounts, including invoicing, web-based account viewing and updating, and phone and web-based customer support. By tapping into the private sector, both states were able to build off capabilities of others more inexpensively than they could by building their own system. They also are able to take advantage of innovation in the private sector around payments and account management more quickly.
- **Europe** likewise has seen outsourcing of many of its RUC systems. However, with the recent exceptions of Hungary and Belgium, most systems are outsourced to a single supplier that acts as a revenue collector and account manager on behalf of the government.
- Interestingly, **New Zealand**'s RUC system, owing to its origins as a paper-based scheme in the 1970s, relies on a network of existing retailers (notably NZ Post, the nation's postal system) and mail-based transactions. By relying on such a network, the New Zealand Transport Agency (NZTA) was able to extend its capabilities to implement a nationwide RUC system
- **Oregon WMT** relies largely on self-reporting and transactions conducted directly with Oregon DOT; likewise, **IFTA** relies on self-reporting and transactions between each motor carrier and its home jurisdiction. The result is "home grown" transaction processing and customer account management and support systems in each jurisdiction. Despite this proliferation of systems, coverage is generally provided by agencies that otherwise *already* have relationships with the heavy vehicle industry and large numbers of customers for regulation of safety, driver licensing, and other assessment of other fees such as registration (including IRP).

4.1.3. Enforcement

Any tax system must be enforceable to a reasonable standard, otherwise there is a risk of widespread evasion, which undermines not only net revenue and fairness (the fundamental public values of RUC), but also trust and confidence in the system, which in turn leads to reduction in legitimacy and support. Therefore, a third high-level function of RUC operations is enforcement. As with road use reporting and fee collection, it is critical for agencies to demonstrate either alone or in partnership with other agencies how it might deploy RUC with enforcement aspects that build confidence in the program.

- **New Zealand** relies on a combination of data analytics, roadside enforcement, and annual safety checks (known as a Warrant of Fitness) to enforce RUC on heavy vehicles and light vehicles alike. In addition, with the incorporation of electronic RUC service providers who tout higher levels of security and accuracy, a certain amount of enforcement is built into the design of the system. NZTA maintains its own Economic Compliance Unit which analyzes RUC data for anomalies, conducts targeted audits based on data analysis, and assess fines and penalties for evasion. It also partners with the NZ Police for roadside enforcement of RUC regulations. Without this network of capabilities, the RUC system in New Zealand would not be possible. However, it is important to observe that the marginal cost and agency level of effort to implement RUC enforcement is

relatively modest, given that the roadside enforcement and safety check components of the enforcement exist regardless of RUC.

- Not unlike New Zealand, **Oregon WMT** relies on existing enforcement infrastructure including weigh stations, roadside inspectors and police, carrier registration processes, IFTA audits, and other touch-points with the industry as a means of enforcing the tax.
- **Ore*GO*** and **California**'s Road Charge Pilot are not testing enforcement explicitly. There are some enforcement features built in, such as reporting of errors and anomalies from automated mileage reporting methods, which can be used as the basis for following up on potential issues. Moreover, the gas tax remains in place as a guard against lost revenue for those who might avoid reporting or under-report mileage. However, the broader issue of enforcement will require collaboration with DMVs, police, and potentially air quality agencies in both states. DMVs present an opportunity to enforce enrollment and participation in any mandatory RUC system, much like vehicle registration holds and driver licensing revocations are used as deterrents to other forms of noncompliance or misdemeanors. Likewise, support of state policy and/or air quality agencies (Department of Environmental Quality and Bureau of Automotive Repair, respectively) may be helpful in enforcing RUC, if necessary, at roadside or at other customer touch-points. In states with a safety inspection process, this can be used as an enforcement opportunity.
- **IFTA** relies on the threat of audit for compliance. Each year, each jurisdiction must audit at least 3% of registered *carriers* for compliance with IFTA reporting, payment, and record-keeping. Most IFTA audit capabilities were developed by individual jurisdictions as an outgrowth of existing regulatory bodies such as DOTs, DMVs, or departments of revenue, which have similar audit functions for fuel taxes and other tax collections. IFTA is also enforced at roadside, for example by state police and at inspection stations, through vehicle decals that must be displayed.

4.2. RUC Technology

Agencies are not technology innovators, nor do they need to be in order to build or demonstrate operational capability for RUC. Quite the contrary; success comes from leading with policy, then analyzing the full range of available technologies to find the options that are most suitable to meet local policy preferences. Building agency capabilities around technology for RUC is not about mastering technology design or implementation; it is about understanding how to relate policy needs to technology options, selecting technologies that respond best to policy needs, and procuring those technologies in the most suitable manner.

Most RUC literature focuses on the mileage reporting technology such as onboard devices, smartphones, and other innovations. However, equally important is consideration of technology for the other functions of RUC – account management and enforcement – as well as cross-cutting areas such as public communications. Below are three dimensions or questions related to RUC technology that impact operational capabilities of state agencies; these dimensions cut across all three high-level operational functions.

- *User reporting vs. system detection*. **Oregon RUC**, **New Zealand**, **California**, and **Washington**, **IFTA**, **Oregon WMT**, and **Europe**'s light vehicle RUC vignettes are all reliant on user self-reporting to some degree as the basis for RUC. This is fundamentally distinct from the heavy vehicle RUC approach taken in most of **Europe** and congestion pricing in **Singapore**, **Stockholm**, and **London**, which resembles tolling in that it relies on detection and measurement by the system. In truth, most systems are a sort of hybrid with elements of both user reporting and system detection, but

fundamentally RUC programs have shifted away from system detection and monitoring toward largely self-reporting systems. There are a number of reasons for this shift, but they are driven primarily by cost and privacy, two over-riding policy considerations. System detection of millions of users over an entire road network at all times is very costly, and it requires some loss of privacy by motorists. Thus the field of available technologies has narrowed somewhat to both manual and automated methods of self-reporting.

- *Commercial-off-the-shelf (COTS) vs. new technology development*. **Oregon**'s first RUC pilot was an example of new technology development, as is **Singapore**'s urban congestion charging system and some of Europe's heavy vehicle RUC systems. By contrast, Oregon's current RUC program and California are relying on COTS technologies for nearly every aspect. Others such as Oregon WMT and New Zealand are hybrid systems in that the rely on COTS for the customer facing aspects but in-house development of systems for back-office aspects.
- *Open vs. closed*. Perhaps the most important RUC technology innovation of the past decade was not a technology at all, but rather a principle. New Zealand, Oregon RUC, and Oregon WMT have all proven the case for open systems, rather than procurement of a single-source service provider or technology to accomplish RUC. Agency strengths typically lie in procurement, administration, and risk management; therefore, there is a tendency for closed systems, which aligns with many agency procurement models. However, closed systems have proven suboptimal due to higher costs, difficulty in evolving technology to meet evolving policy needs, and issues with customer service. Given the lack of familiarity, many agencies risk stumbling over this issue unless they properly invest in understanding the benefits and challenges of open systems.

4.3. Administrative and Legal Mechanisms

In addition to understanding the operational scenarios and technologies that are specific to RUC, agencies must be well versed in the overarching administrative and legal mechanisms of a tax system. This section addresses a few of the issues that agencies need to build capability or partnerships to address. Many, if not all, of these functions already exist in most state governments, but likely not within every DOT. The ability to identify existing capabilities across state government, analyze how they may be leveraged to support RUC implementation, and assembling the necessary agreements and partnerships to support implementation are all key to achieving operational capabilities for RUC.

Administrative capabilities include the following

- Tax processing, including collection, processing, and accounting of funds from external account managers to the state treasury
- Development of administrative rules to comply with statutes related to RUC
- Audit of account managers
- Setting of performance indicators, management of performance, and regular evaluation of performance

Legal procedures include the following:

- Certification of tax measurement basis (e.g., certifying measurement technologies as the basis of RUC)
- Data protection

- Privacy protection
- Managing contracts with partners such as technology providers and account managers
- Managing inter-governmental agreements with other state agencies, or with other states in the case of multi-jurisdictional RUC
- Enforcement proceedings, including adjudication of protests or appeals

4.4. Summary

RUC requires substantial human and financial resources. In order to build legitimacy in support, and in order to deliver on the promised public value, it is essential that one or more agencies in parallel demonstrate its operational capabilities to deliver RUC. This does not mean that the agency must provide each and every function. However, it does entail overall management for the "enterprise." This includes at minimum an initial assessment of organizational capabilities (including strengths, weaknesses, and gaps related to RUC); assessment of legal, policy, or administrative rules that constrain agency capabilities related to RUC; and development of a plan for filling the gaps and overcoming the constraints.

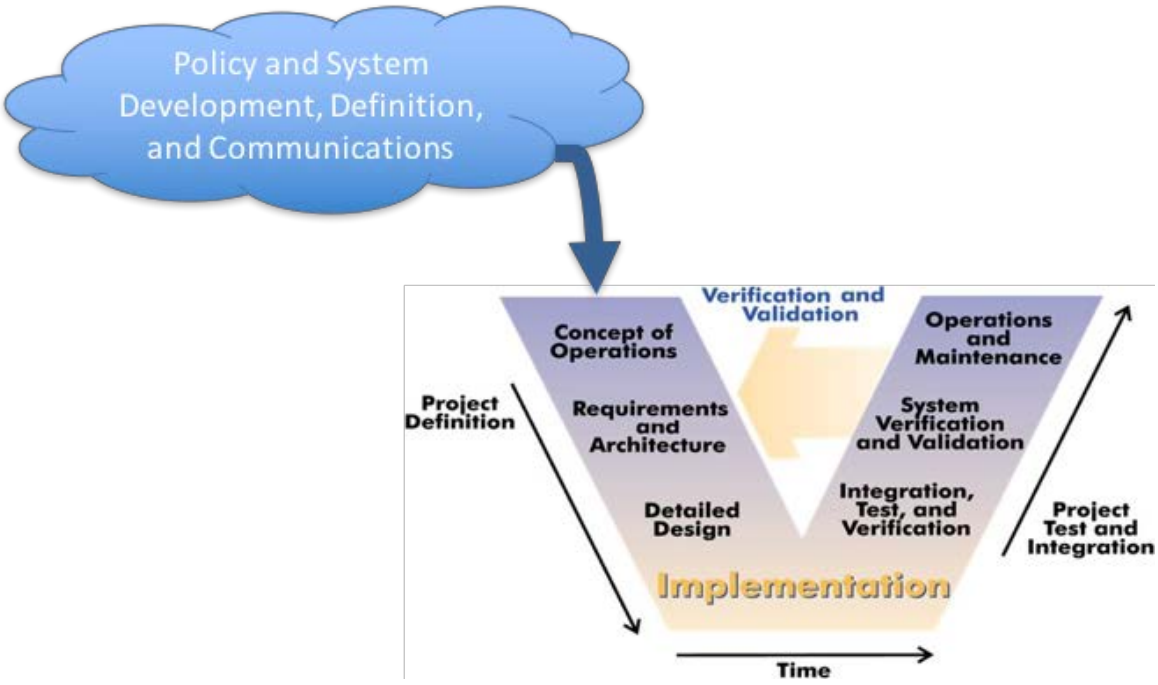
As this section has shown, RUC consists largely of operational components, technologies, and administrative and legal mechanisms that already exist. The case studies illustrate that the most successful RUC efforts have relied on partnerships with the private sector and other agencies to deliver the most efficient possible combination of operational capabilities while still protecting the public sector's obligation to deliver RUC with integrity.

5. Best Practices and Common Pitfalls

5.1. Introduction

This section presents best practices and common pitfalls that emerged from analysis of the RUC case studies. Best practices and common pitfalls are organized by the strategy triangle dimensions: articulating public value, establishing legitimacy and support, and assessing operational capabilities.

Several overarching points provide context for these best practices and common pitfalls. First, it is difficult to know what argument or operational approach will *politically* move a jurisdiction toward RUC. For example, manual reporting could prove effective in starting the conversation as seen in Wisconsin's 2012 study of RUC; it could be autonomous vehicles as seen in Tennessee in 2016; or, it could be congestion pricing, weight-mile taxes, or fairness with respect to highly fuel efficient vehicles. The graphic below illustrates this uncertainty by a "policy cloud." In this cloud, policy formulation is nebulous and frequently changing, but ultimately leads to system definition. Once there is sufficient policy clarity, technical design can begin, as illustrated below using the systems engineering "V-diagram," which begins with a Concept of Operations. This document provides best practices and common pitfalls for agencies to exist in the "policy cloud."



A recurring pitfall in RUC has been a tendency to put technical development ahead of policy and system definition. Regardless of the quality of a Concept of Operations, for example, policy makers are likely to view it with indifference or opposition if it precedes policy formulation. In effect, the technical effort can be counterproductive to policy advancement. On the other hand, beginning at the policy level allows for legislators, other elected officials, and stakeholders to shape the conversation and thus have buy-in to any potential technical solutions that emerge later.

Secondly, political "acceptability" is different from public "support." State legislatures have enacted state gas tax increases in the last five years across more than a dozen states, even though polls show lack of majority public support. The intensity of opposition is low, and the public value proposition is very well defined. This allows majority political acceptance to emerge in spite of the lack of majority public support.

Finally, the best practices and common pitfalls presented here are based on a collective analysis of U.S. and international experiences. The relevance and utility of this section will vary depending on each state's starting point. A decision tool, provided as an accompaniment to the final report, provides more information for agencies on how to approach RUC as a function of its context.

5.2. Articulating Public Value

5.2.1. Best practices

- **Define the problem(s) clearly**. Multiple problems, or compound problems, are potentially present with transportation funding, such as revenue sufficiency, stability, and fairness. By working to diagnose the problem(s), agencies can build common understanding and agreement with policy makers. Such agreement is the foundational step in any exploration of revenue policy alternatives, including RUC. For example, a common starting point is a study or analysis of what is wrong with the consumption tax on gasoline. By exploring and understanding what the shortfalls of a consumption tax are, it is easier to articulate objectives and explore alternatives such as RUC.
- **Articulate and prioritize objectives**. Establishing objectives is closely related to problem definition. A good practice in revenue policy is to have clear, ranked objectives. Like problem definition, this is an activity that agencies and policy makers can address jointly to build common understanding and agreement.
- **Compare alternatives for addressing problem(s) and fulfilling objectives**. RUC has often but not always emerged as a favored tool for addressing transportation revenue objectives at the Federal, state, and even local levels. It is important to consider all alternatives. Once objectives have been agreed upon and prioritized, agencies and policy bodies can work together to define the parameters of an objective analysis of alternatives. By determining each alternative's performance against agreed objectives, the analysis compares policy choices on equal footing. Further, by comparing the alternatives against the stated problem(s), a clear list of pros and cons emerges for each alternative.
- **Conduct a feasibility study of RUC**. Even if an alternatives analysis points to RUC as a favored or promising solution, there will be doubts, skepticism and opposition. A feasibility study is a way to identify show-stoppers and catalog potential issues that must be resolved for RUC to be a viable policy path. The feasibility study need not pinpoint particular solutions or fully design a RUC system. Rather, the bar for feasibility should be to highlight that a "solution space" exists, including one or more operational concepts.
- **Establish clear principles to guide policy.** Principles and objectives are related but distinct concepts. While objectives can often be agreed across ideological divides (e.g., sustainable revenue, fairness), principles are more likely to be debated. They are also more specific to each revenue alternative under consideration. Examples include: user pay (the principle that users should pay directly for the cost of the public services they consume), revenue hypothecation (the principle that revenue collected should be "ring fenced" or dedicated to the public service or activity

from which it was collected), and open markets or systems (the principle that systems should be designed to allow private agents to collect revenues on behalf of the state, within a competitive market). To the extent principles can be articulated by policy makers, it becomes easier to design a RUC system, even at a conceptual level, and to articulate its public value.

- **Consider RUC as part of wider strategy for system funding or management**. In several instances, RUC has been successful when presented as part of a broader package of policy innovations. An example of system funding is to bundle RUC with other fees and taxes. An example of system management is enhanced budgeting based on data collected from RUC. These types of practices should be very carefully weighed against the common pitfall of allowing the conversation about RUC to be overtaken by policy debates over transportation spending.

5.2.2. Common pitfalls

- **Failure to set objectives and evaluate policy alternatives**. By skipping fundamental steps such as setting objectives and evaluating alternatives, agencies may find themselves beset by questions or second-guessing during the RUC policy and operational development process. As RUC encounters technical or policy headwinds, skeptics and cautious supporters may retreat to explore other alternatives. Equally, supporters may attempt to use RUC as a vehicle for other policy priorities, some of them potentially controversial, thus inviting further skepticism or opposition. Clearly-defined objectives and objectively-evaluated alternatives can help to maintain interest in further exploration.
- **Lead with technology**. As mentioned in the introduction, leading the conversation about RUC with technology creates numerous potential challenges to public value articulation. First, it distracts the conversation from one about problem definition, objectives development, and focus on revenue policy toward a conversation about technology. Secondly, because technology is often associated with other transportation topics such as traffic operations and congestion pricing, it can complicate the articulation of objectives. Finally, it can constrain policy makers into technology-driven solutions that reduce policy choices, thus reducing the number of possible paths forward.
- **Discuss rates, including discounts and exemptions, too early in the process**. Rate setting is an inherently political activity. Any discussion or mention of rates for RUC (such as the per-mile rate or rates) should be clearly confined and labeled for analytical or test purposes only, and not as a decision or policy direction. The public value of RUC is in reforming the architecture of revenue collection, and not rate setting per se, which is required for any revenue policy. Likewise, discounts and exemptions can undermine the public value of RUC. These topics – rates, exemptions, and discounts – distract from public value articulation and are best suited for policy debate later, as part of program implementation.
- **Focus on gross revenues**. Gross revenues are important in articulating the public value of RUC. For most jurisdictions, it is the stability of gross RUC revenues over declining fuel taxes that is appealing. However, gross revenues overstate the case for RUC, given the universally higher cost of collecting RUC compared to fuel taxes, and the likelihood of higher levels of evasion of RUC than fuel taxes. Being upfront about *net* revenues provides policy makers with realistic expectations and a more accurate statement of public value in financial terms, so they can properly balance the benefits and costs when the time comes to make decisions about implementation.
- **Fail to analyze impacts on sufficiently wide range of users**. In a representative government with many stakeholder groups, the public value proposition should be considered from many

perspectives, including in particular those of distinct user groups. Examples include commercial vehicles, low-income drivers, major industries in the state (e.g., agriculture, manufacturing, construction, services), commuters, and rural residents. Identifying the important constituencies and analyzing the impact of RUC on each is an important element of any RUC study or test. However, it is important not to oversell "winners" and "losers," as the end-point policy parameters may not turn out precisely according to the early analysis. For example, pointing out that rural drivers tend to drive low-MPG vehicles is accurate, but RUC only benefits them if the gas tax is removed or refunded, a policy choice which may not be possible to confirm early in the process.

- **Failure to communicate with the public and incorporate feedback**. During the earliest stages of exploration, a common mistake is to ignore public communications, which invites misinformation and criticism. As long as no policy decisions have been made, it is a good practice to be clear that the work is research and to welcome comments and inputs to be addressed through the alternatives analysis or development of objectives. Failure to be prepared to incorporate outside ideas in this early stage could make the policy development appear rigid, which invites opposition and could end the process of exploring alternatives.
- **Changing objectives**. Even when objectives are developed early in the process of studying RUC, a common pitfall is to change them in the midst of analysis or testing. By revisiting and reinforcing objectives periodically, the orientation of any RUC analysis can likewise be reaffirmed to address those objectives. Should objectives change (e.g., from revenue sustainability to congestion mitigation), then any analysis in progress should likewise be reoriented toward the changing objectives.
- **RUC evolves into a conversation about spending**. The most common and compelling justification for RUC to date has been to generate stable or sustainable revenues for transportation purposes. Consequently, there is a tendency for the public and policy makers to turn the conversation about RUC into a conversation about spending, including criticisms and suggested reforms. Spending policy is complicated in its own right and can easily overtake and overwhelm the conversation about sustainable revenues. Avoiding this is key to the survival of RUC through early phases of study and testing, and is best accomplished by steady reinforcement of messages about sustainable funding, and by linking RUC to non-controversial spending such as system maintenance and preservation, rather than linking RUC to potentially controversial proposals such as system expansion, alternative modes, and non-transportation projects.

5.3. Establishing Legitimacy and Support

5.3.1. Best practices

- **Provide feedback to legislative efforts intended to enable RUC studies**. Legislative leadership is a key ingredient in advancing RUC as a transportation funding policy alternative. Legislators will benefit by drawing on the deeper subject-matter expertise that resides within state DOTs as they draft their legislation. In particular, DOTs should actively seek to help legislators develop well-crafted findings and legislative intent sections so that their bills more clearly articulate the fiscal and policy issues, the implications of inaction, the reasons to examine new transportation revenue alternatives, and why RUC should be considered among those alternatives. Establishing the factual basis and the scope of an alternatives analysis will improve the likelihood and legitimacy of a successful study.

- **Remain flexible to policy inputs**. Analysis, development, testing, and refinement of RUC policy may last years or even decades. It is important not only to establish legitimacy but also to maintain it by flexibly incorporating policy inputs at all stages.
- **Convene stakeholder committee to go through public value analysis in collaboration with agency**. Convening a broadly-based group of transportation stakeholders provides a 360-degree view of the problem statement and RUC as a potential solution. Providing a forum to share diverse viewpoints enhances the rigor of the analysis, provides structure for stakeholders to express their opinions and policy preferences, and takes pressure off the DOT as the sole project (or RUC policy) proponent. A successful stakeholder process also provides a much broader base of potential support for RUC.
- **Develop public communications protocols for consistency of messages across stakeholders, agencies, and policy makers**. Public communications about a potential transition to a RUC must be consistent, both in the message and in the process for sharing information with stakeholders, affected agencies and the public.
- **Engage local agencies.** Most local agencies are beneficiaries of gas tax revenue, either directly through local gas tax levies, or indirectly through state gas tax-funded projects that impact transportation in local communities. Actively reaching out to local agencies (e.g., cities, counties, regional transportation entities, etc.) will help them better understand the problem with the current funding system and the potential benefits of transitioning away from the gas tax. In addition, local agencies are often in closer contact with their communities than state agencies, making them an important source of information to the public and to DOTs who are pursuing a RUC initiative.

5.3.2. Common pitfalls

- **Declare an approach (technology or operational) that precludes policy alternatives or upsets key stakeholders**. As indicated earlier, declarations of a preferred method or approach for imposing a RUC preclude exploration of other potential policies related to per-mile fee systems. Importantly, they also undermine the opportunity to build legitimacy and support among key stakeholders by involving them in the discovery, findings, and recommendations process.
- **Undertake technology development or operational efforts before ready to progress**. Transitioning from the gas tax to RUC involves several steps, many of which are aimed at establishing the policy preferences and parameters for imposing a per-mile tax. Undertaking technology or system development before establishing the proper policy and stakeholder foundation not only runs the risk of upsetting key stakeholders (described above), but also the risks that the technology is not yet ripe for consumer use, or is not compatible with existing government processes, IT systems, administrative procedures or laws.
- **Let opponents or skeptics dominate public/media narrative with misinformation**. The flip-side of developing an effective public communications protocol (Best Practice, see above), is what happens in the absence of such protocols and message consistency. While public discourse, debate and opinions are to be expected, it is critical that such discourse be grounded in facts, not urban myths, broad assumptions, or misleading statements. In order to reinforce fact-based discourse in public forums, instances of incorrect information or misleading statements must be challenged and corrected, otherwise erroneous information will be repeated in public forums and become “facts” in the public’s mind. A clear example of this is the assertion that RUC requires GPS-based tracking by government of drivers’ travel. This is factually incorrect but remained

unchallenged for too long. As a result, most media stories reference "government tracking" and this remains a top concern of the general public.

- **Neglect key issues or questions that may generate growth in doubt**. Avoiding important issues or questions leaves an information void, which is then filled in by broadcast or social media interpretations, critics' assertions, or drivers' own doubts and fears. If the answer to a key issue or question is unknown, the issue should be acknowledged and a specific plan to conduct research or gather more information should be promptly (and consistently) conveyed.
- **Failure to train spokespersons or stakeholders to present consistent messages to the news or media.** Public communications about a potential transition to a RUC must be consistent. It is paramount that all stakeholders involved in the policy development and analysis are trained and provided with key message when addressing any potential RUC system. Presenting a consistent message for the public and the media helps to reinforce support and legitimacy.
- **Raise the gas tax and declare the problem solved.** In the drive to obtain support for needed transportation funding, public officials often want to assure voters that they are "solving" or "addressing" the funding problem through their support for a gas tax increase. Unfortunately, these policymakers often do not carefully define the problem. An increase in the state's gas tax solves one (or some) problems, usually temporarily. However, it does not solve all transportation funding problems, and especially not the problem of inequities in how (and who) pays for use of the highway system. Once public officials declare that a gas tax increase will "solve the problem," it is much more difficult to confront the longer-term, looming problem of deteriorating per-mile returns from the gas tax.

5.4. Assessing Operational Capabilities

5.4.1. Best practices

- **Inventory organizational assets, processes, and expertise within and beyond DOT and conduct gap analysis**. Some DOTs have extensive experience collecting taxes and fees, including fuel taxes, registration fees, and/or tolls, while others have none. Partner agencies with tax and fee collection experience include Departments of Motor Vehicles (DMVs) or their equivalent, Departments of Revenue or their equivalent, Transportation Commissions, and State Treasuries. The policy process inevitably generates questions about organizational capability to implement RUC. As the likely lead organizations for RUC studies and tests, DOTs can enhance their credibility and capabilities by surveying their internal resources and partner agency resources to identify the building blocks that may already exist for implementing RUC.
- **Study organizational roles and develop recommendations to meet scope of project.** Most DOTs are well equipped to handle studies of RUC, for example through research, planning, and/or policy staff. However, more advanced phases of RUC consideration require more specialized capabilities. A pilot test, for example, requires research, policy, planning, technical, procurement, and operational capabilities all combined in the same team; moreover, a system implementation further requires financial, accounting, and enforcement capabilities, all committed to a program. If RUC evolves from a study to a test to a program (or some similar trajectory), it is important for the "owner" of the concept at the DOT level to be prepared to integrate the necessary resources within and beyond the DOT to capably deliver the program.

- **Begin some organizational reforms in advance of full implementation**. As an extension of the above two practices, it can be a good practice to initiate reorganizations in advance of RUC implementation. Identifying necessary resources, recruiting and training staff, and aligning divisions of one or more agencies can require long lead times. Initiating those processes early can support the building of capabilities for implementation in a timely manner, thus demonstrating readiness to policy makers, especially where such activities dovetail with broader reorganization efforts.

5.4.2. Common pitfalls

- **Commit to an organizational design too early in the process**. As a counterbalance to the third practice above, which suggests implementing some organization reforms in advance of implementation, a common pitfall is to go too far too soon. Like leading with technology, it is perilous to lock in an organizational design prior to the establishment of RUC policy. For example, RUC organizations may need flexibility to respond to new approaches to mileage reporting or integration with other taxes and fees.
- **Allow lack of clarity of responsibilities to generate rivalries between divisions or agencies**. Any new program can become the object of competition among agencies, and RUC is no different. Unaddressed organizational rivalry can interfere with problem definition and policy development. Clarity is often provided by statute, for example in enabling legislation for studies, tests, or programs, which spells out the responsibilities of one or more agencies. In the absence of clarity, there is ambiguity, which can lead to conflict. If such conflict cannot be resolved by the agencies themselves, it may become necessary to seek clarification from the executive or from policy makers.
- **Place responsibility for RUC with an existing organization by default**. On the other end of the spectrum from rivalry is the possibility of RUC becoming a game of “keep away,” in which no agency is particularly equipped or motivated to inherit responsibility. Reasons may include lack of staff or capabilities, lack of funding, or competing priorities. In these scenarios, the responsibility for RUC often falls to an indifferent agency by default. Avoiding this pitfall requires proactive joint exploration of the problem, development of objectives, and consideration of alternative solutions between the executive and legislative branches.
- **Ignore incentives in developing appropriate organizational design**. In every state, DOTs are recipients of user fee revenues to maintain the state’s transportation system, often in partnership with local governments. There is a clear incentive by DOTs to have sufficient revenue to maintain their systems, both for the general public good and for the agency reputation. Other agencies may not share this incentive. Examples abound internationally of RUC falling into the hands of a disinterested agency, such as a customs or enforcement agency. In these instances, customer service suffers, net revenue lags, and the overall program reputation becomes impaired. The key to avoiding this pitfall is not necessarily to ensure that a DOT is the agency responsible for RUC, but rather to ensure that the ultimate recipient(s) of RUC funds have a voice in the program design and operations as part of the policy development process.
- **Neglect key tools required for effective enforcement**. Enforcement has been neglected in many RUC programs in the U.S. because few have advanced to full implementation. This is a “sleeper” pitfall that could undermine program performance down the road, with fault lines emerging long after studies and testing have been completed and a program moves toward implementation. To avoid this pitfall, the building blocks of enforcement should feature in the policy discussion for RUC,

even if not the central point of discussion. At the early stages of investigation, at minimum, the range of possible enforcement tools should be identified, including data, technology, and processes. As RUC progresses from study to testing to implementation, these building blocks should be examined by enforcement experts (including partner agencies) to identify gaps and recommend remediation for ultimate program implementation.

6. Trends & Themes in RUC Public Acceptance and Media Coverage

While the term “road usage charge” is becoming more familiar to DOT executives and elected officials faced with transportation funding challenges, it remains a foreign concept to the public and many in the media. NCHRP’s study of “Public Perception of Mileage-Based Fees” concluded that, “support for replacing the gas tax with a [mileage-based user fee, or MBUF] has increased slightly over time, and surveys of participants in two MBUF pilot programs found relatively high support levels, suggesting that direct experience with an MBUF noticeably increases support for these fees.”

Therefore, in addition to engaging with policy makers, it is important that state DOTs and partner agencies be prepared to address questions from the public and media about RUC. Most importantly, it is paramount to present it as a replacement for the current system of fuel excise taxes and not an additional charge on top of gas taxes. Failing to do so may draw public concern or criticism that undermines research, analysis, and policy development.

This chapter reviews emerging trends in public acceptance and media coverage of RUC studies and programs in the U.S. While there are numerous states in various stages of RUC exploration or implementation, this chapter focuses primarily on trends in Oregon, Washington, and California between 2012 and 2015, which generally are reflective of experiences elsewhere. First, we diagnose common barriers to understanding of RUC. Next, we review trends in media coverage. Finally, we present tactics for states to address trends while in the early stages of RUC exploration.

6.1. Themes and Trends in Public Understanding & Acceptance

As with many policy proposals, lack of familiarity breeds suspicion and opposition. Based on a survey conducted in 2014, 53 percent of Oregonians were unfamiliar with road usage charging, and only 25-35 percent indicated support for a RUC program. Likewise, many of the people engaged through outreach in both Oregon and California initially opposed RUC based on assumptions that such a policy would be unfair (to both rural drivers and hybrid/EV drivers), double taxation, invasive of privacy, and complicated or costly to operate. This section presents recurring trends in public understanding of how roads are currently funded and recurring public concerns about RUC.

6.1.1. Misconceptions about how roads are funded

Perhaps the most common recurring trend relating to public understanding and acceptance of RUC is a fundamental *lack* of understanding about how transportation is funded. In most surveys and focus groups conducted in the U.S., members of the public knew virtually nothing about current sources of transportation revenue. Most participants had no idea what fuel tax rates might be or how much they pay per year in fuel taxes. Thus, one major issue to overcome in addressing RUC is that people do not form their opinions about it with a good understanding of how that revenue option might compare with the existing fuel tax.

Efforts to improve public familiarity with RUC often start with explaining the current state of transportation funding: as motorists increasingly adopt more highly fuel efficient vehicles, Federal and state gas tax funds are diminishing. However, even these explanations assume too much about the average person’s knowledge of transportation funding.

Many participants in focus groups conducted in Oregon understood the connection between gas taxes and transportation improvements; however, they did not understand how much they pay in gas tax or even how the tax was calculated. In California, without being told about gas taxes, very few focus group participants were able to identify them as a source of transportation funding. Unlike sales tax, the gas tax is collected upstream from the retail level and therefore is not itemized on receipts or even posted at pumps, making it not transparent as to how much users pay in gas tax every time they purchase fuel.

This lack of information creates a major barrier. Without understanding the role of the gas tax and the problems with the current system of a consumption tax, people are unlikely to understand any need for an alternative or the role it can play in making the current system fairer, more equitable, or more sustainable. Research conducted by Southern California Association of Governments (SCAG) in 2012 indicated, “few are aware that the gas tax exists in the first place and how much it is,” and that many believe “gas usage and associated gas tax revenues are increasing.” Further, a 2014 survey revealed 53 percent of Oregonians were unconcerned with decreasing revenue from fuels tax, while at the same time maintaining that roads and highways are their highest priority. The linkage between good roads and funding is not understood or acknowledged by the public. In focus groups on road charging conducted in 2015 in California, when asked how roads are paid for or maintained, respondents were more likely to identify “adopt a highway” or “lottery” than gas taxes.

6.1.2. Concerns about RUC: Fairness, privacy, and other issues

Given the challenge of explaining the status quo in transportation funding, explaining RUC is an even bigger challenge. RUC program proposals require the public to imagine paying to use the roads in a new way. If no detail is provided about how RUC will operate or how much it will cost, people fill in the blanks with their own assumptions and fears, leading most often to concerns about fairness and privacy. Qualitative studies and media story analyses provide a detailed picture of the factors that most likely influence the lack of public support for RUC. In a few cases, survey evidence from Oregon and California indicates that these factors matter to the public at large. Privacy and fairness were two of the themes discussed most often.

Privacy was a prominent theme in both the focus group studies and media stories from Oregon and California. The topic was discussed in virtually all the qualitative studies evaluated, and the authors of several of these studies highlighted privacy as one of the main objections to RUC. Perhaps because many early RUC programs tested advanced technologies including GPS, the public associates RUC with GPS devices and perceives those as sharing data about vehicle location, thus raising concerns about privacy, despite system design changes to include non-GPS and non-technology RUC reporting and payment methods. Media reports often get this point wrong and the ubiquitous short hand term “GPS” triggers these concerns in the mind of the public. Furthermore, media coverage analysis supports the notion that privacy is a common concern; approximately half of the media stories reviewed between 2012 and 2015 addressed privacy issues in some way. And according to a summary of public comments submitted to Caltrans regarding its RUC Pilot Program, just over 10 percent of comments raised the privacy issue, with “tracking” of vehicles mentioned as a big concern.

A second prominent theme in media stories was fairness, with RUC systems framed as both fair and unfair. For example, focus group participants in California and Oregon were concerned that fuel-efficient vehicle owners would pay comparatively less in taxes to support the road network than their peers pay under the gas tax system. Many of these people thought it was unfair that a switch from the gas tax to RUC would penalize

those who were "doing their part" to protect the environment and reduce greenhouse gas emissions. On the other hand, others thought RUC was fairer than the gas tax because *all* drivers, including drivers of fuel-efficient and alternative-fuel vehicles, would pay similar amounts to maintain roads. Yet other fairness discussions centered on the impact RUC would have on lower-income drivers, rural drivers, and long-distance commuters. Survey and focus group data do not provide conclusive evidence about which dimension of fairness is most important to individuals, but the data do support the notion that fairness is a serious concern and could be achieved with a RUC system.

While the definition of "fairness" varies across research and outreach reporting, the idea of fairness is a top concern for the public. Common concerns include claims that RUC is:

- Unfair to electric vehicle/hybrid drivers, who are doing the "right thing" for the environment;
- Unfair to cars because they do less damage than heavy vehicles;
- Unfair to rural drivers, who tend to drive farther distances;
- Unfair to long-distance commuters who cannot afford to live near their work; and
- Unfair to shipping and delivery companies whose existence is predicated on using the roads.

People who expressed the latter three types of concerns in focus groups did not recognize they are paying more in gas tax for the same reasons. Making the comparison between RUC and gas taxes, and explaining that one is a replacement for the other (if that is the policy), can help to address many of the fairness concerns. In California, the one common theme that emerged from focus groups and surveys as the most likely public acceptance factor was fairness defined as "paying for what you use." This provides an opportunity to demonstrate that RUC is closer to this definition of fairness than the gas tax.

Media stories, surveys, and focus groups also reveal secondary concerns about RUC. One is the loss of the gas tax as a policy tool to incentivize the purchase of fuel-efficient vehicles. Another is the challenge a household could face in paying RUC if it were charged periodically in large amounts (compared with gas taxes, which drivers pay frequently in small amounts). Further, RUC with a congestion-pricing component were often viewed as unfairly expensive for people with inflexible work hours. Administrative cost and complexity of RUC also appear in the media and responses from surveys and focus groups. These concerns center on distrust of either the technology to be used or the ability of government to administer RUC, compared with the simplicity of the gas tax.

6.2. Key Trends in RUC Media Coverage

Throughout the RUC implementation process, the media has a unique ability to educate, encourage, or discourage public support and participation. Oregon and California are the first two states to launch RUC programs requiring thousands of volunteers. Analysis of media coverage in those two states reveals common trends in media coverage.

The Oregon RUC media audit covers June through December 2014, cataloging 283 media releases or news articles related to the Oregon RUC program. Just over a third of the coverage (32 percent) was produced by an Oregon media outlet. The California RUC media audit covers between January through December 2015, cataloging 426 media releases or news articles related to road charging. More than half were produced by a California media outlet.

The media addressed many of the public's main concerns regarding RUC including privacy, disincentives for fuel efficient vehicle use (hybrid/electric vehicles), and administrative costs. However, the issue of how the system works is not as prevalent. In the California audit, only 76 articles (27 percent) mention the pay per mile process–of which most (62 percent) refer to as "tracking." Tracking has a negative connotation to the public because of the inherent privacy concerns.

6.3. Effective Public Messages

For nascent RUC studies or pilots, it is important to provide education and messaging on the reasons for studying RUC, both to the media and the public. These messages should be consistent. Moreover, it is critical to answer basic questions about RUC to avoid misconceptions. Focus groups conducted in Southern California reveal the following common questions from participants about RUC:

- How much will it cost?
- How much are we paying now?
- How will mileage be reported?
- How will the charge be calculated and collected?
- Who will collect the charge?
- Where will the money go?
- How will it be administered?
- Does everyone pay it?

Preparing messaging and materials to answer these basic questions early in the public engagement process is critical to shaping the conversation.

6.3.1. Break down the problem

Start with breaking down the funding problem. Given that RUC programs are shown as an equitable and sustainable alternative to gas taxes, present facts and figures about RUC in conjunction with the same information about the gas tax. Most drivers don't have any idea how many gallons of gas they use in a year or how much that costs them in gas tax. Compare the two funding mechanisms side by side, showing the differences in rates and out-of-pocket expenses. For the Oregon RUC program, ODOT created an infographic juxtaposing what an average driver incurs in gas tax cost relative to RUC, comparing a hybrid and a pick-up.

This messaging also helps broach the subject of fairness. During the Oregon state listening tours in 2014, nearly all interviewees felt that the overall concept of "paying for what one uses" is a fair way of assessing people for transportation.

6.3.2. Discuss RUC as a solution

Focus group participants in Oregon had varying ideas about what was fair, but nearly everyone embraced the concept that paying for use is fair. "The more you use, the more you should contribute." The "pay for what you use" story proves effective, especially when compared to other user fees like water and electric utility bills. You pay for your use of the roads, no matter what kind of vehicle you drive.

Likewise, in a Caltrans study, most who rated RUC as a good or very good idea focused on fairness: "It comes down to usage. If you're using the roads more, you should be helping to keep the roads maintained." People

recognized that making choices involved tradeoffs, for which each individual must take responsibility. In particular, one participant noted that he has a long commute, but that was a choice he made. The same idea applies to incentives for buying electric and hybrid vehicles, which are better for the environment. If there is a fee for miles driven, that incentive will weaken and the environment may suffer. Several California focus group participants countered this argument by pointing out that high-efficiency vehicles still use the roads and should pay their fair share of infrastructure costs.

Additionally, it was important for Oregonians to know that no one would pay additional in RUC fees if they already pay as much or more in gas taxes. ODOT continually reiterated the Oregon Road Usage Charge program is the most equitable and fair way for all drivers to pay for road maintenance and improvements. In fact, rural drivers, who bear a greater burden of gas tax, could benefit most from RUC since Oregon currently refunds gas taxes paid above the amount of RUC owed.

Finally, the issue of privacy is best discussed in terms of choice. RUC participants are typically provided with options for tracking miles including one or more non-GPS options. Whatever the case, the public must understand what is available and how it works. It is often effective to connect RUC to familiar concepts from everyday life such as smartphones or utility bills.

6.3.3. Tactics to successfully engage the media

The agency responsible for RUC development or deployment should lead media messaging. It is critical that clear, accurate, and consistent information and messages are delivered, so that misinformation and rumors from critics or opponents can be addressed. There should be a focus on addressing popular criticisms appearing in major media outlets, with timely responses that address key concerns. To keep momentum, it is essential to identify and manage organized opposition and also to minimize the risk that well-intentioned reporters and commentators make errors.

Effective media messages must take into consideration the media landscape. Small town media outlets will focus on different topics than more urban areas. Where RUC is concerned, however, no one location is more important than the next when it comes to educating and encouraging participation – every geographic region must be reached.

It is also important to appeal to audiences based on factors besides geography. Expand current media lists to include reporters who cover technology, especially transportation innovations, to create credibility among members of the public who are tech early adopters. Technical messages and stories about the RUC system appeal to these writers and their readers.

State DOTs must bring the media along at every step of the RUC journey. This means creating regular touchpoints with statewide media contacts outside of major program milestones. These touchpoints or briefings are opportunities to establish understanding and direct channels of communication for sharing information as the program evolves. In Oregon, members of ODOT conducted these briefings in-person, over the phone, and via web meeting software like Skype in order to include media from all over the state in a timely fashion. In California, agency executives and Commissioners met with numerous media outlets in person regularly during the program development phase and developed a roster of contacts for fielding questions about the program.

Finally, media messages must include a call to action so that the public understands how to learn more and how to get involved. Coverage should motivate audiences and act as conduit to program websites, social media channels, and other program content. The key is to create continuity of messaging among all channels—from public outreach to media interviews.

7. Public Opinion Research Needs

RUC remains a new and complex concept for the public. As noted in Section 6, public research has been critical to states' understanding of public attitudes and awareness of transportation funding issues, and public understanding of RUC. However, there remain areas that could benefit from further study in order to effectively inform and engage the public and media. This chapter summarizes two categories of future research: assessment of motivators and assessment of barriers. In addition, several other areas are identified. This research can help states to better understand and address public perceptions of RUC to support studies or tests.

7.1. Assessment of Motivators

Motivation has not been a focus of previous RUC public research. For purposes of future research, we characterize motivation in two broad categories: motivation to support the concept of RUC, and motivation to participate in a RUC pilot or demonstration.

- *Motivation to support RUC*. States implementing RUC programs use messages to motivate support including the need for revenue sustainability, enhancing fairness, and ability to support improvement of the quality of road infrastructure. However, most individuals do not support public policy based on wider public merits, but rather on self-interest, which is influenced by messages such as eliminating the gas tax, making local improvements in roads or other transportation services, or reducing a real or perceived inequity. The effectiveness of these and other messages has been studied in baseline public opinion research, but not deeply through longitudinal studies.
- *Motivation to volunteer*. Moving forward, it would be useful to survey participants in existing RUC programs to find out what motivated them to volunteer. Broad behavior models suggest there are different categories of public involvement. Some may be early adopters, while others are civic-minded in general, and still others are transportation enthusiasts. Each volunteer has a story, and it would be useful to classify categories of interest to help drive future recruitment. By the same token, identifying those who had an opportunity but chose not to participate could help to identify "busy" demographics to be avoided in future recruitment efforts.

7.2. Assessment of Barriers to Acceptance in Rural Communities

While many studies have assessed barriers to public understanding and acceptance of RUC, more research is needed to understand why certain groups continue to oppose RUC after they learn how it works and how it could benefit them. In particular, one of the most prevalent barriers to public support and participation is the notion that RUC is unfair to drivers in rural communities. This misperception impedes RUC policy because of the importance and influence of rural communities to transportation policy making at both the Federal and state levels.

At first glance, many assume that RUC would financially disadvantage rural residents because of perceptions that they, on average, drive longer distances for daily errands, and therefore more miles each year. To examine this issue, the Oregon Department of Transportation undertook a study of urban and rural areas in 2013, which revealed that despite perceptions, rural residents, on average, will not be affected significantly by RUC—financially, behaviorally, or technologically. In fact, most rural drivers, who bear a greater burden of gas tax, could benefit most from RUC. A 2015 California study bore similar results.

More study is needed to understand how these facts and benefits are received in rural communities, and if this education will help overcome barriers to participation and support. Studies should help identify the most effective messages and methods to delivering those messages in rural communities, starting with RUC volunteers from rural communities.

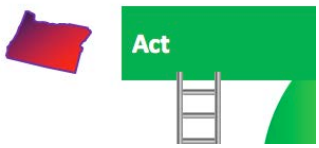
7.3. Other Public Opinion Research Needs

The complexity and novelty of RUC means that a wide range of issues remain poorly researched around RUC policy development. Other possible topics include:

- *Basis for setting RUC rates:* One of the issues of greatest interest to road users is "how much" they would pay under RUC instead of other taxes. The public could be surveyed as to how it thinks charge rates should be set, with several dimensions to the research. Who should set charges: Governor, Legislature, Politically independent Board, DOT with oversight? Should rates vary by vehicle type, e.g., weight categories to reflect wear and tear, engine characteristics to reflect environmental impacts, and size to reflect road space occupancy? On what basis should rates be set: reflective of current gas tax revenues, adjusted for inflation annually, reflective of expected spending in future years, or ability to pay? Should rates be set based on the general need for more revenue (with flexibility to meet changing needs) or linked to specific programs of projects?
- *Linking RUC to spending decisions*: A key issue for road users is what is money collected from RUC to be used for. Research could consider how do road users want their interests represented in spending decisions, e.g., surveys, consultation processes, and collation of data around network usage. What are the priorities of road users: potholes, bridge replacement over bottlenecks, safety, new routes, technology? Do road users find RUC more acceptable if they see a clear link between what they pay and the level of service they get from the roads?
- *Perceptions of the cost of travel:* One theory about RUC is that by making the costs for using roads more transparent, motorists may be more aware and more cautious about making trips because they understand the cost more directly than through gas tax. The potential benefit of replacing gas taxes with RUC, even at a flat rate by location and time of day, at a rate similar to that of gas tax, could be that it has a modest impact on demand and congestion. Research on how the public responds to a *change* in how they pay for road use, in terms of demand, could be valuable.
- *Environmental policy and RUC:* When RUC is proposed as a replacement for fuel taxes, it is common for members of the public, stakeholders, and policy makers to object on the basis that it removes or reduces the incentive for consumers to purchase and use fuel-efficient vehicles. Research is needed to understand better the role of fuel taxes in incentivizing fuel-efficient vehicle purchases or other driving habits. In particular, public opinion research should focus on two aspects of this issue: (1) quantifying the perceived versus real impact of having or not having fuel taxes in place, and (2) testing how various communications about the real impact of fuel taxes versus RUC on vehicle purchases influences opinions about RUC as a policy concept.

8. Roadmap Visual Decision Tool

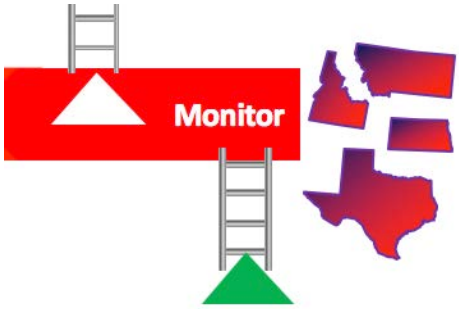
Accompanying this best practices report is a visualization tool that DOTs may follow in consideration of RUC. The tool is a series of graphics that illustrates possible ways to sequence a range of actions that progress the consideration of RUC. Each state has distinct "starting point." We have defined four generic, increasingly ambitious possible starting points as follows:



Act or initiate action within DOT, Legislature, or Governor. This is a rare starting point for a state agency. However, many of the activities in anticipation or response to interest have the practical effect of spurring interest, so it is instructive to consider prospective activities and decisions from this standpoint.

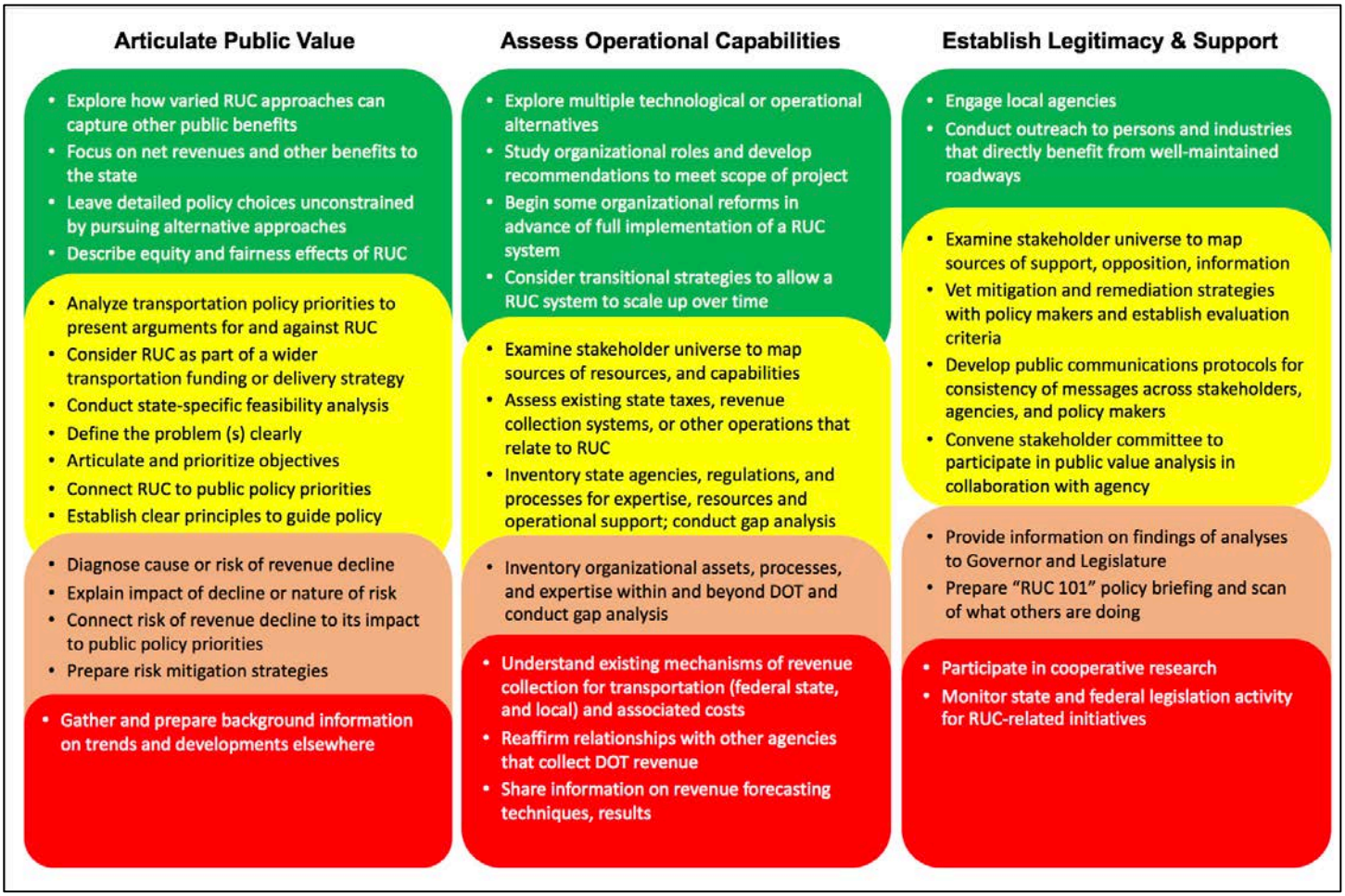
Respond to legislative or executive interest (Governor or within DOT). In these states there has been interest or authorization from the Legislature and/or Governor to assess or even test the viability of RUC specifically.

Anticipate revenue risks and policy developments. These states recognize and have possibly even quantified or otherwise characterized the problem. They have been empowered to anticipate further policy action, possibly by elected officials, but consideration of RUC specifically has not yet been embraced by policy makers.



Monitor revenue risks and policy developments. States in this starting point are characterized by lack of policy interest or clearance to investigate or pursue RUC beyond basic informational research. There may be recognition of a long-term revenue risk and the need to research long-term alternatives, but little appetite to explore RUC as a transportation revenue policy. Other alternatives may be of greater interest, such as raising the gas tax, exploring tolls, or allocating general fund revenues (e.g., sales taxes) to transportation uses.

The various practices covered in this report can be organized by when they are most effectively deployed (e.g., in the monitor vs. respond stages). The accompanying decision tool features an introductory slide that categorizes many of the best practices according to the color coding of each starting point. This is a broad but not quite comprehensive illustration of the range of practices that can be deployed, organized by the strategy pillar they correspond with (see screen capture below).



It is important to take actions that encompass all three pillars of public strategy in parallel. For example, focusing only on operational capabilities, without considering public value or legitimacy and support, increases the likelihood that progress in the consideration of RUC will stall.

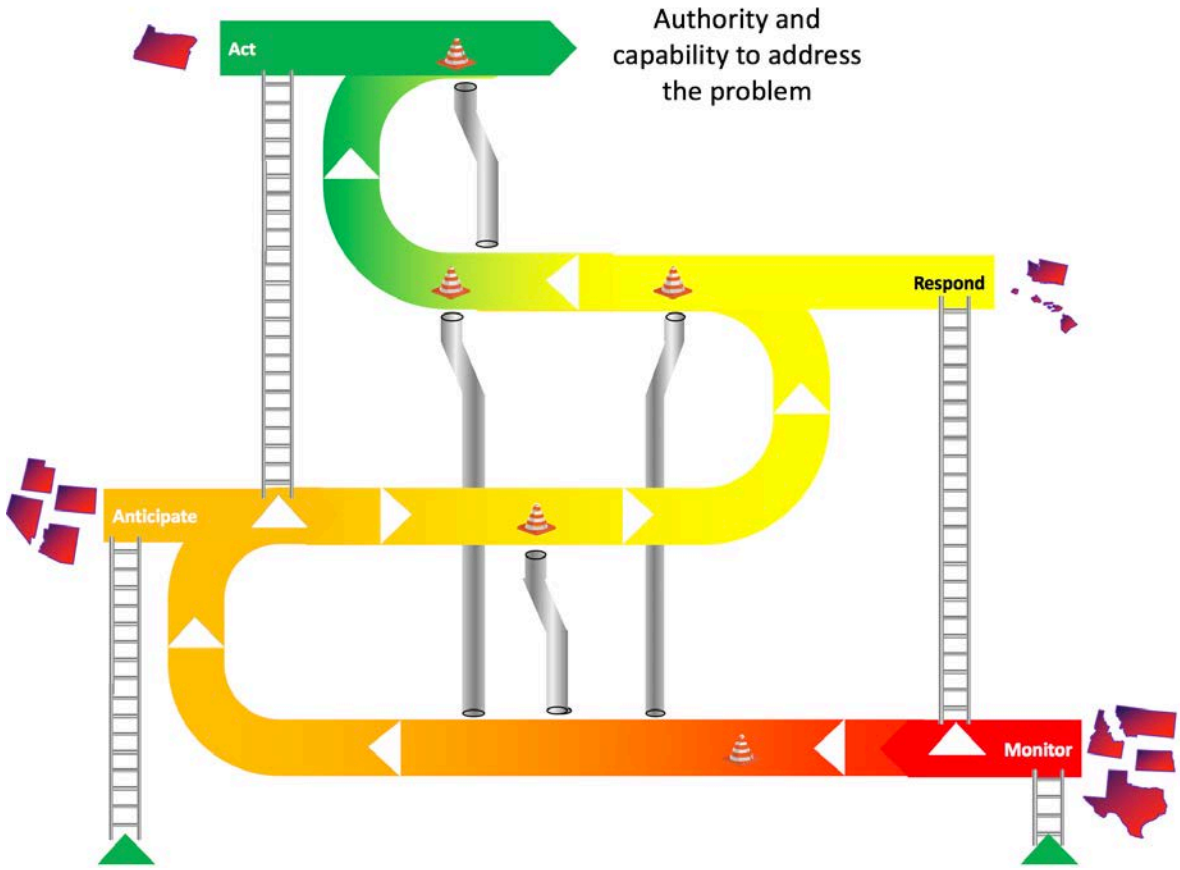
The challenge with portraying a decision tool in this manner (with best practices that move from "monitor" at bottom toward "act" at top) is that it could be interpreted as a linear process. However, the roadmap to RUC is not only non-linear, it is unique to each jurisdiction. In order graphically capture this attribute of RUC policy development (and nebulous early steps of policy formulation generally), the roadmap must reflect both forward movements but also pitfalls. These advances and setbacks are illustrated conceptually as ladders and chutes.

The table below classifies the "starting points" for the 11 participating states in this project:

Monitor	Anticipate	Respond	Spur Action
Idaho	Arizona	Hawaii	Oregon
Montana	Colorado	Washington	
North Dakota	Nevada		
Texas	Utah		

To go from “monitoring” to “spurring action” does not necessarily require passing through all four phases. Rather, the starting point merely provides a way to describe the current position relative to where others fit as of late 2016.

Putting it all together, the roadmap captures four entry points, opportunities for advancement, and possible setbacks (see illustration below). The endpoint is a jurisdiction with both authority *and* capability to address the problem that was articulated at the outset. Along the illustrated roadmap, unique issues and opportunities will arise for each jurisdiction. Both a generic roadmap and “tailored” roadmaps for each state are provided based on individual meetings. However, the visualization is no replacement for the full set of lessons learned, best practices, common pitfalls, and general policy intuition required to successfully navigate the roadmap.



Regardless of the starting point, RUC is a new policy that represents a profound departure from current practice for policy makers, the public, and administering agencies alike. No roadmap can capture precisely all of the steps, actions, or decisions that will result in successful policy transformation. Navigating any policy change of such magnitude requires a combination of talents, resources, and prudent choices sustained over a long period of time. This report attempts to document the many lessons learned from the extensive experiences of others who have attempted to reform transportation funding.

In short, the recipe for successful consideration of RUC cannot be defined as a generic manual or handbook. Each jurisdiction must confront unique local problems, needs, and constraints; understand their values and preferences; and identify and define the opportunities for policy innovation. The lessons learned from others who have attempted or implemented RUC can serve as a valuable input for pursuing common success factors and to avoid common mistakes. As the body of knowledge and quantity of experience with RUC policy grow larger, the roadmap to its consideration will contrarily grow shorter.

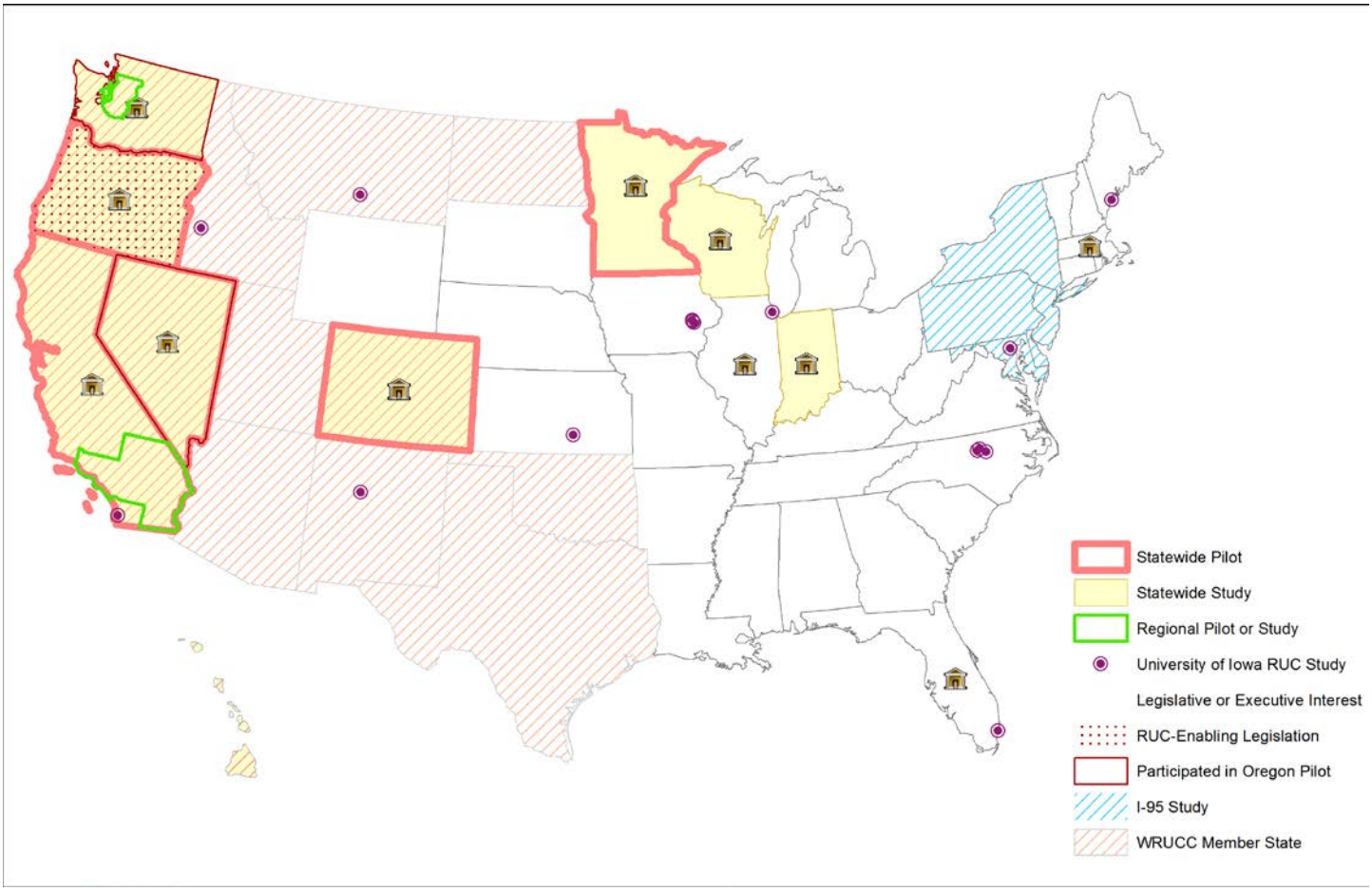
Appendix: Road Usage Charge Case Studies

This chapter contains 19 case studies of RUC and related policies from around the U.S. and internationally. Each case study contains summary information about the RUC or policy initiative, its origins, its implementation, and a table summarizing key characteristics. The information contained herein is descriptive in nature. Sections three and four, covering implementation scenarios and jurisdictional criteria and assessment, provide more in-depth analysis of the case studies.

A. U.S. Light Vehicle RUC

The Western Road Usage Charge Consortium was formed to share research and collaborate on the development of knowledge around light vehicle RUC. Therefore, we begin closer to home by reviewing case studies of U.S. states in exploring, developing, testing, and implementing light vehicle RUC policies. The three case studies selected for this section are Oregon, Washington, and California –states who have undertaken the greatest of amount of light vehicle RUC policy development activity in the past five years. However, those three states are not alone; others have undertaken varying degrees of policy exploration as summarized in Figure 2 below.

Figure 2: Summary of light vehicle RUC efforts around the U.S.[23]



Two notable efforts outside of Western RUC are Minnesota and I-95 Corridor Coalition. In 2011, Minnesota DOT conducted a RUC pilot with 500 participants paying charges with rates varying by zone and time of day through a smartphone app that communicated through a device installed in the vehicle's data port. The Mileage-Based User Fee Task Force found road charging to be financially sustainable, equitable to various driver groups, and technically feasible. However, some of the participants reported billing errors, missed mileage, and technical glitches with the smartphone app. Simultaneously, a minority report from the Task Force was critical of road charges. Minnesota's legislature has not authorized further study of RUC.

The I-95 Corridor Coalition is an organization of toll authorities, state DOTs, and other transportation agencies from Florida to Maine. In 2009, the Coalition launched a study of multi-jurisdictional RUC. Given the smaller size of East Coast states and higher frequencies of cross-border travel relative to Western states, it is likely that RUC would develop as a regional effort. The study resulted in a high-level concept of operations (ConOps)

[23] "Regional pilot or study" refers to metropolitan areas (Puget Sound and Southern California). Multi-state regional pilots proposed for RUC West and the I-95 Corridor, along with other pilots proposed under the FAST Act but not yet begun, are not represented on this map.

for multistate RUC, concluding that multi-jurisdictional RUC is feasible, but there are significant institutional issues that must be handled through a centralized back office.

A.1. Oregon Road Usage Charge Program

Oregon has been the most active state in developing light vehicle RUC policies, dating back to 2001 when the Legislature created the Road User Fee Task Force (RUFTF). RUFTF was empowered to study and recommend alternatives to the gasoline tax for sustainable revenue. Over a period of years, Oregon DOT and RUFTF extensively analyzed and developed policy, testing of several operational approaches to RUC (pay-at-the-pump in 2006-2007 and several methods in an open architecture in 2012-2013). These efforts culminated in 2013 with enabling legislation for a volunteer program of up to 5,000 vehicles and no end date, launched in 2015 as OR*eGO*, the nation's first program for light vehicle RUC without a sunset. The Legislature capped volunteer enrollment at 5,000 vehicles.

The origins of RUC exploration in Oregon was motivated by several factors that are also present in many other states:

- State funding of roads is done through a trust fund that receives dedicated funding from users through fuel taxes, registration fees, and weight-mile taxes.
- At the outset in 2001, the fuel tax component of the dedicated highway funding was seen to be at risk of declining due to adoption of more fuel efficient and alternative fuel vehicles.
- Preserving the dedicated funding model would require either raising the fuel tax (which elected officials foresaw as difficult to begin with but, even if successful, an increasingly inequitable approach to user-pay road funding) or considering alternatives.

Two other factors provided precedent for RUC in Oregon that are not present in many other states:

- Oregon already has a distance-based tax on heavy vehicles (weight-mile tax), so extending the policy basis of charging to light vehicles was familiar to many legislators, and the trucking industry was not a source of opposition.
- Oregon conducts a highway cost allocation study every two years in order to determine cost responsibility between heavy (>26,000 pounds) and light vehicles. The results of this study are used to calibrate weight-mile tax rates against expected fuel tax revenues from light vehicles.

Legislatively, the consideration of RUC in Oregon was pursued by a bipartisan group of legislators. One success factor was that several of the key proponents of exploring RUC were members of the Revenue Committees of the House and Senate, as opposed to the Transportation Committee. In Oregon, as in many other states, the Transportation Committees tend to focus more on expenditures and projects and less on revenues. Revenue Committee legislators, on the other hand, deal with tax policy not only for transportation-related taxes but also for other special-purpose taxes and general taxes. In Oregon, a pre-existing bi-partisan consensus to preserve user-based transportation funding and to preserve dedicated transportation funding sources were factors in the initial willingness to explore RUC.

The Legislature provided authorization to Oregon DOT (ODOT) to explore, develop, and test RUC alternatives. ODOT provided dedicated staff to support RUFTF with research and policy analysis that informed their

direction and decisions. Many of the early ideas and efforts were, operationally, unsuccessful in persuading legislators to enact a RUC system. Examples included a concept of "tolling" several key points representing a large amount of statewide traffic and the 2006-2007 pay-at-the-pump pilot, which raised privacy concerns due to a GPS mandate. Through iterative consideration of operational alternatives with RUFTF and two trials, ODOT was able to find a solution that resonated as a potential permanent system. Its features included an open system architecture with private sector account managers that addressed privacy concerns by offering choices and technology concerns by leaving the evolution of mileage reporting technology in the hands of the private sector rather than the agency. In 2013, the Legislature enacted a program for volunteers, which launched in 2015 under the brand ORe*GO*.

Several hurdles remain for legislators in Oregon to expand the ORe*GO* Program. Perhaps the most significant hurdle is operational costs of collection. Although the architecture is open to multiple solutions, account managers to date have offered only the OBD-II device solution for mileage reporting. Although it has operational advantages, the OBD-II device reporting solution remains problematic. Even at scale, there are concerns that the cost of collection will be higher than policy makers are willing to pay.

ODOT is exploring with account managers and others ways to create or incentivize lower-cost reporting options. In September 2016, RUFTF recommended a fleet transition policy to the Oregon Legislature featuring all-new vehicles above 20 MPG beginning in 2025. The Legislature will consider this recommendation in a future session.

CATEGORY	DESCRIPTION
System name	ORe*GO*
Year operation commenced	2015
Contracting authority	Oregon DOT's Office of Innovative Programs and Alternative Funding (OIPP)
Charged network type	All public roads in Oregon, with automated exemption of off-road and out-of-state miles for motorists who opt for GPS reporting and manual refunds for motorists who do not opt for GPS reporting
Length of charged network	73,479 centerline-miles
Vehicle categories charged	To be eligible, volunteer vehicles must have four wheels, registered in Oregon, be under 10,000 pounds and (at present) be equipped with an OBD-II port (most gasoline-powered vehicles manufactured after 1996 and diesel vehicles manufactured after 2006)
Elements of charge	Distance
Impact on other taxes	Fuel taxes attributed to the fuel used to drive taxable miles are

	calculated and credited against RUC owed
Procurement approach	Oregon DOT operates an outsourced “Oregon Account Manager” and has certified two “Commercial Account Managers” under common market contract terms which compete for customers
Primary distance measurement technology	Open to any technology that meets Oregon’s certification requirements; presently there are several variations of OBD-II devices in use, including with and without GPS
Basis for charge calculation	Based on legislative negotiation; ultimately set near revenue neutrality with fuel taxes for average driver
Discounts and exemptions	Off-road and out-of-state mileage are exempt for vehicles who report mileage using GPS; paper-based refund claims can be filed for vehicles who do not report mileage using GPS
Gross revenue per annum	~US$180,000 at current program size of about 1,000 vehicles
Use of revenue	Fully pledged to State Highway Trust Fund
Capital costs	~$6.4m to design, procure, and implement (current program only)
Operating costs	~$2m annually at current program size
Range of charges per km	US$0.015 per mile
Occasional user product	None

A.2. Washington State Road Usage Charge Study

The impetus to explore RUC as an alternative funding mechanism is rooted in alternative financing studies that began in 2007, especially the Governor’s Connecting Washington Transportation Task Force, which in 2012 recommended pursuit of a per-mile charge to provide future funding. Since 2012, the Washington Legislature has provided annual appropriations to the Washington State Transportation Commission (WSTC) to fund research and initial design of a potential RUC system. A 25-member Steering Committee (which includes 8 legislators) guides the work and makes policy and design recommendations to the WSTC, Governor, and Legislature. To date, the Steering Committee has completed a feasibility assessment; business case evaluation; developed policy parameters for a future RUC system; developed formal Concept of Operations documents; and recommended a statewide public demonstration project to test four separate methods of mileage reporting.

CATEGORY	DESCRIPTION
System name	Road Usage Charge

Year operation commenced	N/A
Contracting authority	N/A
Charged network type	All public roads in Washington; motorists who opt for non-GPS mileage reporting pay for all miles driven regardless of location
Length of charged network	81,417 miles
Vehicle categories charged	Steering Committee is considering all vehicles under 10,000 pounds GVWR
Elements of charge	Distance
Impact on other taxes	RUC is deemed as a replacement for fuel taxes, so any fuel taxes paid would be calculated and credited against RUC owed
Procurement approach	N/A
Primary distance measurement technology	Odometer, smartphone, OBD-II device, and in-vehicle telematics are all under consideration
Basis for charge calculation	Steering Committee has consistently recommended revenue neutrality with the current Washington gas tax
Discounts and exemptions	Off-road and out-of-state mileage are exempt
Gross revenue per annum	N/A
Use of revenue	Depending on how RUC is characterized, it may be subject to 18th Amendment restrictions in Washington State, which fully hypothecates vehicle-related revenue to the State Highway Trust Fund
Capital costs	N/A
Operating costs	N/A
Range of charges	N/A
Occasional user product	Steering Committee has recommended a “time permit” for occasional users and others who wish to opt out of mileage reporting

A.3. California Road Charge Pilot Program

California’s road charging initiative can be traced back to the 2013 California Transportation Infrastructure Priorities Working Group, a body of stakeholders convened by the Governor, which explored how the state could pursue road charging as a more sustainable funding source than gas taxes. In 2014, the California State Legislature enacted SB 1077, which authorized a statewide road charge pilot test; created a 15-member

Technical Advisory Committee appointed by the California Transportation Commission comprising public officials, private and non-profit stakeholders to make recommendations on the design of the test; and provided policy parameters for conducting the test, including privacy protection requirements. Caltrans, under the direction of the California State Transportation Agency, is responsible for administering the Road Charge Pilot Program. The pilot test involves over 5,000 vehicles chosen to ensure demographic representation from all regions of the state. The 9-month pilot test began in July 2016 and will be followed by a post-pilot evaluation and recommendations to the Governor and Legislature by Fall 2017.

CATEGORY	DESCRIPTION
System name	California Road Charge Pilot Program
Year operation commenced	2016
Contracting authority	California State Transportation Agency through Caltrans
Charged network type	All public roads in California; motorists who opt for non-GPS mileage reporting pay for all miles driven regardless of location
Length of charged network	225,531 miles
Vehicle categories charged	All vehicles are eligible to participate in the pilot project, including 55 heavy-duty trucks; participants will not actually pay the bill
Elements of charge	Distance
Impact on other taxes	Legislative intent is that road charge would replace the fuel tax, so fuel tax would either not be collected or it would be offered as a credit toward RUC owed by individuals in a transition period
Procurement approach	Caltrans has procured a consortium of consultants, account managers, and technology vendors under a turnkey contract to conduct the pilot program
Primary distance measurement technology	The Technical Advisory Committee recommended a mileage permit, odometer charge, smartphone, in-vehicle telematics, and OBD-II devices
Basis for charge calculation	Technical Advisory Committee recommended revenue neutrality with the California gas tax
Discounts and exemptions	Off-road and out-of-state mileage are exempt from charging
Gross revenue per	N/A

annum	
Use of revenue	N/A
Capital costs	N/A
Operating costs	N/A
Range of charges per mile	1.8 cents per mile (applies to all vehicles, for testing purposes only)
Occasional user product	A time permit is available for occasional users and volunteers who wish to opt out of mileage reporting

B. U.S. Heavy Vehicle Charging

Although light vehicle RUC remains the focus of much research and deliberations among states as a prospective innovation in funding policy, heavy vehicle charging *already* exists. At one time, 22 states had a ton-mile or weight-mile tax system. Following a series of lawsuits by the American Trucking Associations, however, many states dismantled their tax systems in favor of a diesel tax. The most recent was Idaho, which repealed its weight-mile tax in 1997. Only four states today have a weight-mile tax (WMT): Oregon, New Mexico, Kentucky, and New York. Of those four, Oregon is the only state to rely exclusively on WMT for heavy vehicle charging (along with registration fees); the other three states also collect diesel and other fuel taxes on heavy vehicles. Meanwhile, a coalition of 58 jurisdictions (48 lower U.S. states plus ten Canadian provinces) have created the International Fuel Tax Agreement (IFTA) to handle reconciliation of diesel taxes across borders based on mileage driven by motor carriers. This section discusses Oregon's WMT program and IFTA.

B.1. Oregon Weight-Mile Tax

Oregon enacted a ton-mile tax in 1925, not long after enacting the nation's first fuel tax in 1919. A ton-mile tax requires motor carriers to report their tonnage and distance traveled. In 1947, the program was reformed to a weight-mile tax (WMT), which requires carriers to declare a weight category based on the maximum payload of the vehicle, rather than reporting actual tonnage of each trip. Though long targeted by the trucking industry as unfair, easy to evade, and costly to comply, the Oregon WMT program has proven sustainable and effective over many decades for several reasons: revenue fairness and sustainability, administrative efficiency, and operational flexibility.

First, Oregon's WMT provides fairness and sustainability in the payment of fees that reflect road use and damage. Under a system of fuel taxation, heavy trucks under-pay relative to their cost responsibility according to Oregon's cost allocation study, and this gap grows wider for heavier vehicles. Because the per-mile rates vary with the weight of the vehicle, rather than fuel efficiency (as is the case under fuel taxes), Oregon can more accurately reflect road costs in the amounts charged to motor carriers. Moreover, all trucks continue to pay less as overall fleet fuel economy improves, especially with the advent of CAFE standards for medium- and heavy-duty trucks for 2014 and beyond. Oregon's WMT is impervious to changes in engine technology and performance since the revenue source is based on road usage rather than fuel usage.

Secondly, Oregon's WMT has a low cost of administration and high rates of compliance. The system has been audited externally on at least two occasions, and both times evasion was independently estimated at less than 5%, far below the only available estimates of diesel tax evasion (15-25% according to FHWA's most recent estimate in 1992). ODOT, which administers the WMT, has a cost of collection of less than 5%, which is comparable to the cost of diesel tax collections in the state.

Finally, ODOT's Truck Road Use Electronics (TRUE) pilot test in 2010 proved the concept of electronic WMT reporting and payments. In 2013, the first commercial vendor to offer automated WMT reporting and payment services entered the market following successful certification and audit. The introduction of electronic services for WMT reporting and payment makes compliance for motor carriers easier and less costly while simultaneously reducing administrative costs to the state. Motor carriers have a choice of whether to maintain paper-based records or electronic records.

Politically, Oregon's WMT is popular primarily because it provides a fair, sustainable revenue source for the state highway fund. Rates are adjusted periodically to reflect changes in traffic and actual costs imposed by various categories of vehicle by weight (as measured through the highway cost allocation study), as well as by legislative action to address the rising costs of maintenance and construction over time. Implementation of Oregon's WMT happened nearly a century ago, so implementing such a program would obviously face an entirely distinct political environment. However, once operational, the WMT program in Oregon has been proven a reliable source of transportation funding.

CATEGORY	DESCRIPTION
System name	Oregon Weight Mile Tax
Year operation commenced	1933 (as ton-mile tax); reformed in 1947 to a weight-mile tax
Contracting authority	Oregon DOT's Motor Carrier Transportation Division (MCTD)
Charged network type	All public roads in Oregon
Length of charged network	73,479 miles
Vehicle categories charged	All vehicles over 26,000 pounds GVWR whether based in Oregon or elsewhere
Elements of charge	Distance and weight
Impact on other taxes	Heavy vehicles in Oregon do not pay diesel taxes, which are collected at the pump by retailers only on diesel fuel sold to light vehicles
Procurement approach	MCTD operates a full service tax collection program for manual reporting and payment of WMT; Truck Road Use Electronics (TRUE) project demonstrated concept of electronic reporting in 2010; MCTD integrated with one commercial service provider for electronic

	reporting following successful audit by MCTD and the Oregon Secretary of State in 2013; MCTD is open to accepting electronic reporting and tax collection from other compliant service providers
Primary distance measurement technology	Manual reporting based on trip reports, odometer, and electronics at the option of the carrier; electronic reporting with certified provide EROAD is based on proprietary e-hubo device which measures distance using a combination of GPS and other sensors
Basis for charge calculation	Highways cost allocation study is used to determine per-mile rate in 2,000-lb. increments from 26,000-80,000 lbs; from 80,000-105,000, rates are in 2,000-lb. increments but vary by number of axles.
Discounts and exemptions	If Oregon state fuel taxes are paid in Oregon, they may be claimed as a credit against WMT; miles travelled off-road or on private roads are exempt from charges
Gross revenue per annum	$308 million in 2015
Use of revenue	Fully hypothecated to State Highway Trust Fund
Capital costs	N/A
Operating costs	4.5% of revenue
Range of charges	5-16.4 cents per mile under 80,000 pounds; 13-23 cents per mile over 80,000 pounds (varies by axle count)
Occasional user product	None

B.2. International Fuel Tax Agreement (IFTA)

Before the 1980s, each state licensed trucks operating inside its boundaries, regardless of the domicile (or base state) of the carrier. These state-centered regulations included fuel tax reporting to ensure that trucks paid proper fuel taxes to the states where they were operating. The result was a complex maze of licensing, regulatory, and reporting requirements on the trucking industry, with some carriers required to keep paperwork, maintain certifications to operate, and face chance of audit in as many as 58 jurisdictions. The trucking industry encouraged states to find an easier solution to compliance for fuel tax reporting.

Three states (Arizona, Washington, and Iowa) began work toward forming a “base state agreement” in the early 1980s, later formalized as the International Fuel Tax Agreement in 1986. In 1991, following nearly a decade of exploration of alternatives, a non-profit corporation known as IFTA Inc. was formed to administer the agreement. IFTA requires all motor carriers operating heavy commercial vehicles >26,000 pounds across two or more state or provincial borders to register and report all fuel purchases and all miles traveled by jurisdiction quarterly to the IFTA division of their base state. The base state is also responsible for auditing at least 3% of all registered carriers in its jurisdiction on an annual basis, on behalf of all other jurisdictions.

Over the next two decades, membership in IFTA expanded to include the lower 48 U.S. states and all 10 Canadian provinces. In 1996, U.S. federal funding was made available to develop a clearinghouse, along with a mandate for states to join. By 2000, the clearinghouse was implemented for electronic exchange of demographic and transmittal data among jurisdictions. By 2004, the clearinghouse was implemented for exchange of funds. Each motor carrier files returns quarterly and either pays additional fuel taxes or gets a refund, based on the reconciliation of miles driven and fuel taxes already paid to each jurisdiction. Each member jurisdiction reports summaries of all carrier tax returns to the clearinghouse, which calculates the total amounts owed from and due to each jurisdiction to every other jurisdiction. The results at the end of this process is only 58 actual transactions between the clearinghouse and each of the jurisdictions.

Today, IFTA continues as the linchpin to the fuel tax system nationally, ensuring transportation funds for states and provinces function properly, with taxes collected distributing to the correct jurisdiction based on mileage traveled in each jurisdiction rather than where fuel is purchased. This core aspect of IFTA – paying fuel taxes based on where the miles were driven rather than where the fuel was purchased – reflects the broad consensus preference for a user-pay transportation system.

CATEGORY	DESCRIPTION
System name	International Fuel Tax Agreement
Year operation commenced	1991
Contracting authority	IFTA itself is an agreement among the states; operations are conducted by IFTA, Inc., a not-for-profit corporation in Arizona
Charged network type	Generally speaking, fuel taxes are owed for any fuel burned to operate a vehicle on public highways; exemptions for off-road mileage vary by state
Length of charged network	Lower 48 U.S. states (District of Columbia does not participate) and 10 Canadian provinces
Vehicle categories charged	All vehicles 26,000 pounds and above that operate across jurisdiction borders
Elements of charge	Charge is based on fuel tax per gallon, but payments are reconciled to each jurisdiction based on mileage driven
Impact on other taxes	N/A
Procurement approach	Each state operates its own IFTA division in house to process motor carrier returns quarterly,
Primary distance measurement technology	At the option of the motor carriers; ranges from manual odometer-based reporting to electronic measurement based on GPS and other sensors

Basis for charge calculation	Fuel tax rates determined in each state
Discounts and exemptions	Exemptions for off-road mileage vary by state
Gross revenue per annum	$380 million in revenue is transferred through the IFTA Clearinghouse annually
Use of revenue	Varies by jurisdiction
Capital costs	N/A
Operating costs	IFTA Inc. has an annual operating budget of about $1 million/year; each jurisdiction funds its own IFTA division which varies in size and cost
Range of charges	Varies by jurisdiction
Occasional user product	Instead of filing IFTA returns, a carrier can purchase a single-trip permit (valid for three days) to cross borders into another jurisdiction

C. Other U.S. Policies

The participating states in this project expressed interest in studying innovative transportation policies beyond RUC as they may potentially inform the development of a roadmap for considering RUC. This section explores two such policies: special fees on electric vehicles and policies to encourage or accommodate autonomous vehicles among state DOTs.

C.1. Washington State Electric Vehicle Fee

Washington was the first state in the U.S. to enact an annual fee on electric vehicles. As of January 1, 2016, nine states impose electric vehicle (EV) fees, including fellow WRUCC members Colorado and Idaho. In the case of Washington, the fee was originally enacted in 2012, along with several other transportation-related fee increases intended to help backfill funding shortfalls. For the EV fee, Washington law states that the purpose of the fee is two-fold: “to provide funds to mitigate the impact of vehicles on state roads and highways, and for the purpose of evaluating the feasibility of transitioning from a revenue collection system based on fuel taxes to a road user assessment system.”

As is the case with RUC, the rationale for the EV fee in Washington is that some vehicle owners are not paying their fair share for roadway use, and if this situation continues unabated into the future, highway revenues will be insufficient to meet the basic funding needs of the roadway system. Thus, equity and revenue sustainability were the primary motivations for the EV fee in Washington.

The Seattle Electric Vehicle Association, which in 2012 was the largest such organization in the U.S. with over 3,000 members, expressed their concern (but not opposition) about singling out EVs for this flat-rate, annual

fee. SEVA argued that a flat fee was unfair to EV drivers because it is not proportional to usage, and on average, EVs tend to drive fewer miles than the average vehicle. The Association advocated for a per-mile fee to be applied to all drivers, and has maintained their support for RUC efforts in Washington as a more equitable method of ensuring all drivers contribute to roadway use.

The legislation that passed includes intent language that the EV fee be repealed once a RUC is enacted in the state, and directs the Department of Licensing to provide written notice of the enactment of a RUC to "affected parties" (meaning EV drivers). Furthermore, the law specifically identifies evaluation and assessment of a RUC as an intended use of the fee proceeds (in addition to providing roadway funding).

C.2. U.S. Autonomous Vehicle Policy Development

Advancements in automotive and information communications technology will enable the deployment of autonomous vehicles (AV) into the consumer market in the near future. Although there is no consensus as to when these vehicles will be commercially available, estimates generally fall between 2020 to 2030 for market launch. To better understand the range of technological capabilities of AVs, the National Highway Traffic Safety Administration (NHTSA) categorizes the various levels of vehicle automation as follows:

- Level 1: A single function of the vehicle is automated.
- Level 2: Multiple functions are automated simultaneously, but the driver remains constantly attentive.
- Level 3: All driving functions are automated, allowing the driver to engage in other activities.
- Level 4: The vehicle can drive itself without any attention from a driver/passenger.

Fully autonomous vehicles are expected to provide many benefits to drivers, passengers, and society as a whole. These benefits include: reduced accident rates, since over 80% of all accidents result from impaired driving, distracted driving and excessive speed – all of which involve poor driver judgment; improved traffic flow resulting from more predictable and responsive vehicle behavior; increased mobility for those unable to drive (e.g., elderly, disabled, and those without driver licenses); reduced need for parking spaces in urban areas, particularly if AVs are put into shared use; and other public benefits.

These benefits are far from certain, and in some cases, there is disagreement on the likely results of wide deployment of autonomous vehicles. There are differences of opinion about whether AVs will substantially lower the cost of driving, and if so, whether congestion might increase as a result rather than decrease. Some also question whether AVs will lead to increased mobility, if they become so ubiquitous that other modes that provide mobility, such as transit and taxis, struggle to maintain service levels.

There are many wide-ranging policy implications of a market shift to AVs. Some of the policy issues are more immediate, primarily related to sorting out liability for accidents, how driving risks should be scored and factored into insurance policies, whether or how government should regulate manufacture and use of AVs, any many others policy issues. The longer-range issues (2030 and beyond) have more to do with the broader systemic effects on the economy, land use patterns, and the transportation system. Narrowing in on potential implications for transportation funding sufficiency, sustainability and equity, the potential effects of wide deployment of AVs would seem to parallel those of a future vehicle fleet that is much more fuel efficient, with a

majority of vehicles propelled by some form of electric drive engine (powered by batteries recharged from the grid, or from on-board electricity generation enabled by hydrogen fuel cells).

Several states are not only accommodating but encouraging AV development and adoption. Legislatures and agencies in several states (notably California and Nevada) are working with technology developers and researchers to understand the impact of AVs on driving rules, legal issues such as liability, and infrastructure impacts. State-level policy makers are attempting to better understand and address how to modernize government regulations and agency operating procedures to most effectively accommodate a paradigm shift in the vehicle fleet. The policy evolutions in vehicle regulation being driven by AVs are not dissimilar from the policy evolutions in infrastructure funding being driven by fuel efficient vehicles. If both trends are in some sense inevitable, then lawmakers and agencies must understand the implications and be prepared for how to adjust their laws, regulations, and operating procedures to meet future needs.

D. New Zealand Heavy and Light Vehicle RUC

Of all the international case studies, New Zealand is perhaps the most relevant to U.S. states for the following reason: like the U.S., New Zealand hypothecates revenues collected from road users to road spending. Officials refer to New Zealand's user-pay approach to road sector as an "implicit social contract." It is a social contract because it is understood that road-related fees such as petrol taxes, registration fees, and RUC are dedicated to maintaining and enhancing the road network. It is an implicit contract because the people of New Zealand never actually voted for it, but rather it evolved due to the unique circumstances of the island nation.

New Zealand implemented its Road User Charge (RUC) system as part of transport policy reforms in the 1970s to liberalize competition between rail and road transport. By introducing RUC, the government sought to better reflect the infrastructure costs attributable to heavy vehicle use of the road network. The other alternative was a diesel fuel tax, but New Zealand struggled with how to administer it since well over 50% of all diesel consumed in New Zealand at the time, as now, was consumed for marine, agricultural, and other non-road uses.

Until recently, the only means of paying for RUC was through the purchase, in advance, of paper licenses for distance not yet traveled (in minimum 1,000-km increments). This was verified against certified hub-odometers on heavy vehicles and odometers on light vehicles. A major study in 2004 indicated that there were viable options available to modernize the system. Following a change of government in 2008, the RUC system was subject to an independent review. The review considered the merits of alternatives, including diesel tax. It concluded that the RUC system should be retained and enhanced by various reforms, including allowing for the introduction of more modern technology to allow for electronic collection of RUC. The first provider was established in 2009.

RUC provides over NZ $1 billion annually for the land transport fund. As of 2009, 76% of RUC revenue came from heavy vehicles (around 164,000 powered and 31,000 trailers), with the remainder from light diesel vehicles (around 530,000).

CATEGORY	DESCRIPTION
System name	Road User Charges

Year operation commenced	1978 (2009 for electronic)
Contracting authority	Ministry of Transport (New Zealand Transport Authority has delegated authority to manage the system)
Charged network type	All public roads
Length of charged network	58,775 miles
Vehicle categories charged	All vehicles with GVW of 3.9 (US tons) and above, and all other vehicles not powered by a fuel taxed at source (i.e. diesel cars/vans)
Elements of charge	Distance, weight and axle configuration
Impact on other taxes	Replaced diesel tax, reduced vehicle registration taxes
Procurement approach	In-house ownership and operation (manual system), open system (electronic system)
Primary distance measurement technology	Hubodometer (manual system), GPS based OBU (electronic system) measuring all vehicle distance travelled
Basis for charge calculation	Infrastructure costs based on forecast National Land Transport Programme expenditure using cost allocation model
Discounts and exemptions	Vehicles unsuited for use on public roads are exempt. No discounts.
Gross revenue per annum	US$780 million
Use of revenue	Fully hypothecated to National Land Transport Fund, for road expenditure, public transport subsidies, ancillary transport activities.
Capital costs	n.a. for initial system. ~US$1.3m to establish certification process
Operating costs	~ US$16m per annum including administration and enforcement
Range of charges per km	US$0.06 per mile (light vehicles) US$0.06 per mile to US$0.40 per mile (heavy vehicle powered) US$0.03 per mile to US$0.31 per mile (trailers)
Occasional user product	None.

E. Europe Heavy Vehicle Charging

Another region of the world with extensive reliance on direct charging of heavy vehicles is Europe. The heavy vehicle charging schemes of Europe arose primarily out of interest in collecting fees for use of the roads of the central European nations with high levels of pass-through traffic, but has evolved considerably such that now

schemes are in operation across much of the continent. Although, as in the U.S. and New Zealand, European RUC systems aim to collect fees proportional to costs imposed by heavy users as a sustainable revenue source for road funding, they nevertheless tend (with the exception of Switzerland) to apply charges strictly to the motorway networks of nations, with local roads funded through general national taxation and/or by local authorities.

E.1. Switzerland Heavy Vehicle RUC and Light Vehicle Vignette

Switzerland was the first country to introduce an electronic heavy vehicle charge based on distance and remains the only distance-based heavy vehicle charge in Europe that charges for all roads, not just motorways.

The charge was introduced primarily to address the perceived imbalance in charging for truck transit routes between northwest Europe and Italy. As both France and Italy have extensive toll road networks, some road freight operators had previously seen Switzerland as a “cheaper” option, causing concern in the country about the impacts on road infrastructure and pollution. Swiss transport policy has been to encourage the use of railways for large volumes of transiting freight, so there was also an opportunity to improve the competitiveness of rail (and to use some net revenues for major rail freight corridor projects). In parallel, weight limits on heavy vehicles were lifted from 28 tonnes to 40 tonnes.

The proposal was put to a referendum to all voters in Switzerland and passed by 57% in 1999. The charge calculation has been subject to legal challenges, due to concerns over the inclusion of environmental costs.

Switzerland also has a vignette system for light vehicles using its motorways. Any light vehicle seeking to use Swiss motorways for any length of time must pay for one year’s access at US$39.

CATEGORY	DESCRIPTION
System name	LSVA (Leistungsabhängige Schwerverkehrsabgabe)
Year operation commenced	2001
Contracting authority	Swiss Customs Administration
Charged network type	All roads
Length of charged network	44,739 miles
Vehicle categories charged	All vehicles with GVW of 3.9 US tons and above, including buses
Elements of charge	Distance, weight and EURO emission rating
Impact on other taxes	Replaced time-based vignette
Procurement approach	In-house ownership and operation
Primary distance	OBU connected to electronic tachograph with GPS measuring

measurement technology	all vehicle distance travelled. DSRC precisely limit charging within national borders.
Basis for charge calculation	Infrastructure, congestion and environmental costs forecast by expenditure, monetized future costs with cost allocation model
Discounts and exemptions	Military vehicles, emergency service vehicles, electric vehicles, vintage vehicles, driving school vehicles, agricultural vehicles, unlicensed unsold new vehicles and some others exempt.
Gross revenue per annum	US$1.47 billion
Use of revenue	Support spending on road maintenance and capital investment in major rail freight corridor projects to encourage modal shift.
Capital costs	US$170 million (2004 values)
Operating Costs	~US$21.6 million (2015 estimate)
Range of charges	US$0.11 per mile – US$0.19 per mile
Occasional user product	Foreign vehicles can choose to get odometer reading on entry and exit at border crossings to measure distance travelled.

E.2. Germany Heavy Vehicle Charging

Germany began testing alternatives for distance-based heavy vehicle charging in the late 1990s and ultimately decided to replace its membership of the time-based Eurovignette system (whereby a group of European countries offer passes for trucks to use their main highway networks that can be used across all of the countries) with a distance-based system for three reasons. First, it was forecast revenue would increase substantially with a distance-based charge given the recent accession to EU Membership of several eastern European countries, and Germany's size and location as a major freight and transit hub. Secondly, distance-based charging would more closely reflect infrastructure costs imposed by heavy vehicles and could also incent more environmentally friendly vehicles (and transport modes). Finally, it was thought that the development of the world's first fully GPS based RUC system would give German business an opportunity to develop technologies and experience they could export to other countries.

The procurement and development of the system was fraught with difficulties, with the original contract award challenged in court. Although the court found in favor of the original decision, technical difficulties saw the contract cancelled by the vendor and ultimately renegotiated to extend the time for introduction. The system, by Toll Collect, ultimately became operational in January 2005.

Most recently, the Toll Collect public-private partnership was extended beyond the initial ten-year concession by three years, from August 2015 (as was permitted under the concession agreement), in parallel with the expansion of the charged network to include many more federal highways and to include charging vehicles between 7.5 and 12 tonnes from 1 October 2015.

At present, 820,000 vehicles have OBUs installed, of which 35% are foreign registered vehicles. Germany reports a <2% trip evasion rate. Over 95% of trips are undertaken by trucks with OBUs paying by account, with the remainder paying by purchasing a trip pass for a specific route on the charged network.

Germany has no charging system for light vehicles, other than vehicle licensing fees and fuel tax.

CATEGORY	DESCRIPTION
System name	LKW-Maut (LastKraftWagen Maut)
Year operation commenced	2005
Contracting authority	Federal Ministry of Transport and Digital Infrastructure (BMVI)
Charged network type	All motorways, and federal highways with four or more lanes connected with motorways or longer than 2.5 miles
Length of charged network	Over 8,700 miles
Vehicle categories charged	All good vehicles with GVW 18.3 US tons and above
Elements of charge	Distance, axle count and EURO emission rating
Impact on other charges/taxes	Withdrawal from multi-national Eurovignette system.
Procurement approach	Single supplier PPP (10-year concession from commencement of operations, recently extended by three years)
Primary distance measurement technology	OBU with GPS correlated with on-board map to measure distance travelled on charged network
Basis for charge calculation	Infrastructure costs based on depreciation-based accounting with cost-allocation, with environmental factors
Discounts and exemptions	Buses, emergency vehicles and some other public vehicles exempt.
Gross revenue per annum	US$5.2 billion
Use of revenues	All revenue goes to the VIFG (federal agency responsible for allocating transport funds). It allocates funds primarily to roads, but also railways and inland waterway infrastructure.
Capital costs	US$2.4 billion
Operating costs	US$535 million per annum payment to Toll Collect for charging services (2010) US$55 million per annum additional for

	enforcement
Range of charges	US$0.14 per mile – US$0.38 per mile
Occasional user product	Pre-book online/by kiosk specific intended route by day.

E.3. Austria Heavy Vehicle Charging

Austria is notable for implementing the first dedicated short range communication, or DSRC-based (also known as “tag and beacon”) nationwide distance-based heavy vehicle charge. To implement this, 800 charging gantries were installed across the Austrian motorway and expressway network to detect heavy vehicles installed with DSRC tags. The use of the DSRC tag is mandatory for all trucks. The system was set up following a restructuring of the Austrian highways sector that saw the reform of ASFiNAG (the state-owned road infrastructure agency) into a federally owned commercial company that raised debt to “buy” its highway assets from the Federal Government. In parallel with this, ASFiNAG gained the legal right to levy tolls on heavy vehicles and apply a vignette to light vehicles and retain all of the net revenue. Given the introduction of the Swiss heavy vehicle charge (and vignette for light vehicles), Austria was subject to increased levels of transit traffic. The introduction of the Austrian charge was intended to raise revenue from this traffic, and also to recover costs from the growth in heavy vehicle traffic from new EU Member States bordering Austria (Hungary, Slovakia, Czech Republic, and Slovenia). DSRC technology was introduced in part because of the speed by which it could be introduced, and also supporting national industrial policy (as a key provider of tags and beacons for the system was the Austrian company, Kapsch, which has subsequently exported its technology internationally).

Evasion rate for the GO-Maut is estimated to be 1% of all trips. Several parts of the highway network are subject to additional tolls, reflecting the specific costs of sections of road constructed in mountainous terrain. All customer service is provided by a subsidiary of ASFiNAG.

CATEGORY	DESCRIPTION
System name	GO-Maut
Year operation commenced	2004
Contracting authority	ASFiNAG (Federal highway company)
Charged network type	All motorways and national expressways
Length of charged network	1,356 miles
Vehicle categories charged	All vehicles (heavy vehicles are 3.9 US tons and above)
Elements of charge	Distance, axle count and EURO emission rating (higher rates on a

	few high infrastructure cost routes)
Impact on other taxes	Cancellation of heavy vehicle vignette (light vehicle vignette retained)
Procurement approach	Arms-length state company established to own and operate charged network. It procured system for in-house ownership and operations.
Primary distance measurement technology	DSRC OBU (tag and beacon) with gantries to detect road segment use on charged network
Basis for charge calculation	Infrastructure costs based on depreciation-based accounting with cost-allocation, with environmental factors
Discounts and exemptions	Emergency, military vehicles and some public vehicles are exempt.
Gross revenue per annum	US$2 billion (61% from heavy vehicles)
Use of revenues	All dedicated to ASFiNAG highway maintenance and capital improvement programme
Capital costs	US$404 million
Operating costs	US$186 million
Range of charges	US$0.27 per mile – US$0.77 per mile (heavy), US$8.91-US$149.84 (vignettes 10 days to 1 year)
Occasional user products	None.

E.4. Czech Republic Heavy Vehicle Charging

For much the same reason as Austria, the Czech Republic followed with the world's second distance-based heavy vehicle charge using DSRC technology. Austrian company Kapsch won the contract to design and install the system within nine months. That contract includes a ten-year installation, maintenance, and operations contract for the on-road tolling equipment and supply of tags. The Czech Customs Administration undertakes enforcement. The charge was initially applied to vehicles 12 tonnes and over on motorways and expressways, but was expanded in scope in 2008 to include some 1st class roads (largely because of diversion of traffic on some such roads to minimize toll payment) and vehicles weighing between 3.5 and 12 tonnes from 2010. In addition, from 1 February 2010 it became the first system to introduce a peak congestion charge, applying a 50% surcharge from 3-9pm on Fridays. It is also notable for charging lower rates for 1st class roads compared to motorways and expressways. This is because of the lower proportion of heavy

vehicles on those roads (so a higher proportion of common costs are not attributable to those vehicles), and to minimize the distortions of only charging some 1st class roads (primarily because they may be used as shortcuts). The current contract allows for all new motorways to have the charge extended to them, until the management contract with Kapsch expires in 2017.

CATEGORY	DESCRIPTION
System name	My-To
Year operation commenced	2007
Contracting authority	Road and Motorway Directorate of the Czech Republic
Charged network type	Motorways and expressways, some “Class I” national roads
Length of charged network	Over 808 miles
Vehicle categories charged	All vehicles with GVW of 3.9 tonnes and above, including buses, vignette for light vehicles
Elements of charge	Distance, axle count, vehicle type, type of road, EURO emission rating and time of day
Impact on other charges/taxes	Cancellation of heavy vehicle vignette
Procurement approach	In house operation, subcontracted system maintenance/operations
Primary distance measurement technology	DSRC OBU (tag and beacon) with gantries to detect road segment use on charged network
Basis for charge calculation	Infrastructure costs based on depreciation-based accounting with cost-allocation, with environmental factors
Discounts and exemptions	Discounts apply for particularly high distance users of between 5 and 13% for usage above a set level. Exemptions for emergency vehicles, military vehicles, and buses used to transport the disabled, network company vehicles.
Gross revenue per annum	US$393 million (HGV) US$129 million (light)
Use of revenues	Supports maintenance and capital expenditure on motorways and highways
Capital costs	~US$984 million
Operating costs	~US$66 million

Range of charges	US$0.05 – US$0.77 per mile (HGV) US$13.11-US$62.27 (light) 10 days to 1 year
Occasional user products	None

E.5. Slovakia Heavy Vehicle Charging

In a break from its nearest neighbors, Slovakia followed the German approach and became the second country to introduce a distance-based heavy vehicle charge using exclusively GPS technology. It introduced the charge for similar reasons to those of Austria and the Czech Republic. Heavy vehicle traffic volumes, both due to export/import trade and transit traffic passing through the country, had increased significantly since joining the EU in 2004. With Austria and the Czech Republic having installed systems in 2004 and 2007, respectively, Slovakia had quickly become a "cheap" transit country for truck traffic. A key difference between the Slovak and the German systems is that the Slovak OBU is less complex, as it does not carry an on-board map and does not calculate the charges owed in the OBU, rather but collects location and distance measurement data to be transmitted by mobile data communications networks. The back office calculates the charge based on this collected data. The driver can install the Slovak OBU, unlike the German one. As a result, no occasional user product exists, requiring all users to obtain an OBU at a deposit of US$55.

The procurement in Slovakia started in 2007, and was awarded to the Skytoll consortium (for a 13-year concession). The procurement was challenged in court, and accepted.

72% of OBUs registered for the My-To system are with foreign operators. There are ~245,000 registered with the system. Uniquely, the My-To system allows for heavy user discounts for trucks that range from 3% to 11%.

CATEGORY	DESCRIPTION
System name	My-To (Skytoll)
Year operation commenced	2010
Contracting authority	NDS (National Highway Company)
Charged network type	Most motorways and expressways, some 1st class national roads
Length of charged network	Over 1491 miles
Vehicle categories charged	All vehicles with GVW of 3.9 tonnes and above, including buses and light vehicles
Elements of charge	Distance, axle count, weight category, vehicle type, type of road, EURO emission rating
Impact on other charges/taxes	Cancellation of heavy vehicle vignette

Procurement approach	Arms-length state company procured single-supplier PPP
Primary distance measurement technology	OBU with GPS, distance data is transmitted to the back office to calculate the charge
Basis for charge calculation	Infrastructure costs based on depreciation-based accounting with cost-allocation, with environmental factors
Discounts and exemptions	Exemptions for military vehicles, road maintenance contractors, prison service, authorized state company vehicles, National Bank of Slovakia vehicles transporting money and some others. Buses have a 50% discount incorporated into charges.
Gross revenue per annum	US$202 million (HGV) US$36 million (light)
Use of revenues	Supports spending on maintenance and capital improvements of highways
Capital costs	US$943 million
Operating costs	Included in 13-year concession of capital costs
Range of charges	US$0.03- US$0.43 per mile, HGV. US$10.92-US$54.62 (10 days to 1 year) vignette
Occasional user products	None

E.6. Hungary Heavy Vehicle Charging

Hungary's distance-based heavy vehicle charge is the latest evolution of a general policy to charge for truck use of its major highways since the 1990s. Until 1999, Hungary had manual toll collection systems on its major motorways for all vehicles. It replaced tolls with a sticker based vignette system from 1999 in an effort to avoid the distortions of traffic patterns from tolling specific points on the network and to eliminate the congestion from manual toll booths. In 2008, the sticker-based vignette was replaced with an electronic vignette, enabling vignettes to be purchased online and reducing operating costs. However, this system did not respond to increases in heavy vehicle traffic, as pre-purchasing network access for a month or a year did not necessarily reflect intensity of usage. The Hu-Go GPS based charging system was established in 2013 to address the growing gap in road maintenance costs relative to revenue from heavy vehicles (although the electronic vignette system remains for light vehicles).

The key advance of the Hungarian Hu-Go system is being the first full system implementation (rather than voluntary option within an existing system) to adopt the open procurement model of allowing any entity to become a certified service provider offering accounts to those paying the charge. The certification process has meant that 22 businesses offer a charging service to heavy vehicle users, all of them responsible for supplying and maintaining OBUs, managing accounts, and forwarding revenue to the State Motorway Management Company.

The introduction of Hu-Go also saw a more than threefold increase in the size of the charged network, in part to address issues of diversion from the previously charged network, but also to increase revenues. Hungarian users pay around 57% of charges, the remainder by foreign vehicle operators. Around 150,000 vehicles are registered with accounts, of which there are 81,000 OBUs distributed. Around two-thirds of trips are undertaken with OBUs, and one-third with the "route-ticket" occasional user product. About 92% of Hungarian users have OBUs, compared to 26% of foreign users. Certified service providers to date have been almost exclusively Hungarian, indicating insufficient market entry to date for those that serve the needs of foreign users.

CATEGORY	DESCRIPTION
System name	Hu-Go
Year operation commenced	2013
Contracting authority	State Motorway Management Company
Charged network type	Most motorways and some major highways
Length of charged network	4047 miles
Vehicle categories charged	All goods vehicles with GVW of over 3.9 tonnes, light vehicle vignette
Elements of charge	Distance, axle count, type of road, EURO emission rating
Impact on other charges/taxes	Cancellation of heavy vehicle vignette (and previously manual tolls)
Procurement approach	Arms-length state company procured in-house system for compliance and enforcement and open system for user services and charge processing
Primary distance measurement technology	OBUs with GPS to measure distance travelled on charged network
Basis for charge calculation	Infrastructure costs based on expenditure forecasting with cost-allocation, with environmental factors
Discounts and exemptions	Buses, military vehicles, police, highway company vehicles and certain agricultural vehicles are exempt.
Gross revenue per annum	US$666 million
Use of revenues	Supports expenditure on maintenance and capital projects on highway network

Capital costs	US$95 million
Operating costs	US$45 million per annum
Range of charges	US$0.11 – US$0.77 per mile, US$5.17-US$703 (vignettes including buses 1 week to 1 year)
Occasional user products	Prepay route ticket based on intended distance travelled on charged network.

E.7. Russia Heavy Vehicle Charging

Russia introduced a weight- and distance-based heavy vehicle charge on major highways in November 2015 applying to all trucks 12 tonnes and over. A 12-year concession was granted to RT Invest to charge all major highways in Russia. However, there have been considerable protests from the trucking industry, with blockades of roads, vandalism of road side equipment and truck operators refusing to pay. In response to this, the price of the charge has been halved until October 2016 and formal enforcement has been suspended, twice (with the suspension in operation until October 2016). To placate the industry, President Putin has signed an executive order that abolishes the annual vehicle registration fee for all trucks 12 tonnes and over as of October 2016. The hope is that with the system being seen as a replacement for that existing charge, it will be more acceptable.

CATEGORY	DESCRIPTION
System name	Platon
Year operation commenced	2015
Contracting authority	Federal Road Agency of Ministry of Transport
Charged network type	All motorways and some major highways
Length of charged network	31550 miles
Vehicle categories charged	All goods vehicles with GVW of over 12 tonnes
Elements of charge	Distance
Impact on other charges/taxes	Cancellation of registration fee (post introduction)
Procurement approach	Single supplier PPP concession
Primary distance measurement technology	OBUs with GPS to measure distance travelled on charged network

Basis for charge calculation	Unspecified
Discounts and exemptions	Passenger vehicles, emergency vehicles and military
Gross revenue per annum	US$545 million (was US$678 million)
Use of revenues	Supports expenditure on maintenance and capital projects on highway network
Capital costs	Included in opex
Operating costs	US$130 million per annum concession covering capex/opex
Range of charges	US$0.03 per mile (doubling to US$0.06)
Occasional user products	Prepay route ticket based on intended distance travelled on charged network.

E.8. Belgium Heavy Vehicle Charging (Under Development)

The Belgium system is due to be introduced on 1 April. Belgium has been a member of the Eurovignette heavy vehicle charge, but has faced pressure on transit traffic following Germany's introduction of its LKW-Maut system and France's extensive toll road network. However, it is not Belgium's Federal Government that has developed the system underway at present, but a collaboration of the three Belgian regional governments (Flanders, Wallonia, and Brussels). One dimension this has brought is specifically higher charges for roads in the capital of Brussels, in part to seek to deter heavy vehicle use of roads in the city because of congestion. The planned network is intended to cover all motorways and major highways, including urban orbital routes. Regional governments can add further routes if they are subject to diversions of traffic seeking to avoid the charge.

The intended concept of operations is for all users to obtain an OBU that can be installed by the driver and is supplied once a method of account payment has been supplied (e.g. bank account or credit card details).

The Satellic consortium won the 12-year concession public-private partnership contract to design, install, and operate the system (76% owned by T-Systems, 26% by STRABAG).

CATEGORY	DESCRIPTION
System name	Expected to be ViaPASS
Year operation commenced	Expected to be launched in 1 April 2016
Contracting authority	ViaPASS (joint agency of Wallonia, Flanders and Brussels regional governments)
Charged network type	Most motorways, highways and major roads, including main

	urban roads in Brussels.
Length of charged network	1864 miles
Vehicle categories charged	All vehicles GVW 3.9 tonnes and above, and vignette for light vehicles
Elements of charge	Distance, weight category, type of road, EURO emissions rating
Impact on other charges/taxes	Expected withdrawal from multi-national Eurovignette
Procurement approach	Multi-region government entity established to procure Single-supplier PPP, option to allow for competing customer service providers (11-year concession from commencement of operations)
Primary distance measurement technology	Not specified, but expected to be OBU with GPS correlated with on-board map to measure distance travelled on charged network
Basis for charge calculation	Infrastructure costs based on depreciation-based accounting with cost-allocation, with environmental factors
Discounts and exemptions	Military, emergency vehicles, vehicles used rarely on public roads (agricultural, forestry equipment), buses and large camping vehicles.
Use of revenues	Support regional government spending on roads
Estimated capital costs	US$328 million estimate
Range of charges	US$0.13-US$0.52 per mile

F. Europe Light Vehicle Vignettes and Congestion Charging

Although the emphasis in Europe has been on heavy vehicle charging (and the concomitant revenue that such charging delivers), there have been notable advances in light vehicle RUC and congestion charging in Europe. The RUC related advances are the time-based electronic vignettes for occasional travel into foreign countries. Congestion charging, meanwhile, is more of a localized issue, except for Sweden where it has become a national story.

F.1. Vignettes

In 1985, the first light vehicle vignette system was established in Switzerland to charge vehicles transiting the country as an attempt to recover road maintenance costs from foreign users. A “vignette” is essentially a ticket or time pass for accessing a road network over a period of days, weeks or months. Nationals of the countries

with vignette systems would usually purchase an annual vignette, with visitors typically buying products ranging from 4 to 10 days.

The main objective was to ensure that foreign users of a national road network paid to use it, particularly in countries with no or few toll roads. In all cases, light vehicle vignettes are only applied to motorways and other major highways. Users of local roads do not have to purchase vignettes. Given the size of many European countries, it is common for road users to pass through smaller countries without refueling, and so do not make a contribution through fuel tax. As cross border travel increased, so did the interest in implementing vignette systems. However, under European Union law (which also applies to Switzerland by bilateral treaty), it is illegal for any EU Member State to discriminate against foreign users. This meant that vignettes would have to apply to nationals as well as foreigners.

With expansion of the European Union in the late 1990s, light vehicle vignette systems were implemented progressively in other countries. Austria was first following Switzerland, as it is a central transit country. As the EU expanded eastwards the Czech Republic, Poland, Slovakia, Hungary, Slovenia, Romania and Bulgaria, all introduced light vehicle vignettes. However, it is notable that countries with extensive toll road systems have chosen not to implement vignettes (e.g. Italy, France, Spain, Portugal). Germany has most recently announced that it will implement a vignette on light vehicles in 2017, but in parallel with a countervailing reduction in registration fees. Another recent trend is the replacement of sticker/paper-based vignettes with electronic vignettes, which simply link a number plate to a vignette (with enforcement using ANPR cameras).

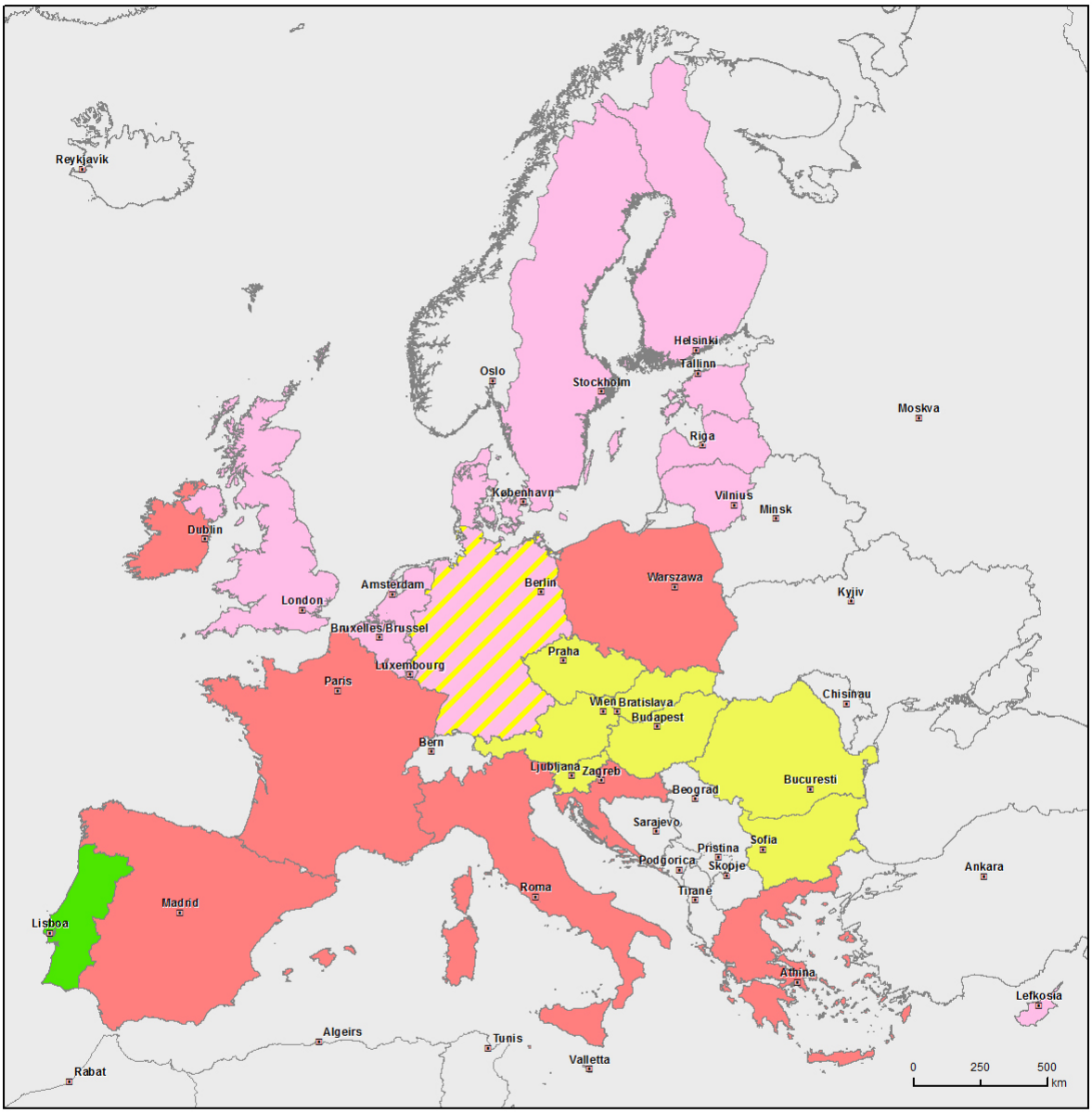
Almost all countries that introduced light vehicle vignettes also introduced heavy vehicle vignette systems, but Switzerland, Austria, the Czech Republic, Slovakia, Poland and Hungary have all replaced their heavy vehicle vignettes with distance-based heavy vehicle road charging systems (and Bulgaria is in the process of doing so). However, there is little sign that light vehicle vignette systems are under threat, rather with Germany introducing such a system and Belgium expressing interest in doing so, they appear to be seen as a step toward more sophisticated direct charging for road use for highway networks.

More recently, the European Commission expressed concern about the pricing practices of some Member States in setting vignette charges, particularly because the price of short term products would tend to be very high proportionate to annual products (e.g. €20 for 10 days, €50 for 1 year) which appears to be discriminatory towards short term users (i.e. foreigners).

Below is a map depicting the countries in the EU that have light vehicle vignette systems in yellow.

European Commission

Road infrastructure charges for light private vehicles in the EU



Legend

- Vignette (time-based charge)
- Electronic network-wide toll (distance based charge)
- Toll with physical barriers (distance-based charge)
- Neither vignettes nor tolls
- Vignette (time-based charge) under preparation

F.2. Stockholm, Sweden Congestion Charging

In 2002, as part of the agreement with the Green Party for coalition support, the newly elected Social Democratic Government was required to undertake a full-scale trial of congestion charging in Stockholm. There was much negative media coverage about the idea, and it was agreed, after some campaigning by the opposition, to hold a referendum following the trial to determine if it had sufficient public support. The trial was to be undertaken to test the impact on congestion and the environment, with charge rates set to reduce traffic levels by 10-15%. The trial started in January 2006 with a charge that was higher during peaks with a single cordon that operated for six months. The result was a 22% in traffic levels reducing congestion delays by over 30%. The trial included an expansion of bus services to accommodate mode shift.

This impact was seen as positive, with negative media coverage reducing considerably prior to the September 2006 referendum. When the trial was discontinued, all equipment that had been installed was removed, so as to not influence the decision whether or not to continue.

The referendum was held in a defined area of Stockholm and saw a 53% positive vote to implement the congestion charge. In parallel with the referendum both the local Stockholm and the national Swedish governments changed, but both governments accepted the outcome of the referendum (although the center-right liberal/conservative coalition opposed the concept previously). The congestion tax was implemented with two key changes. First, it was decided that for enforcement reasons it must be a tax legally, but that required change in the law because the local authority had no power to levy a tax. Secondly, the use of revenue was decided to be primarily for a new bypass road rather than public transport. Between the end of the trial in July 2006 and full implementation in August 2007, traffic returned to almost the previous levels, and once again when the tax was implemented, congestion reduced and has remained at those levels ever since (albeit with some inflation adjusted increases).

The key lesson from Stockholm was the success that a demonstration had in changing public opinion about the effectiveness of road charging in delivering behavior change that can reduce congestion.

CATEGORY	DESCRIPTION
System name	Congestion tax
Year operation commenced	2007 (after 2006 trial)
Contracting authority	Swedish Transport Agency
Charged network type	Cordon around central Stockholm and motorway passing through cordon
Length of charged network	N/A
Vehicle categories charged	All cars, freight vehicles and buses with GVW of less than 14 tonnes.
Elements of charge	Time of day, location.

Impact on other charges/taxes	None
Procurement approach	Build, operate service delivery contract
Primary chargeable event measurement technology	Automatic Number Plate Recognition
Basis for charge calculation	Sufficient elasticity of demand to reduce congestion
Discounts and exemptions	Emergency vehicles, mobile cranes, motorcycles, mopeds and buses over 14 tonnes are exempt.
Gross revenue per annum	US$100 million
Use of revenues	Supports new urban highway projects and public transport infrastructure
Capital costs	US$123 million
Operating costs	US$26 million
Range of charges	US$1.29-US$4.09
Occasional user products	None

G. Australia Transport Infrastructure Sector Reform and RUC

Most of Australia's 24 million residents live in or around the main cities of Sydney, Melbourne, and Brisbane and the related corridors to the north and south on the southeast coast. Despite its relatively small, sparse population, due to its vast size, the nation's 545,000 miles of road rank ninth in the world.

Like the U.S., Australia has a federal system. Management of roads lies with states and local governments, but charges for road use are split between the state and the Commonwealth (federal) Government. The federal government collects and deposits all fuel taxes into the country's General Fund, including $17.5 billion in fuel taxes. However, only $5.7 billion is expended in transportation. States raise over $8.2 billion in vehicle registration fees, but spend about $12.4 billion on 145,000 miles of roads assigned to state agencies. Cities and local authorities

Federal	
Revenue (fuel excise)	$17.5 billion
Expenditure	$5.7 billion
Length of roads	0 miles
States and territories	**6 states, 2 territories**
Revenue (rego, stamp duty)	$8.2 billion
Expenditure	$12.4 billion
Length of roads	145,000 miles
Local	**565 councils**
Revenue	$0
Expenditure	$6.7 billion
Length of roads	400,000 miles

receive grants from the Federal Government and the State Government and expend $6.7 billion on the remaining 400,000 miles of road network owned by this third level of government.

As a result of the inverted transportation funding situation, reform has been a growing debate since the late 1990s. Federal and state governments, whether led by the Liberal/National coalition or the Labor Party, have commissioned multiple studies on tax, infrastructure and economic policy that have almost all commented on how existing motoring taxes are a great source of transport policy weakness and a drag on the economy.

- In 2010, the "Australia's Future Tax System Review" was headed by the Treasurer of the Commonwealth, Dr. Ken Henry (sometimes called the Henry Tax Review). It aimed to study and simplify taxes for all Australians, but had a profound effect on transportation taxes and fees. The transportation section of the Henry Tax Review identified the following problems: *"Road markets are subject to major market failures and poorly adapted institutions… congestion costs in urban areas are almost entirely unpriced… road-wear charges for heavy vehicles do not accurately reflect the damage that particular vehicles do to the roads."* The proposed solution was to consolidate the myriad of taxes, fees, and charges on motorists into a single distance-based charge.
- Shortly thereafter, the opposition party took control of the federal government and placed the Henry Tax Review recommendations in limbo. Road reform ideas nonetheless persisted throughout other branches of government and stakeholder groups.
  - In 2012, Infrastructure Australia's report on finance and funding of infrastructure further reinforced the Henry Tax Review in its Report to the Federal Government: *"Currently, user charges are levied on an ad hoc basis, which can result in a network with little apparent rationale for user charges, and contradictory signals for transport choices."*
  - Various groups, such as Roads Australia (an industry consortium of road agencies, road builders, and other transportation firms), kept the Henry Tax Review ideas spotlighted in its Reform the Transport Network (RTN) movement.
  - Government actions created several national committees to further study road reform, especially for heavy vehicles. These reforms focused on freight movement and productivity. Unfortunately, these committees became bogged down with technical specifications that derailed them and prevented real reform from advancing.
- In July 2014, The Australian Productivity Commission published a report making a compelling case for RUC and for conducting a RUC pilot test. The final report of the Productivity Commission inquiry on public infrastructure identified an urgent need to comprehensively overhaul processes for assessing and developing public infrastructure projects, evaluating them on a benefit-cost regime, identified aging infrastructure and need to regenerate it, linked transportation improvements firmly with economic benefits, downplayed the technology focus and supported running demonstrations to better judge public reaction to the concept. The report solidly backed pilot studies to test RUC concepts and specifically called out the tests being conducted in the United States, notably Oregon, as a model for moving the issue forward by placing the concept in the hands of the motorists.

Most recently, in 2016, Australia published its latest Infrastructure Report, picking up the basic themes of the Henry Tax Review and the Productivity Commission reports. In citing that road revenues were less than expenditures, the report identified a significant mismatch between who owns the roads, who funds them, and who collects the tax revenue from users. Furthermore, the 2016 Infrastructure Report reinforced the Productivity Commission report and the Roads Australia TRN mantra that road owners were being funded

budget to budget. According to the report, this prevents planning and investment in road infrastructure for the long term; and it significantly increases lifecycle road costs. In addition, the report identifies improving vehicle fuel economy as an alarming trend for future government revenues and transportation in particular.

Importantly, the Productivity Commission report also cites growing stakeholder support for a national reform of transportation funding. This includes respected, independent economic advisors to government, the Australian Automobile Association, academics, and some heavy vehicle industry bodies. From government, echoing the Henry Tax Review, Treasury sees value in reform and remains interested in opportunities to improve economic efficiency and productivity through setting of proper pricing signals. State and local authorities see direct value in reform by securing revenue for improving and maintaining roads in their jurisdictions.

Unlike the U.S. and New Zealand, Australia does not have a hypothecated road fund. Transportation is funded out of general revenue, competing with other priorities; likewise, transportation-related revenues such as fuel taxes and registration fees flow to the general fund.

Australia's roadmap to reform is illustrated at a high level in the graphic at right. It includes four overlapping phases described below spanning a 5- to 10-year period:

- Above all, Australian officials and policymakers see the value in hypothecation and are taking steps toward dedicating funds to transportation to provide long-term stability, rather than year-to-year budgeting. The U.S. and New Zealand model of dedicating funds to transportation is seen as an attractive end point, but getting there first requires fundamental steps to improve planning and decision making, including asset management and project prioritization and costing (Phase 1).
- In Phase 2 of the reform, the analysis will look forward in an effort to forecast future needs and establish the costs of future system management and enhancements. This will allow dedication of revenues to be more closely connected to the anticipated needs.
- Phase 3 explicitly connects the outputs of Phases 1 and 2 (systems costs) with revenues by reforming the way that transportation is funded in Australia toward a dedicated user-pay model. This phase will include demonstrations of distance-based charging for both heavy and light vehicles.
- Phase 4 of the reform is to implement more direct user charging where appropriate based on the outcomes of Phases 1-3. The hope is that by direct linkage of pricing to the asset base, the benefits of the reform can be better understood and accepted by road users.