



A-15

**RUC & RATE-
SETTING**

 **WA RUC**



RUC and Rate Setting



PREFACE

The purpose of this report is to provide information for the Washington Road Usage Charge Steering Committee's consideration as it deliberates on the prospects for the State of Washington to transition to a per-mile fee system as a future replacement for the state's motor vehicle fuel tax (gas tax).

This report examines various considerations and approaches for setting a rate structure for a road usage charge (RUC) including application of appropriate factors based on policy priorities.

This report is being presented to the Steering Committee as a draft version for review and discussion at its upcoming meeting on March 14, 2018.

TABLE OF CONTENTS

- 1 Introduction..... 5
 - 1.1 Determining the purpose and scope of a road usage charge 5
 - 1.2 Is a road usage charge a tax or a fee? 6
 - 1.3 Rate setting governance 6
 - 1.4 Approach to rate setting 7

- 2 Road usage charge products 9
 - 2.1 Post-pay mileage charge 9
 - 2.2 Pre-pay mileage charge 10
 - 2.3 Pre-pay time-based charge 11

- 3 Per-mile rate determination 13
 - 3.1 RUC policy objectives relevant to determining rates..... 13
 - 3.2 Basic steps for determining a per-mile rate..... 13
 - 3.3 Approaches to determining a per-mile rate 15
 - 3.4 Considerations for revenue neutrality 21
 - 3.5 Rate reviews 23

- 4 Time Permit Rate determination..... 25
 - 4.1 Time permit customer segments..... 25
 - 4.2 Determining time permit rates 25

- 5 Exceptions 30
 - 5.1 RUC exemptions 30
 - 5.2 RUC refunds 31
 - 5.3 Fuel tax refunds or credits..... 33

- Appendix A: Approaches to RUC rate setting in other jurisdictions 36
 - A.1 Introduction 36
 - A.2 New Zealand..... 36
 - A.3 European vignette systems..... 41
 - A.4 European heavy vehicle RUC rate setting 44
 - A.5 Nebraska Fuel Tax: a small step towards a forward-looking cost basis 49

EXECUTIVE SUMMARY

This paper provides considerations for setting rates for road usage charges (RUC). The paper begins by pointing out the legal context for RUC rate setting that must be resolved by the legislature, including determining the purpose and scope of a road usage charge and answering whether RUC is a tax or a fee. These determinations impact the governance of rate setting, namely whether the Legislature can delegate it to another entity.

Regardless of whether the Legislature delegates rate setting functions to another entity, it retains ultimate authority and discretion for rates and their methods of determination. As a practical matter, this means RUC rates ultimately are subject to political negotiation like any other tax or fee. Nevertheless, a model approach to rate setting can inform the Legislature's deliberations, and/or it can constitute the approach the Legislature defines for a delegated entity to follow.

This paper provides such a model approach to rate setting, consisting of four steps:

- ▶ Determine the RUC products to offer;
- ▶ Determine the per-mile rate(s);
- ▶ Determine the time permit rate(s); and
- ▶ Determine any exceptions

Products definitions determine the method and basis of payment, such as whether RUC is a pre-pay charge or a post-pay charge, and whether it is based on distance or time. The WA RUC pilot tested both pre-pay and post-pay distance charges, and the Steering Committee has long recommended including a time-based charge as a user option in any RUC system.

The recommended method for determining per-mile rates follows four basic steps itself:

1. Gather inputs
2. Conduct cost responsibility (also known as cost allocation) modeling (optional)

3. Conduct revenue modeling
4. Determine rate structure and rates

These four basic steps can be followed under any approach to rate setting, whether it is done purely by political negotiation, whether it uses revenue neutrality as a basis, or whether it is done purely as an analytical exercise by a delegated entity. Some distinctions exist for the available methodologies within each step, depending on the approach taken. For example, if the approach taken is revenue neutrality, it limits by definition the available bases for determining revenue targets.

Setting rates for time permits differs methodologically from the mileage permit, since it aims to offer an alternative to mileage-based fees for certain customers. A logical method for setting time permit rate(s) is to determine the mileage equivalent it should represent, then multiplying by the mileage rate. However, setting the mileage too low (e.g., at the median mileage driven) opens the overall system to substantial unrealized revenue, since high-mileage drivers can elect time permits to save cost relative to their cost responsibility based on mileage driven.

Exceptions to rate setting include exemptions for certain classes of vehicles and types of mileage driven (e.g., based on location), refunds, and credits/refunds against fuel taxes paid. Exceptions form an important part of rate setting because they limit the total revenue available, which impacts the base rates.

An appendix is included containing international examples of RUC rate setting including New Zealand's RUC program, Oregon's RUC and weight-mile tax program, and European vignette systems.

1 INTRODUCTION

This paper provides considerations for setting rates for road usage charges (RUC). This introductory section provides context for considerations for RUC rate setting, including a summary of several legal aspects of rate setting that go beyond the scope of the paper. Sections 2 through 5 provide considerations and alternatives for each of four steps in developing a RUC program rate structure: determining charge “products,” determining per-mile rates, determining time permit rates, and determining exceptions. An appendix provides examples of rate setting from charging programs worldwide.

1.1 Determining the purpose and scope of a road usage charge

The purpose and scope of the RUC will largely determine the nature of its rate structure. The public policy purposes for RUC can vary. In Washington, the purpose is to restore lost revenue from declining gas taxes. Elsewhere, policy purposes have included new revenue, traffic management, and mitigation of environmental impacts.

The policy purpose impacts the RUC rate structure directly. If a legislature seeks only a revenue solution, the rate structure could be flat.¹ To manage traffic, the rate structure would likely need vary by geographic location and time of day. A legislature may consider attempting to achieve multiple policy goals with RUC, leading to a blending of purposes and a more complex rate structure.

Which agencies benefit from RUC revenues may also impact the rate structure. A legislature might allow augmentation of a state government RUC program by allowing local governments to use RUC for their own purposes by adding their own rates on top of the state rate.

In Washington, the legislature has expressed the policy purpose of RUC as a statewide revenue source to replace or restore lost revenue as fuel taxes decline.

¹ For light vehicles, as the Steering Committee has limited the scope of RUC consideration to light vehicles.

1.2 Is a road usage charge a tax or a fee?

Under state law, RUC may be determined to be either a tax or a fee. The outcome of this determination could impact which entity can set a rate structure for RUC and the threshold for its enactment.

A tax is usually considered a revenue raising measure applied for public purposes, in that the revenue raised is either not directly connected to a service or not limited by the cost of the service provided. A fee, on the other hand, is considered a revenue raising measure applied for a specific purpose and limited by the cost of provision of that service. The legislature's statement of the purpose of a RUC program may help determine whether RUC is a tax or a fee. Courts consider other factors for this determination such as whether the charge is voluntary or used for regulatory purposes, but the differentiating characteristics are not uniform across the states.²

The legal opinion of whether RUC is or should be a tax or a fee may differ from state to state, and may be determined by the legislature in the law that creates the RUC. In the state of Oregon, Legislative Counsel determined that a RUC imposed for maintaining or upgrading the state's road system was for a general purpose and therefore was a tax. This legal defining factor had import because passage of a tax in Oregon requires a 3/5 majority of each chamber of the state legislature. In Colorado, transportation funding advocates regard RUC as a fee. If this opinion holds legally, it will allow RUC enactment by the legislature without going to Colorado voters for approval.³

Whether RUC is a tax or a fee may also determine which entity—the state legislature or an authorized agency—has initiating authority to set the RUC rate structure. Detailed analysis of whether RUC is or should be a tax or a fee under Washington law is beyond the scope of this paper.

1.3 Rate setting governance

State constitutions tend to give sole authority to establish tax rates to the legislature, providing only limited ability for the legislature to delegate that

² <https://www.bna.com/extras-excise-difference-b17179894455/>

³ <https://leg.colorado.gov/agencies/legislative-council-staff/tabor>

authority. Setting fee rates are another matter. State legislatures often delegate to an authorized government agency broad authority to set fee rates, such as Washington’s delegation of toll rate setting (with guidelines and limits) to the Transportation Commission.

Subject to constitutional limitations, some state legislatures may have the ability to delegate to a state agency the setting of a RUC rate—the actual number(s)—provided that rate setting is confined by certain parameters such as range, limitations on rate variability, the precise RUC payers, and other defining factors. Whether and how a state legislature can delegate rate setting will be determined by state law. Detailed analysis of whether the Washington state legislature can delegate setting a RUC rate to a state agency, or how it could do so, is beyond the scope of this paper.

1.4 Approach to rate setting

How a legislature sets a rate for either a tax or fee tends not to be defined in law. Relevant data and analysis, often conducted by expert authority, often informs the legislature’s rate setting process, especially in complex situations. The outcome of an expert analysis, however, may not be conclusive. Often political negotiation enters the rate setting process and can have a major impact on the outcome. For example, under Oregon’s proposed RUC program implementation legislation in 2013, the data and formula used to determine revenue neutrality between the fuel tax and RUC indicated the RUC rate should be 1.55 cents per mile,⁴ but negotiations lowered the rate for the voluntary program to 1.5 cents per mile.⁵

For rate setting processes delegated by the legislature to a designated agency, the legislature may strictly limit the agency’s discretion to inside the bounds of relevant data, formula and expert analysis but, if not, political negotiations can enter this sphere of decision-making as well.

⁴ The calculation was based on the fuel tax rate and the average fuel consumption of a light motor vehicle. The calculation therefore was: 30 cents/19.355 mpg = 1.55.

⁵ In 2017, the Oregon legislature simultaneously raised the fuel tax rate to 34 cents per gallon and the RUC rate to 1.7 cents per mile for 2018. The RUC rate increase directly relates to the fuel tax increase: (34 cents per gallon (new fuel tax rate)/30 cents per gallon (old fuel tax rate)) x 1.5 cents per mile = 1.7 cents per mile. Thus, the original, negotiated RUC rate has held fast, relative to the 2018 gas tax increase, without further application of data, formula or analysis.

Should it enact a RUC program, the legislature will have full authority and discretion to set or delegate the setting of RUC rates. As with any tax or fee, no matter how rigorous the inputs or processes, the rate ultimately is a policy choice resulting from a political negotiation. This paper aims to inform that negotiation process with information and choices.

2 ROAD USAGE CHARGE PRODUCTS

We break down the process for setting RUC rates into four stages: determining products to offer, setting per-mile rates, setting time-based rates, and determining exceptions. This section covers the first stage: deciding which RUC product or products to offer.

A product is an item to which a rate can apply. Product choices available for RUC include the following.

- ▶ A post-pay, per-mile charge. The WA RUC pilot tested several operational approaches to quantifying a post-pay, per-mile charge product, including the plug-in device, odometer charge, and *MileMapper* smartphone application.
- ▶ A pre-pay, per-mile charge. The WA RUC pilot tested one approach to operationalizing a pre-pay, per-mile product: the mileage permit.
- ▶ A pre-pay, time-based charge. The WA RUC pilot did not test a time-based charge, but earlier work by the Steering Committee identified a time permit as a viable RUC product.

The sections below discuss each of these products in detail.

2.1 Post-pay mileage charge

A post-pay mileage charge structure can be as simple as a single rate for all vehicles on a per-mile basis. Although the pilot made a pre-pay option available (the mileage permit), only about 1% of participants elected this method, with the other 99% electing one among several post-pay options. Per-mile rates can also vary according to the following factors:

- ▶ Geography. Where and on what roads does the charge apply? Does it vary by location? The Washington RUC assessment, and the pilot, applied a single, per-mile rate for all light vehicles for use of public roads in Washington, regardless of geography. To exclude miles driven off road or out of state from a real per-mile charge, drivers would have to select a reporting option with location-detecting technology. In the pilot, about half of drivers selected location-aware reporting options.

- ▶ Vehicle type. On what vehicles does the charge apply, and does it vary by vehicle characteristics? Rates can vary by vehicle type, particularly if the DOL registry can identify relevant characteristics (e.g., weight, fuel type, fuel economy, age). The Washington RUC assessment thus far has examined only four-wheel, light-duty vehicles, and the pilot was limited to participation by such vehicles. The RUC assessment and pilot neither assumed nor applied any variation in rates among those vehicles.
- ▶ Time and date. On what dates and times does the charge apply, and does it vary by time or date? Washington’s RUC concept applies the same per-mile rate on all days, at all times, just like the gas tax.
- ▶ Other factors. Are there other factors that influence the rate, such as environmental factors, differentiation by vehicle occupancy, or discounts or exemptions by vehicle type? No other factors have been assumed or proposed for RUC policy in Washington, but it is possible to exempt or discount certain vehicle categories for specific policy purposes. Such exemptions or discounts reduce revenues and increase administrative costs to apply and enforce.

2.2 Pre-pay mileage charge

A pre-pay mileage charge is based on pre-purchasing future travel. As with the post-pay product, a pre-pay per-mile product could have variable rates by vehicle type, but not for other factors that might vary during travel such as location, time, or other factors. Other factors to consider for a pre-pay mileage charge product include the base per-mile rate and the mileage increments available for purchase.

The pre-pay per-mile rate could theoretically differ from the post-pay rate. The policy reasons for varying the rate could include the time value of money (i.e., cash flow benefit to the state of capturing revenue upfront merits a lower rate). On the other hand, the transaction costs of pre-pay mileage permits, especially small increments, could outweigh such benefits. Such considerations are likely so trivial as to not merit rate distinctions between per-pay and post-pay products.

Another factor that can vary for a pre-pay charge product is the quantity of miles available for purchase (“blocks of miles”). To minimize transaction costs, a minimum quantity sufficient to avoid the need to frequently purchase further blocks

of miles will reduce administrative costs. New Zealand's its RUC system requires purchases in 1000km increments (621 miles). This allows for an infrequent road user to purchase distance infrequently, while a high-frequency long distance driver can purchase several thousand miles at once to avoid the need to undertake more transactions unnecessarily. The WA RUC pilot featured a minimum block of 1,000 miles and a maximum of 10,000 miles.

2.3 Pre-pay time-based charge

The RUC Steering Committee previously explored and recommended a time permit as a feature in any prospective RUC policy. A time permit allows road users to opt out of the requirement to report miles altogether by paying for access for a period of time rather than for distance, akin to a vehicle registration fee. Although various European countries have used time permits to charge for road use, none have done so as an alternative to charging by distance, fearing that high-mileage users would opt for a time permit to pay less than their mileage traveled would require. The simplicity and familiarity of a time permit notwithstanding, it has the potential to distort behavior and cap the revenue available from distance-based charges as high-mileage users “game” the system.

There are two high-level options for designing a time permit:

- ▶ Offer a single product for one time period, based on the likely profile of users most likely to prefer a time permit over a distance-based product. For example, an annual time permit could be offered as an alternative for all users subject to RUC. Such a product would be most attractive to users who travel the most miles in a year, so effectively caps revenue from those who drive the most. Such a product would incentivize such users to use the road network as much as they wish with no financial impact, unlike the gas tax or distance-based RUC. To address this concern, the rate could be set sufficiently high to disincentivize all but the highest mileage users of the network from gaming the system.
- ▶ Offer a range of time-based products to meet needs of various classes of users. Multiple products could range from a day to a year and allow the time permit more flexibility. It could allow for very short visits, vacations, or short business trips through to providing a real alternative for

residents, by setting a fee based on annual mileage. In Europe, it is common for such products to exist for visits of four days, one week, one month, or one year. Such an array of products could also be attractive to out-of-state visitors, should the policy apply to them. However, such products would need rigorous enforcement, to ensure they were not being regularly violated.

3 PER-MILE RATE DETERMINATION

The second stage of setting RUC rates involves determining a per-mile rate. Setting the per-mile rate requires understanding the purpose of RUC, the use of revenue collected, and the beneficiaries of spending. This section presents relevant objectives, rate-setting steps, and alternative approaches to determining per-mile rates. It concludes with special considerations for revenue neutrality and regular rate reviews.

3.1 RUC policy objectives relevant to determining rates

The approach for setting a per-mile RUC rate should follow from policy objectives. The list below summarizes relevant RUC policy objectives expressed by the legislature and RUC Steering Committee throughout the RUC assessment.

- ▶ Sustain revenues. The motivating force for the legislature to explore RUC has been to sustain road revenue, in light of declining gas tax revenue as vehicle fuel economy improves.
- ▶ User pays. User pays is an inherent policy feature of both the gas tax (historically) and RUC. The Steering Committee has captured this in its guiding principle that “all users should pay a fair share.”
- ▶ Revenue neutrality. The Steering Committee has inferred from its legislative directive to study RUC as a possible gas tax successor that it also remain revenue-neutral with the gas tax. RUC business case analyses and the pilot itself assumed revenue neutrality.

These three policy objectives guide the RUC rate setting steps (Section 3.2) and alternatives (Section 3.3) presented in this section.

3.2 Basic steps for determining a per-mile rate

Figure 1 illustrates and the text below describes the analytical steps to determining a per-mile rate.

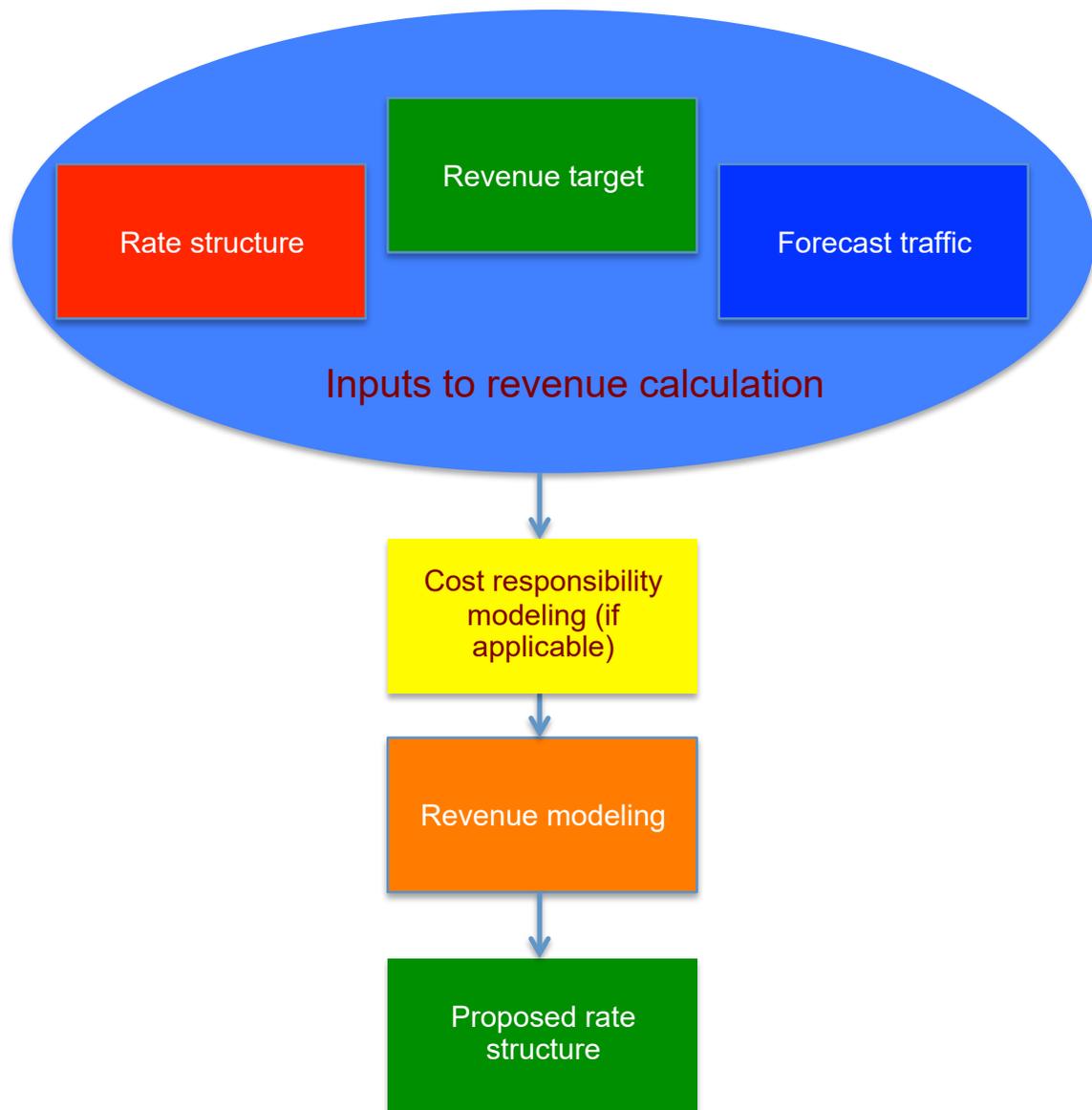


Figure 1. Steps in rate setting

Gather inputs: The three primary inputs to rate setting are:

- ▶ Proposed revenue target. How much revenue is expected or intended to be collected by RUC. This may be a simple revenue target (e.g., based on revenue neutrality or a fixed increase from prior years) or it could be total forecast expenditure on the road network to be funded by RUC and other revenue sources. It may be for one year or for multiple years if the rate is intended to apply for a longer period before being reviewed.
- ▶ Forecast mileage traveled. Expected vehicle miles traveled by all vehicles or just vehicles subject to paying RUC. This may be for one year

or for multiple years if the rate is intended to apply for a longer period before being reviewed.

- ▶ **Rate structure.** With the above two inputs, it is possible to identify an initial set of raw rates based on dividing the revenue target by expected traffic volumes by each category of vehicle under the rate structure.

These inputs form the core data used to set rates to meet a specific revenue target. Although they are not all necessary for all approaches to rate-setting, best practice is to at least consider all three sources of data to inform decision makers of the revenue impacts of any chosen rates.

Cost responsibility: For a more refined approach to user pays, the revenue target may be disaggregated into various areas of spending or costs to which economic principles can be applied to determine how to set rates by vehicle type (or by type of revenue). Although considered a best practice for optimizing rates, this step is optional.

Revenue modeling: A pure division of forecast miles traveled with the revenue target will not produce a rate that is likely to reflect what will be generated from RUC. Revenue modeling considers demand elasticities to reflect the impact of price on the number of miles traveled, and conducts sensitivity testing to observe how changes in key inputs affecting traffic demand (e.g. fuel prices, economic growth, population growth) impact revenue. This provides a more realistic calculation of what revenue may be generated by proposed rates.

From this analysis, a proposed rate structure can be derived, which is then subject to approvals and changes.

3.3 Approaches to determining a per-mile rate

Applying the steps outlined in Section 3.2, there are four broad approaches to determining a per-mile RUC rate.

- ▶ **Revenue neutrality/replacement.** Set rates that are broadly equivalent to what vehicles are charged with the gas tax.

- ▶ Revenue targets. Set rates primarily to raise a specific amount of revenue, which may be based on budgetary requirements for spending on roads.
- ▶ Cost responsibility. Set rates primarily to ensure that charged vehicles pay an equitable share of the costs of maintaining and developing the road network based on economic principles. Cost responsibility takes “user pays” a step further by linking the costs imposed by users on the road system to the amounts they pay for it.
- ▶ User acceptability. Set rates according to the levels likely to be acceptable to users, in order to balance revenue targets against public and political acceptability.

These approaches are not mutually exclusive, so elements of each can be combined. For example, revenue neutrality implies meeting a revenue target, and a revenue target can be the foundation for a cost responsibility approach. The key differences between these approaches lie in how the various steps in rate setting outlined above are undertaken. The remainder of this section walks through the rate-setting steps, highlighting variations for each step under each of the four approaches.

3.3.1 Set revenue targets

There are two broad approaches to setting a revenue target that reflects road infrastructure costs:

1. Forecast the budgetary requirements to maintain and develop the road network over a period of years, informed by engineering and policy analysis of the network’s needs to meet specific performance and policy objectives (this is the approach used in Oregon and New Zealand, as discussed in then appendix);
2. Develop a forward-looking cost base, using core accounting principles, to capitalize and amortize the capital costs of the road network (including the opportunity cost of capital), along with the operating costs of managing the road network over a period of years. This approach seeks to optimize the value of the network to road users, by calculating the base long run costs of sustaining the network, and allow for choices to be made on capital

spending on top of this (this is the approach used in some European countries).

Both approaches may seek to only recover a portion of the budgeted and/or amortized costs of the road network from RUC, either because of revenue from other sources (e.g., fuel tax, registration fees) and/or because it is politically unacceptable to recover all such costs. However, they do provide sophisticated targets for revenue that can be used to inform the setting of RUC rates, which can be revised regularly and provide highly transparent and robust bases to justify revenue targets over the longer term.

Table 1 summarizes options for revenue target setting under each approach to rate setting.

Table 1. Options for setting revenue targets

Rate setting approach	Options for revenue target setting
Revenue neutrality/replacement	<ul style="list-style-type: none"> Forecast gas tax revenue assuming no erosion due to fuel efficiency/change in motive power. OR Forecast gas tax revenue assuming vehicles subject to RUC would pay the fuel tax as the average MPG vehicle. AND Include estimated administrative costs of RUC in addition to gas tax.
Revenue targets	<ul style="list-style-type: none"> Proposed contribution of RUC to roads budget. Proposed contribution of all motoring taxes to roads budget. Proposed total roads budget.
Cost responsibility	<ul style="list-style-type: none"> Proposed contribution of all motoring taxes to roads budget. Proposed total roads budget.
User acceptability	<ul style="list-style-type: none"> No specific options.

Under a revenue neutral approach, the target would be to replace revenue that is raised under the gas tax. This could be based on historic revenue or on forecasts

of gas tax revenue that assume no change in fleet fuel economy. In both cases, revenue neutrality might also consider the relative costs of raising revenue by RUC compared to the gas tax, to ensure that *net* revenues were similar. If RUC is only a partial replacement (e.g., only applies to some vehicles), then the cost of collection becomes less important since all revenue raised is effectively new revenue.

In the longer term, revenue neutrality with the gas tax is not compatible with revenue sustainability, so establishing a revenue target that is linked to the costs of providing the road network may be a more sustainable, more sound policy basis for rates for RUC (along with rates for other road revenue sources).

3.3.2 Forecast estimated traffic volumes

To meet revenue targets, there must be forecasts of estimated total miles traveled in the state by the vehicles subject to RUC on the roads subject to RUC. Traffic forecasting is typically based on forward projection of recent historic data and trends, with sensitivity testing based on key inputs that affect vehicle miles traveled. Factors to consider include:

- ▶ Population changes, including demographics;
- ▶ Changes in the vehicle fleet;
- ▶ Inputs into the costs of driving, such as fuel prices; and
- ▶ Economic growth.

Traffic forecasts should be sufficiently disaggregated to enable estimates of mileage for those vehicles subject to RUC, as well as any subsets of vehicles with RUC rates that vary by vehicle type. There should be no differences in the methodologies used for forecasting traffic under each of the rate setting approaches (i.e., future miles traveled should not depend on whether RUC rates are set based on revenue neutrality, revenue targets, cost responsibility, or user acceptability).

3.3.3 Model cost responsibility (optional)

With a revenue forecast and traffic volume forecasts basis, a uniform rate can be calculated by dividing revenue by total miles. This approach is the simplest

approach. It assumes that RUC is the only source of revenue and all subject vehicles will pay the same rate.

If either of those assumptions does not hold, then further analysis can determine what proportion of revenue should be raised from RUC, and how to set rates that differentiate between types of vehicles. There are two approaches to further analysis:

- ▶ Forecast estimated revenue from other sources, and identify the funding gap that RUC needs to fill;
- ▶ Undertake a cost responsibility study to identify how revenue should be raised from various sources, depending on the types of costs covered by the overall revenue target (e.g., fixed costs of road maintenance may be better raised from non-usage based taxes and charges).

If there are numerous classes of vehicles subject to RUC (e.g., ranging from motorcycles to heavy trucks), there is merit in undertaking analysis to allocate costs among vehicle types, so that each contributes according to the costs they impose on the road network or the benefits they receive from different categories of spending on roads.

If RUC aims purely to replace gas tax on all vehicles, then a cost responsibility study that allocates different types of spending on the roads in proportion to factors such as wear and tear should be undertaken, so that revenue is raised in accordance with the user pays principle. Oregon uses such an approach for its RUC system, and this approach is commonly used for RUC systems in Europe and New Zealand, largely to help inform rate setting so that rates do not significantly under or over-recover road costs attributable to those paying RUC.

Table 2, which present New Zealand's cost allocation model treatment of various elements, exemplifies how such a study may suggest road cost allocations among vehicle types.

Table 2. New Zealand's cost allocation model treatment of elements

Description	Cost allocation model treatment
Fixed costs not attributable to road use, such as weather-related wear and tear, administrative costs, and policing	Allocated to all vehicle types in equal proportions
Projects to increase network capacity	Allocated to vehicles based on road occupancy (using passenger car equivalent units)
Projects to benefit specific vehicle types	Allocated to the class of vehicle benefitting
Maintenance and replacement of infrastructure based on vehicle mass	Allocated to vehicles according to their relative impact based on equivalent standard axle mass

Details of how RUC rates around the world use cost responsibility models or studies are included in Appendix A.

3.3.4 Model revenues

Regardless of whether a cost responsibility approach is taken, it is important to undertake revenue modeling to accurately calculate the revenue generated by a range of rate options. Although RUC replaces or restores gas tax revenue, the rates may have an impact on traffic demand and vehicle miles traveled, however small. Revenue modeling should employ demand elasticities to determine how the introduction of RUC influences miles traveled. In addition, sensitivity tests can be applied to consider the impacts of macroeconomic changes on overall vehicle miles traveled. Revenue modeling from various rate levels increases the confidence of estimates.

If a rate structure is complex, revenue modeling will need to reflect different rates (and different forecasts of mileage) for different vehicle types, and even different products.

3.4 Considerations for revenue neutrality

A revenue-neutral RUC rate seeks to raise the same amount of revenue from vehicles that would otherwise pay through gas taxes. As simple as that appears, there are at least four dimensions to consider and define before computing a “revenue neutral” RUC rate, as summarized in the list below: mathematical, subject vehicle, financial, and temporal.

- ▶ **Mathematical dimension: Average vs. median vs. aggregate.** These three distinct mathematical approaches to defining revenue neutrality result in three distinct rates. Therefore, it is important to choose one explicitly in calculating a revenue-neutral RUC rate.
 - > **Median.** Revenue neutrality could refer to the notion that the “median” vehicle (according to fuel economy) is treated the same under both a fuel tax and a RUC, in terms of total tax paid. In this case, the revenue neutral rate is determined by finding the median miles per gallon of all vehicles subject to RUC and converting that individual’s gas tax into a mileage-based rate. For example, if the median vehicle driven in Washington gets 25 MPG, and assuming a fuel tax conversion basis of 49.4 cents per gallon, the RUC rate would be **2.0 cents per mile**.
 - > **Average.** Alternately, revenue neutrality could refer to the notion that the “average” vehicle pays the same in RUC as fuel tax. This is the approach taken for the WA RUC pilot. Mathematically, this has a different result from the median vehicle. Average MPG, determined by averaging the MPG of all vehicles, is likely lower than median MPG. For example, if the average MPG is 21, the corresponding revenue-neutral RUC rate is **2.4 cents per mile**.
 - > **Aggregate.** Revenue neutrality could also refer to the notion that aggregate revenues under both a fuel tax and a hypothetical RUC generate the same revenue. This calculation is made by dividing the total miles driven in Washington by total gallons consumed, and converting the resulting MPG into a mileage-based rate. This method

results in the lowest MPG of the three methods. If the aggregate fleet MPG is 19 MPG, it results in a revenue-neutral rate of **2.6 cents/mile**.

- ▶ Subject vehicle dimension: all vehicles or subsets? The definition of the applicable vehicle population is necessary for the correct computation of a revenue-neutral RUC rate or rates. The key question is to define the baseline population of vehicles to be included and for which subsets of those vehicles, if any, should the rate vary. There are many options.
 - > **One rate – do not vary.** If only a single rate is to be computed for all subject vehicles, then the computation is trivial.
 - > **Vary by fuel type.** One possibility is to vary the road charge rate by fuel type or motive source, so that diesel vehicles pay one rate while gasoline vehicles pay another. An unresolved question of this approach is how to address electric vehicles and other alternative-fuel vehicles, namely, whether they are included in the calculus for gasoline, diesel, or some separate classification(s).
 - > **Vary by weight.** Another possibility is to vary the rate by weight
 - > **Vary by weight and fuel type.** The rate could also vary by both weight and fuel type.
 - > **Vary by other factors.** The rate could vary by any other vehicle factor or classification, with a determination to compute the revenue neutral on the basis of that factor.
- ▶ Financial dimension: gross vs. adjusted gross vs. net. Using revenue neutrality as the basis for a RUC rate requires the specification of whether revenue is neutral with respect to gross, adjusted gross, or net revenue.
 - > **Gross.** A rate or rates based on gross revenue neutrality ensures that the total revenue expected to be generated by RUC is equal to revenue from corresponding fuel taxes, before consideration of leakage or collection costs.

- > **Adjusted Gross.** A rate or rates based on adjusted gross revenue neutrality ensures that the total revenue expected to be generated by RUC is equal to revenue from corresponding fuel taxes after consideration of leakage (including losses due to evasion and negligence)
- > **Net.** A rate or rates based on net revenue neutrality ensures that the total revenue expected from a RUC is equal to revenue from corresponding fuel taxes, after subtracting leakage and collection costs. As long as leakage and collection costs are higher for RUC than fuel tax, then the net revenue neutral rate for RUC will be higher than the gross revenue neutral rate.
- ▶ Temporal dimension: past year vs. current year vs. future year. Fuel tax rates change regularly as do MPG by vehicle fleet, so it is critical to define the year on which to base the computation of revenue neutrality. Over time, following rates on a MPG basis will result in reductions in rates, so care needs to be taken as to how closely RUC rates should follow trends in fuel consumption. For example, the aggregate, gross, revenue-neutral RUC rate for all vehicles in Washington in 2017 was likely higher than it would be in 2018, given that the overall MPG of the fleet would have improved in that year.

3.5 Rate reviews

Regardless of the approach taken, rates should be reviewed and revised at regular intervals to account for the wide range of factors that affect revenue:

- ▶ Inflation: RUC is not immune to the effects of inflation eroding the real money value of revenue collected. A range of inflationary measures could be used, from consumer prices to the costs of road maintenance and construction.
- ▶ Vehicle mileage traveled: If actual distance traveled is higher than forecast, revenue will be higher and this may be used to either increase spending on the road network or moderate any increases in rates for other factors. If it is lower, this may require rates to increase to meet revenue targets, although consistently lower levels of vehicle mileage

- may also reduce costs to develop and maintain the road network over the longer term.
- ▶ Changes in revenue targets/preferred expenditure levels: A range of factors may influence decisions to change the amount of revenue sought from RUC, either to change levels of spending on roads or to utilize other sources of revenue. Rates should be revised to account for significant changes in any revenue targets.

4 TIME PERMIT RATE DETERMINATION

Rate-setting for time permits represents a unique challenge. If Washington wishes to offer a time permit in one or more denominations (e.g., one week, one month, one year), the per-mile rate should be set first, and then the rates for the time permits should be set on that basis. This section presents considerations for setting the rates for various time permits. The appendix offers more information about rate setting for vignettes (time permits used in Europe).

4.1 Time permit customer segments

The first step in determining rates for time permits is the intended customer segment. Time permits may be desirable to residents and visitors alike.

For residents, a time permit may be attractive to avoid any requirement to report odometer readings and/or to avail themselves of the simplicity of paying once to avoid any perceived hassle. In some cases, policy may require residents to utilize a time permit, for example if they have evaded or failed to comply with mileage-based method, or if they have a vehicle for which no mileage reporting option works (e.g., a pre-1996 vehicle no OBD-II port and a broken odometer).

Out-of-state visitors, if subject to RUC, likewise may find time permits attractive, particularly if short denominations are available, such as one week or one month. While frequent out-of-state visitors may opt to set up an account with a service provider, infrequent out-of-state visitors may prefer a simple, short-term product they can purchase online. Offering time permits would allow them to drive however much they need for a period without buying a new permit, whereas a mileage permit may need to be renewed.

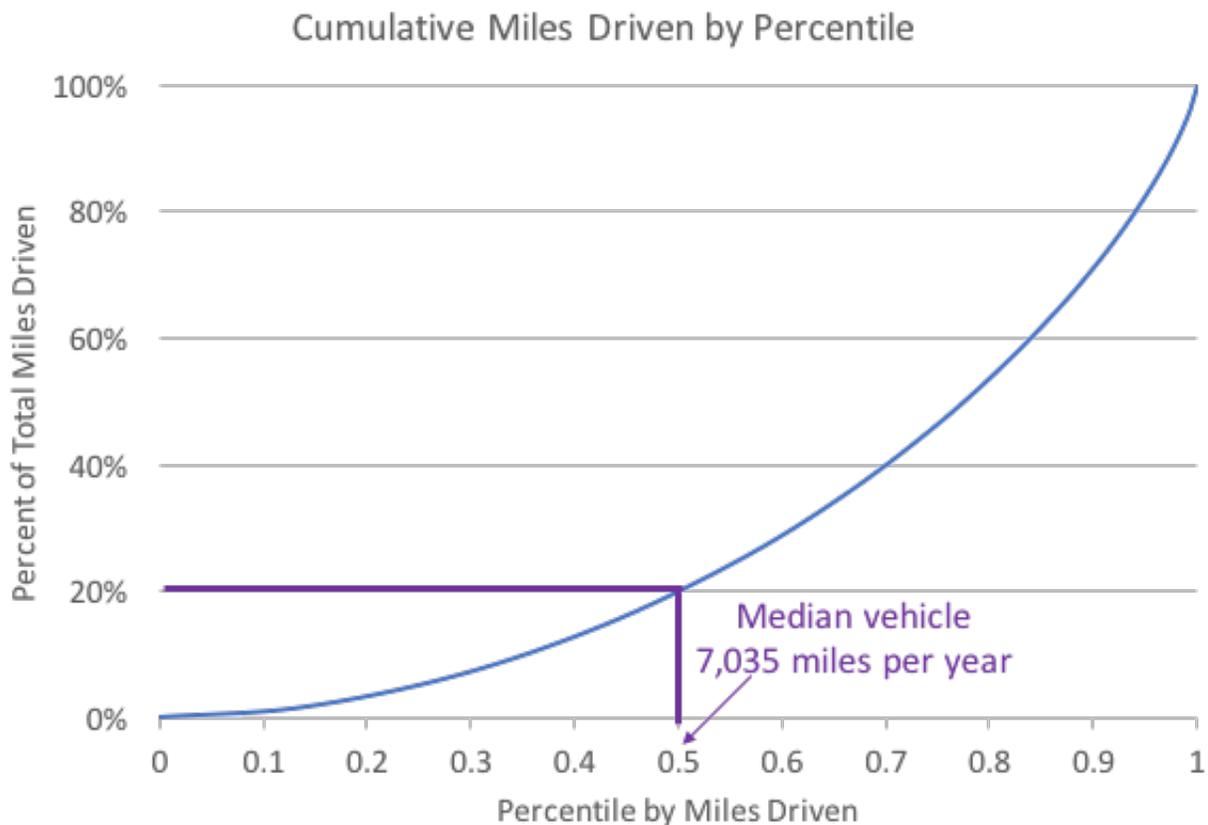
4.2 Determining time permit rates

The key trade-off in determining a rate for time permits is understanding how motorists might “game” the system. For example, consider if RUC applied to all drivers, and the state also offered an annual time permit set at a price equal to the median mileage driven by Washington drivers. In this scenario, the 50% of vehicle owners whose mileage exceeds the median would save money by purchasing a time permit and not paying for their mileage.

The median Washington vehicle (the fiftieth percentile) drives 7,035 miles per year. This means that half of all vehicles drive 7,035 miles or fewer per year. The other half drive 7,035 miles or more per year.

The blue curve in Figure 2 depicts the cumulative distribution of miles driven in Washington by percentile. The fiftieth percentile vehicle (the one that drives 7,035 miles per year) is indicated by a vertical purple line. What the chart reveals is that the half of vehicles that driver 7,035 miles or fewer drive, cumulatively, only about 21% of all miles driven by Washington vehicles in a year. The other 79% are driven by the 50% of vehicles that drive more than 7,035 miles per year.

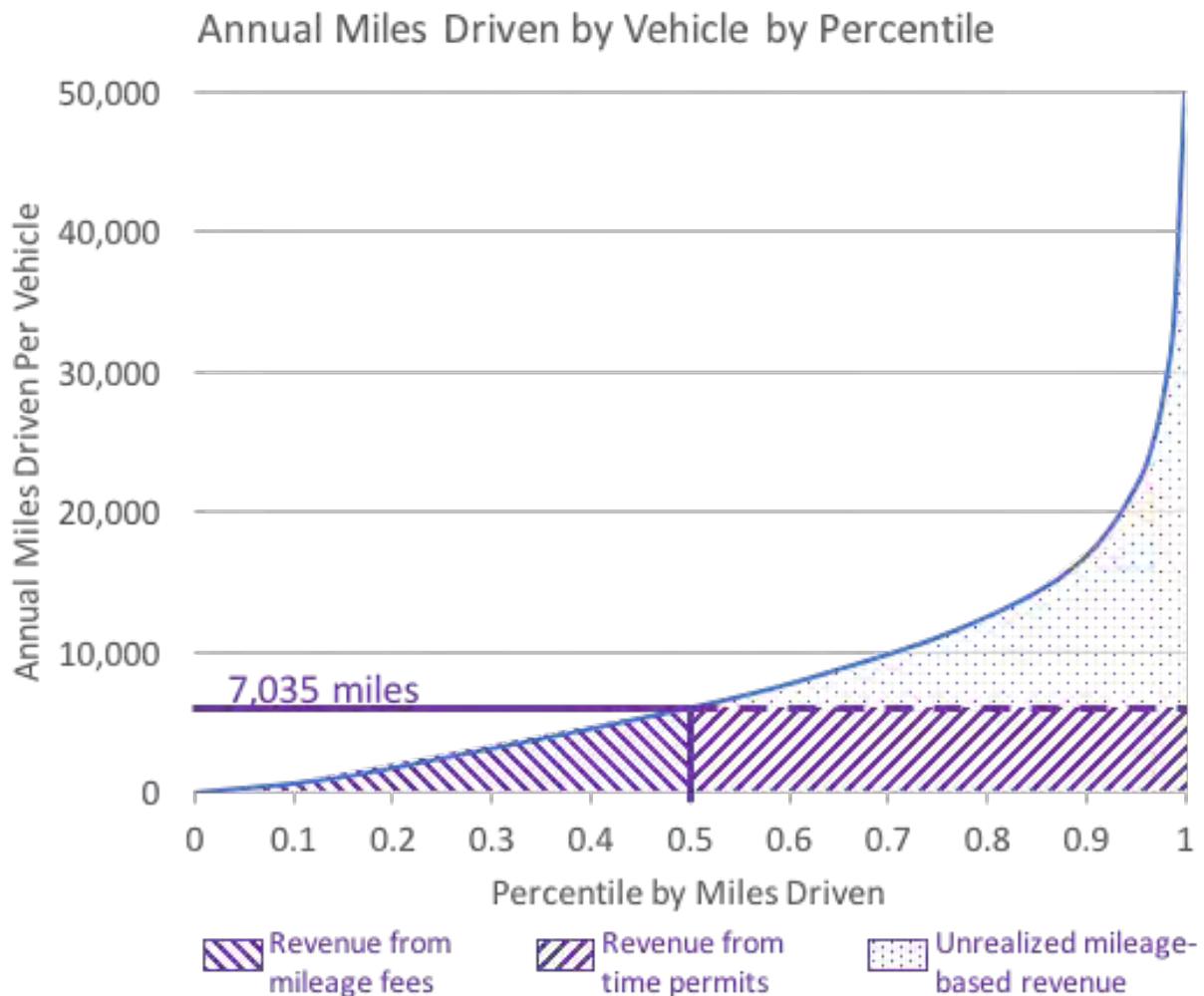
Figure 2. Cumulative distribution of miles driven by Washington vehicles



A possible temptation is to set the time permit rate at a price commensurate with the “average” vehicle, so that the cost is akin to what the average driver would pay under a mileage-based fee. The problem with this approach is that it leaves the entire policy susceptible to gaming. If every vehicle owner were perfectly rational,

those driving fewer than 7,035 miles per year would opt to pay by mile, and those who drive more than 7,035 miles per year would opt to pay for a time permit. Figure 3 depicts this outcome. The triangular, diagonal-shaded area under the curve on the left represents revenue collected from mileage-fees by vehicles driving fewer than 7,035 miles per year. The rectangular, diagonal-shaded area to the right represents revenue collected from time permits priced at the equivalent of 7,035 miles. The dotted area beneath the curve on the right side represents unrealized mileage-based revenue from those high-mileage vehicles opting for time permits, and it accounts for 40% of all miles driven. Thus, setting the time permit rate at the median mileage driven opens the state up to as much as 40% revenue loss compared to a fully mileage-based system.

Figure 3. Revenue impacts of a time permit at 50th percentile mileage



Setting the time permit rate at a higher percentile mileage equivalent reduces the risk of revenue loss caused by this phenomenon. Figure 4 depicts the same phenomenon when the time permit rate is set at the 90th percentile vehicle by mileage, which corresponds with about 18,000 miles. Under this scenario, the dotted area on the upper right under the curve corresponding with unrealized mileage-based revenue is only 9%. If the rate is set higher still, at the 98th percentile, the mileage equivalent is 30,000 miles, and the potential for unrealized revenue drops to 2%.

Figure 4. Revenue impacts of a time permit at 90th percentile mileage

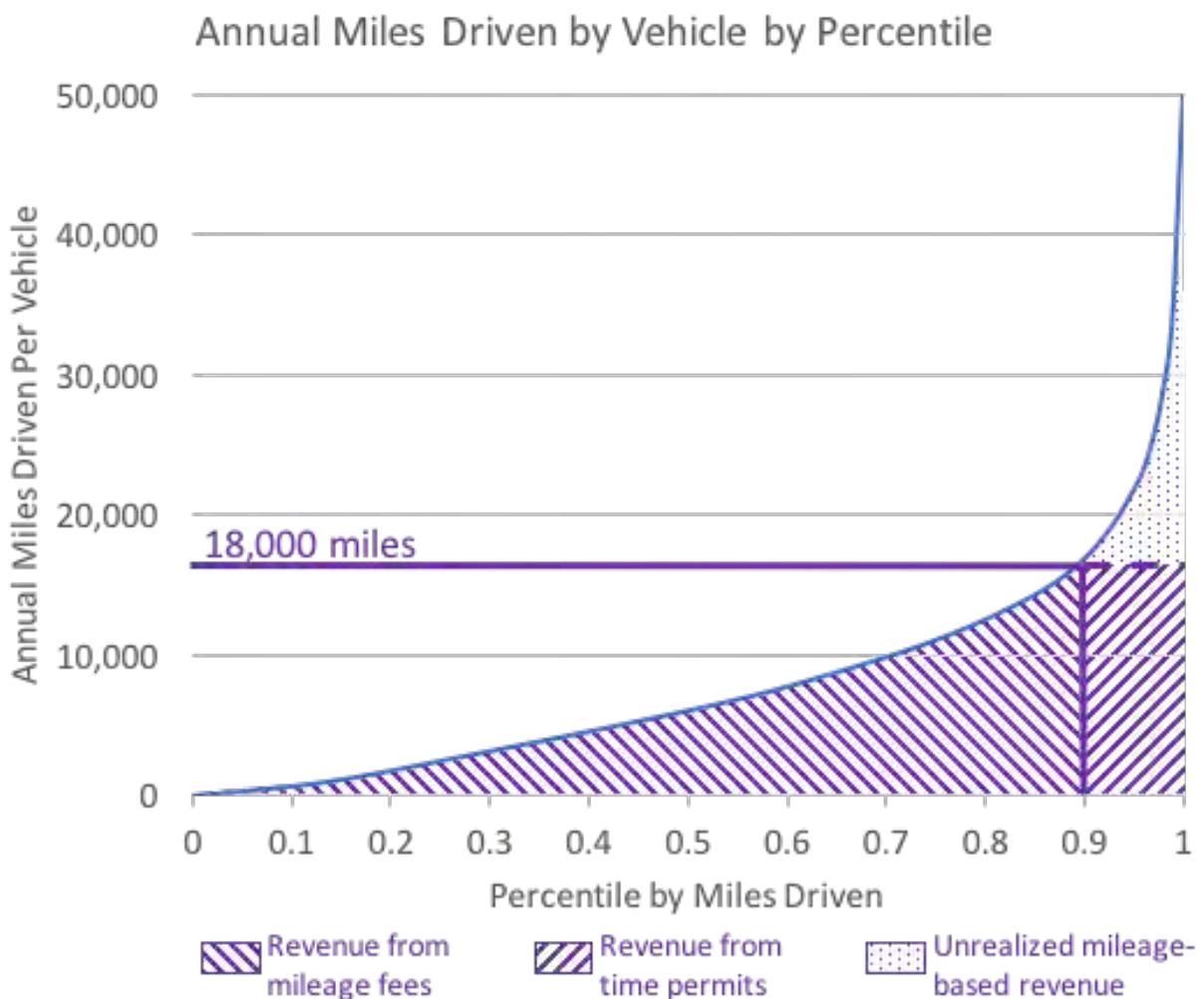


Table 3 summarizes these three possibilities using a per-mile equivalent rate of \$0.024 per mile, as simulated in the WA RUC pilot.

Table 3. Time permit prices and revenue loss impacts at various mileage percentiles

Percentile	Annual Mileage Driven in WA at Percentile	Time Permit Equivalent Price at \$0.024 per mile	Upper Bound of Unrealized Revenue
50th	7,035	\$169	40%
66th	10,000	\$240	16%
90th	18,000	\$432	9%
98th	30,000	\$720	2%

Once a percentile and corresponding annualized permit price are established, shorter denomination prices can be set as well. These rates can either be prorated based on the annual price, or they can be slightly larger than the prorated amount to account for higher transaction costs. For example, if the time permit price is set at the 98th percentile (\$720) for one year, then the prorated rate for a one month permit would be \$60, and the rate for a one week permit would be \$13.84. These could be increased, for example by a flat amount (e.g., \$5) to account for additional transaction costs.

5 EXCEPTIONS

The final step in the rate setting process is to determine exceptions to the rates through exemptions, discounts, or fuel tax refunds/credits. This section discusses each type of exception and its application.

5.1 RUC exemptions

RUC exemptions are an important component of rate setting, because such exemptions determine which revenues are not collected, and thus impact the revenue that a given rate will generate. There are two types of exemptions: vehicle-based and location-based. This section considers each in turn.

5.1.1 Vehicle-based exemptions

Once the legislature determines the class of vehicle upon which to apply RUC, it can consider exempting certain vehicles within that class for various reasons. If the pool of subject vehicles is “all vehicles,” then the possible exemptions are numerous. As the pool of subject vehicles narrows (e.g., “only new electric vehicles”), the possibilities for exemptions likewise narrow.

There are two ways to effectively exempt a vehicle from RUC. The first and preferable way is to define the subject class of vehicles in a clear way to include only those intended to pay RUC. The second way, if the first fails, is to call out specific exemptions in statute.

Any exemptions from RUC should follow a public policy reason for the exemption. One logical class of vehicles to consider exempting from RUC is vehicles not intended primary for use on public roads. For example, purely agricultural vehicles such as combines or farm tractors should be exempt from RUC. Other agricultural exemptions (e.g., driving a truck on a farm) can be covered through location-based exemptions. Other classes of vehicles commonly considered for exemption include emergency vehicles, government-owned vehicles, and public transit vehicles. Under Washington law, all of these vehicles pay at least some fuel tax. The public policy reasons for a RUC exemption are dubious given all these vehicles use roads and contribute to wear and tear. There may be other legal or political considerations for considering such exemptions, such as a prohibition on taxing federal property in the case of US government-owned vehicles. In other

jurisdictions, exemptions for such vehicles do not generally apply, in part due to the complexity of ensuring correct identification of such vehicles for enforcement purposes.

5.1.2 Location-based exemptions

As with vehicle-based exemptions, location-based exemptions can be accomplished either by defining subject locations clearly or, failing that, by carving out explicit exemptions in statute. Likewise, a public policy reason for a location-based exemption is desirable.

Locations of travel that do not involve roads built or maintained with state funds may be exempted from RUC. The primary types of such locations are the following:

1. Out-of-state
2. Private roads
3. Off-road

In order to exempt (never charge for) travel on all of these categories from being charged, location-based technology must be used in vehicle to verify that the vehicle is in fact traveling in these locations. The potential for refunding RUC for drivers using non-location-based options is discussed in the next section.

Other possible candidates for location-based exemptions include travel on US government-owned property (e.g., military bases, Forest Service roads) and tribal lands, although no exemptions or refunds are available for consumption of tax-paid fuel on such roads under present statutes.

5.2 RUC refunds

There are two cases in which it may be desirable for the state to offer refunds for RUC paid: unused time or distance permits (pre-pay charge products) and miles driven in exempt locations using a non-location-based reporting method.

5.2.1 Refunds for unused pre-paid time or distance products

If RUC payers purchase a time or mileage permit that they do not fully use, they may ask to have the unused portion refunded. For example, payers may seek this if the vehicle is sold or destroyed.

- ▶ Sale could result in transfer of the remaining permit time or mileage along with the vehicle.
- ▶ When a vehicle is destroyed, it is reasonable to allow for a refund of remaining miles or time.
- ▶ For a mileage permit, refunding unused miles may be desirable when a vehicle owner moves or sells the vehicle out of state. Providing such a refund should consider the cost of capturing and verifying an odometer reading, relative to the benefit of the policy.
- ▶ In other cases, providing refunds for unused time permit length would encourage RUC payers who are taking brief but long trips to choose the time permit for those days, then switch away when their period of intensive driving is over, potentially paying an effective per-mile rate lower than they would have on a mileage-based product.

5.2.2 Refunds for mileage traveled on exempt locations

RUC payers who do not choose a location-based method may wish to be refunded or credited RUC paid for miles driven on exempt areas, as listed in the preceding section. Refunds could be offered in such cases, but doing so has several drawbacks:

1. Having exact location information is the only way to eliminate the possibility of fraud, so whatever refund method is offered would be susceptible to fraud.
2. In order to reduce susceptibility to fraud, the state would need to require that refund requests include some information (e.g., dates and locations of travel) along with corroborating evidence of exempt travel (e.g., purchase receipts from locations along the route). Thus, it would be a complicated, potentially frustrating process for those requesting a refund.

3. Validating refund claims (verifying internal consistency) may be difficult to automate, requiring substantial staff time (and consequent cost).

Several alternatives exist, by which the state could offer some credit or refund for travel in exempt locations for those that do not choose a location-based method

1. The state could offer a “standard deduction” for all non-location based methods. This assumes, for example, that on average, all RUC payers experience a certain percentage of exempt travel (for example, 10%). As with all refunds and exemptions, this type of deduction would impact the revenue forecasts and potentially increase the RUC rate across the board.
2. The state could offer a supplementary smartphone app usable on long trips, which RUC payers who opt for location-free reporting methods could use to demonstrate their travel is in fact out of state. The WA RUC pilot built and demonstrated this concept (the *MileMapper*).
3. The state could offer a deduction for people who live on private roads, or who have a long driveway that is far from a public road. Such a deduction would require some processing effort (subject to fraud), but less than that required for refunds generally.

5.3 Fuel tax refunds or credits

To avoid double taxation on vehicles subject to RUC, the state can offer fuel tax refunds or credits as long as it collects fuel tax. Lacking any financially-feasible or enforceable gas station technology at present to charge fuel tax to some vehicles and not others, any potential future RUC system will need refund fuel tax paid to RUC payers.

Fuel tax refunds or credits may be processed as follows for the various mileage reporting methods.

1. **Time Permit.** Time permits by design do not involve recording any distance data. Thus, no fuel tax refund should be offered.
2. **Odometer reading and smartphone apps.** These post-pay, mileage-based products require an odometer reading submission, so a fuel tax

refund or credit can be computed by multiplying the distance traveled by the fuel economy of vehicle. While the precise fuel economy that a vehicle achieves depends on driving locations and style, the EPA's combined city-highway fuel economy offers the most accurate, consistent, externally-sourced value.

3. **Mileage permit.** For this pre-pay, mileage-based product, the state cannot afford to give out an unlimited amount of cash up front. Thus, while the price of a mileage permit can be discounted to account for the fuel tax refund (using the same calculation method as used for odometer charge and smartphone apps), it should never be less than zero. Drivers wishing to get a net refund will need to choose another method.
4. **Plug-in Device.** This approach to the post-pay, mileage-based product enables direct measurement of fuel consumption on most vehicles. Fuel consumption is currently not a mandatory field on the OBD port, but it will be added, so that by 2021, all US vehicles will have fuel consumption available on the OBDII port. For the relatively small population of vehicles for which fuel use cannot be computed, fuel tax credits can be based on fuel economy, similar to the other methods. For plug-in devices with location information, fuel tax refunds should only be offered for non-exempt travel, as fuel tax associated with exempt travel may not be exempt under state law.
5. An issue arises when fuel is purchased out of state but used for in-state travel: fuel tax refunds/credits may be offered when no fuel tax was paid to the state in the first place. Indeed, this occurs today near state borders when drivers cross state lines to buy fuel. In cases where a vehicle gets better than average fuel efficiency, and would not be earning a net refund, this may not be a problem, since such vehicles are not paying for their roadway usage today, and would be paying at least something for their usage in the future. But low fuel efficiency vehicles would be getting a bonus in the form of a credit or refund from the state that they are not receiving today. There is no technical solution to this challenge. However, the legislature can choose not to apply RUC to vehicles with low fuel economy,

or it could choose not to offer net refunds for fuel taxes paid (i.e., RUC could be fully covered by a credit, but it would never lead to a refunding of cash).

APPENDIX A: APPROACHES TO RUC RATE SETTING IN OTHER JURISDICTIONS

A.1 Introduction

With relatively few systems in the United States and internationally for light vehicles, there is little experience in RUC rate setting. In the United States, the leading jurisdiction is Oregon (discussed in Section 0), given its experience both in light and heavy vehicle RUC over many years. Other jurisdictions have rate setting methodologies for gas taxes and tolls, but these are not easily translatable to RUC.

The remainder of this section covers international examples. New Zealand is the only jurisdiction with distance-based RUC for light vehicles, and has a long-established approach of cost responsibility that applies to RUC and fuel taxation in parallel. In Europe, there are rate setting approaches for time-based RUC for light vehicles and distance-based RUC for heavy vehicles.

This section concludes with a brief mention of an emerging methodological advance in rate setting for road taxation from Nebraska.

A.2 New Zealand

A.2.1 Background on New Zealand Road User Charging

New Zealand assesses a fuel excise tax only on gasoline, not diesel. Consequently, since 1978, New Zealand's Road User Charge (RUC) system has charged all diesel and heavy (over 3.5 metric tonnes) vehicles a weight and distance fee for travelling on public roads.

Light diesel vehicles (which includes any commercial vehicles with a maximum legal weight of less than 3.5 metric tonnes, as well as private automobiles) must purchase a RUC license with prepaid distance to cover future travel, similar to the mileage permit concept tested in the WA RUC pilot. Vehicle owners must purchase distance in 1000km increments, with no upper limit (e.g. 100,000km can be purchased at once). The first distance license should match the odometer

reading of the vehicle upon registration. The current rate is NZ\$0.062 per kilometer (approximately US\$0.068 per mile, nearly triple the rate used in the WA RUC pilot) for light vehicles (up to 3.86 US tons).⁶ About 41% of revenue raised in New Zealand from road users comes from RUC (for both light and heavy vehicles), and all revenue is directed by law to the National Land Transport Fund (NLTF).

A.2.2 Process for setting RUC rates in New Zealand

The five-step process for setting RUC rates also applies to the setting of fuel excise tax rates in New Zealand.

1. New Zealand Transport Agency (NZTA) prepares a three-year program of projected future NLTF road expenditures, separated by category (e.g., state highway maintenance, local road improvements), with input from local authorities;
2. NZTA forecasts future traffic volumes by vehicle category over the three-year period, measured by distance;
3. The Ministry of Transport (MOT) applies its Cost Allocation Model (explained in Section 0) to calculate how the Government should raise needed revenues from each category of vehicles, based on economic principles (e.g., relative impact on road maintenance, types of vehicles to benefit from different types of spending);
4. MOT uses the results of the Cost Allocation Model to develop proposals for changes to RUC and fuel tax rates to the Minister of Transport to meet projected spending estimates;
5. Cabinet makes the final decision on changes to RUC and fuel excise tax rates.⁷

A.2.3 Revenue forecasting and traffic forecasting

As the public body responsible for allocating funds from the NLTF, the NZTA budgets a three-year program of spending. It funds both national highways (which

⁶ Higher rates apply for heavier vehicles, and also vary based on the wheel/tire configuration.

⁷ Parliamentary assent is subsequently needed as part of the budgetary process, but legislation does not authorize Parliament to amend the detail of the rate changes. It can merely approve or reject them.

it manages itself) and contributes funding to local authorities for their road networks and contracted public transport services.

Spending is separated into activity classes, such as the ones listed in Table 4.

Table 4. Sample New Zealand NLTF expenditure categories

Road maintenance	Funding to maintain and operate the road network to a minimum standard, including renewals, against asset management plan objectives.
Road improvements	Funding for capital improvements to the road network to meet safety, congestion and access objectives.
Promotion of road safety	Funding to promote safe and efficient use of the transport network, through education, advertising and provision of public information.
Road policing	Funding for the Police to patrol and enforce road rules.
Investment management and transport planning	Funding for planning, research and development, to support the development of land transport programs.

NZTA and local authorities prepare three-year land transport program forecasts for their respective activities, based on detailed criteria to justify the scale and types of spending sought. NZTA undertakes an assessment of these forecasts, which typically includes requiring additional information and preliminary decisions to approve or reject some elements of land transport programs. These are compiled into a forecast of total spending for each year, broken down by activity category. Some spending will cover activities already been committed for in previous years, such as completion of major construction projects and continued funding of long-term maintenance contracts. This is prioritized for any future revenue. A three-year program is developed based on delivering best value for money to achieve the strategic outcomes of the government around land transport (these may include

reducing congestion, improving road safety, improving network resilience, and encouraging use of other modes).

NZTA forecasts future traffic volumes based on data it collects from road network traffic counts, from local authorities, and the data behind revenue collected from fuel tax and RUC over recent years. It projects traffic over three years, taking into account expected population growth, economic growth, and trends in vehicle usage and ownership. It uses this data to project expected revenues from RUC based on *existing* charge levels, and identify what can be funded from the three-year program with existing revenue, and what additional revenue would be needed to fully fund the program.

A.2.4 Rate setting based on cost allocation

To set charge rates, MOT inputs forecasted traffic demand and projected expenditures into a Cost Allocation Model. That model calculates what proportion of each expenditure category should be allocated to different types of vehicles based on a number of factors summarized in the table below.

Table 5. New Zealand's cost allocation model treatment of elements

Description	Cost allocation model treatment
Fixed costs not attributable to road use, such as weather-related wear and tear, administrative costs, and policing	Allocated to all vehicle types in equal proportions
Projects to increase network capacity	Allocated to vehicles based on road occupancy (using passenger car equivalent units)
Projects to benefit specific vehicle types	Allocated to the class of vehicle benefitting
Maintenance and replacement of infrastructure based on vehicle mass	Allocated to vehicles according to their relative impact based on equivalent standard axle mass

The model produces proposed rates for RUC that vary according to the various categories of vehicle in the charge tables. The model then proposes a rate for fuel tax by converting the distance-based RUC rate for light vehicles to a fuel-based rate for gasoline powered light vehicles based on their average fuel efficiency (based on data from the Motor Vehicle Register about the age of vehicles in the fleet).

MOT regularly reviews and updates the model, including its calculations and underlying assumptions, to ensure it reflects latest research on the impacts of vehicle types on the network, the relative benefits different types of road projects have on vehicles, and economic research on cost allocation principles.

A.2.5 Forecast revenue based on revised rates

Using the proposed revised RUC rates, MOT undertakes revenue modeling to estimate how much revenue would be generated from them. This takes into account elasticities of demand (i.e., how much less will people drive if the rate increase goes into effect) based on historic data of the impact of rate increases on vehicle distance traveled. MOT uses revenue modeling in concert with cost allocation modeling to develop a rate structure that should generate the intended levels of revenue for the forthcoming three years. MOT uses these outputs to advise Cabinet on what (if any) rate changes are needed to fully fund the forthcoming three-year National Land Transport Programme. If Cabinet does not support the proposed changes, then the proposed three-year program will be amended accordingly, with NZTA prioritizing spending according to its own appraisal framework.

A.2.6 Regular revisions

Every year, the forecast revenues are updated based on actual revenues received, and changes in traffic demand, to reduce the risk of surprise from revenues excessively below or above expectations. Typically, if revenues are below forecasts, NZTA will manage the program of expenditure to meet the reduction, with discretionary projects likely deferred. If revenues are above forecasts, additional projects may be funded prudently. As the next three-year funding cycle approaches, the process is repeated to revise rates taking into account intended spending, inflation, and traffic demand.

A.3 European vignette systems

European vignette systems are included as an example because they are a product analogous to the time permit, although in Europe they only allow for travel on highways, not all roads.

Eight countries in Europe charge light vehicles a time-based pass (known as a "vignette") to use their main roads—limited access highways, and in some cases major arterials.⁸ Such passes are similar to the Washington RUC concept of a time permit—unlimited use for a specific period of time—but differ in the sense that they only are needed for access to motorways and other principal roads, not for minor arterials, residential, or rural roads. Enforcement techniques vary from country to country, but most include visual roadside inspections, or the use of Automatic License Plate Recognition (ALPR) cameras to match passes to number plates of passing vehicles.

Although the original purpose of vignette systems was to raise revenue from foreign road users (because they neither pay registration fees nor necessarily much fuel tax when they visit or transit other countries), they apply both to vehicles registered within each country and any visiting foreign vehicles equally under EU law and treaties. They have become a cost-effective way of raising revenue for widespread use of highway networks, without the need for tolling infrastructure.

All of the countries with vignette systems also have fuel taxes, but this has little relationship to the setting of vignette rates. There appears to be a closer relationship between annual vehicle registration and licensing fees, and the establishment of vignette systems. Typically, as countries have introduced vignettes on foreign vehicles, they have reduced registration and licensing fees on resident vehicles. This has effectively spread the cost of raising revenue for the road network from residents only to include non-residents.

⁸ The countries with light vehicle vignettes are Austria, Bulgaria, Czech Republic, Hungary, Romania, Slovakia, Slovenia and Switzerland. Germany has such a system under development.

With the exception of Switzerland (which applies a single rate for annual access to its motorway network), all countries with light vehicle vignettes offer short, medium and long term passes to pay to use their main highway networks. A single vignette will typically apply to all main roads in the country for the period of the pass. Vignettes have a range of products that correspond as to whether a user is a resident (using the roads regularly) or a visitor for various durations. Table 6 summarizes rates across Europe.

Table 6. European rates for light vehicle vignettes

Country	Duration of vignettes	Prices ⁹ (private cars only) ¹⁰
Austria	10 days/2 months/annual	\$10.52/\$30.66/\$102.04
Bulgaria	weekend/1 week/1 month/3 months/annual	\$5.85/\$8.77/\$17.55/\$31.59/\$56.74
Czechia	10 days/1 month/annual	\$13.87/\$19.68/\$67.10
Hungary	1 week/1 month/annual	\$12.40/\$16.93/\$152.27 ¹¹
Romania	1 week/30 days/90 days/annual	\$3.43/\$8.01/\$14.87/\$32.03
Slovakia	10 days/1 month/annual	\$11.44/\$16.01/\$57.20
Slovenia	1 week/1 month/annual	\$17.16/\$34.32/\$125.83
Switzerland	annual	\$40.62

A.3.1 Approaches to rate setting

There is no uniform approach to rate setting in each country, but countries generally take one of two approaches:

⁹ Converted to US\$ at market rates as of 15 January 2019.

¹⁰ Different rates can apply for motorcycles and light commercial vehicles such as vans.

¹¹ A separate cheaper regional only annual vignette is available for vehicles that travel only on roads within a region of the country.

- ▶ Use of a cost responsibility approach, to forecast revenues needed to sustain the road network, estimating what distance would be traveled by various types of road users, and allocating costs by vehicle type, to determine charge levels based on the period of each product;
- ▶ Forecasting maximum revenue able to be generated for various categories of road users based on forecasted demand and the effect of vignette levels on demand.

Most countries forecast revenues needed to support the maintenance and renewal of the roads being charged. A cost responsibility study is undertaken to develop a forward-looking cost base for the roads to be charged. The model establishes what proportion of costs for the roads should be charged to light vehicles compared to heavy users, and is then used to inform how the charges to light vehicles should be allocated between various types of users including high frequency users and occasional users such as visitors.

Annual rates are developed based on the average distance traveled on the network by vehicles registered in the country, divided by day. The rates for shorter intervals are based on surveys and other sources of estimates of distance travelled by visiting vehicles (including data from providers such as Google). For example, a vehicle purchasing a one-week vignette would typically travel more distance during that one week than a similar vehicle with a one year vignette, as it could either be visiting and making multiple journeys, or be transiting the country (traveling across the network). By contrast, many vehicles with an annual vignette may not travel any distance for several days and may only make long trips occasionally.

Instead of a cost responsibility approach, some countries treat the setting of vignette rates as an exercise in revenue maximization, and use data on vehicle usage by both resident and foreign vehicles to estimate what rates would generate the greatest revenue, taking into account demand elasticities for various user groups. Annual vignettes have a distinct impact, as they are effectively permits for residents to use the highway network and so are part of the costs of owning a vehicle. On the other hand, foreign visitors almost exclusively buy short-term vignettes, so they can sustain higher rates unlikely to deter visitors from making a single trip, nor invite opposition from residents.

Geographical location has been a key factor in vignette rate setting. For example, Slovenia has charged the highest short-term vignette of any country because it has the only direct routes from Central and Western Europe to the coastal resort locations in Croatia, the western Balkans, and for visitors to Greece. It charges a one-month vignette at double the rate of the one week vignette, to encourage visitors to remain in the country over a vacation period, as it is highly likely that those transiting the country over one week will need to transit back. By contrast, Switzerland actively discourages visiting car traffic, due to congestion and environmental concerns, as it is already a country with high levels of transit traffic between Germany, Italy, France and Austria.

The European Commission has expressed concern that some charge rates for short trips are disproportionately high, as under European Union law it is prohibited for EU Member States to discriminate against visitors (including their vehicles) registered in other EU Member States.¹²

A.4 European heavy vehicle RUC rate setting

Ten countries in Europe apply RUC to heavy vehicles, charging them by distance, location and size¹³. Under EU law and treaty, the rates for such systems must apply principles of cost responsibility, so that RUC for heavy vehicles is not used as a means to tax heavy vehicles excessively for their use of the roads, hindering free trade and the movement of goods within the European Single Market. To meet this requirement, countries apply cost accountancy-based methodologies to establish the basis for setting charge rates. The key steps in the process include:

- ▶ Valuate the road network and identify operating costs;
- ▶ Forecast vehicle traffic split into categories used to set charge categories for rate setting;
- ▶ Apply cost responsibility principles to determine how costs under each cost category should be allocated between various types of vehicles;

¹² See detailed report on private vehicle vignette systems at <https://ec.europa.eu/transport/sites/transport/files/modes/road/studies/doc/2012-02-03-impacts-application-vignette-private-vehicles.pdf>

¹³ Either by maximum allowable weight or numbers of axles.

- ▶ Develop charge rates based on recovering the full life-cycle costs of the network based on forecast vehicle traffic (taking into account any elasticity of demand influenced by applying charge rates);
- ▶ Apply any additional factors to charges, such as rates varying based on environmental impact.

A.4.1 Valuation of road network

In Europe, the two main techniques of estimating infrastructure costs are the Perpetual Inventory Method (PIM) and the Synthetic Method (SM). The PIM assesses the total value of the road network based on past capital spending on the network. Historic spending on the road network is capitalized and depreciated to establish the value of capital spending today. For example, a bridge may have a depreciated life of 40 years, so if it were paid for 20 years ago, it would be valued at half the initial price due to depreciation. For any assets that are fully depreciated (e.g., spending on earthworks for a highway of a century ago), costs are not included as they are sunk. The depreciated value also needs to include a calculation of the opportunity cost of that capital, being the interest rates that would apply to that capital in each year.

The SM estimates the cost of replacing the existing network today with the same assets of a similar quality (including the current level of wear and tear on those assets).

In both cases, the capital costs of the network are amortized on an annual basis, to establish how much expenditure is needed to recover the costs of the network in a sustainable, forward-looking way. A number of approaches are available to calculate the amortization of such costs. Some assets may be amortized according to actual consumption (e.g., pavement), while others may be linear (based on an operating life). The table below outlines examples of various approaches to amortize such costs.

Table 7. Examples of amortization approaches for highway assets

Type of asset	Type of depreciation	Reason
Pavement	Usage, exposure based with reference to heavy traffic volumes, climatic conditions and design	Pavement deterioration is directly a function of design, usage and exposure to the elements, so will vary considerably
Base layers	Progressive or usage based.	Base layer deterioration likely to accelerate as traffic increases.
Bridges	Linear by value or progressive	Deterioration tends to be a function of design and age, although higher volumes of heavy traffic can impact on life expectancy
Tunnels	Linear by value	Little deterioration over time
ITS systems	Linear by proportion	Higher loss of value in earlier years as technology-based assets lose value greatest in initial period
Earthworks	Linear by value	Little deterioration over time
Land	Special treatment	Land tends to appreciate in value, although land under a road tends to have no realistic alternative usage if it provides access to adjacent land

A.4.2 Operating costs

Once capital costs are calculated, operating costs for the year or years in question are estimated. These are based on budgeted estimates for the costs of managing the network and minor repairs as they become necessary. Operating costs might include:

- ▶ Administration;
- ▶ Energy, water, telecommunications and other utility services;
- ▶ Consumables (e.g. stationery, grit/salt);
- ▶ Staff training and activities not construction project specific;
- ▶ Costs of collecting, communicating and enforcing RUC;
- ▶ Cleaning, painting, clearance of flora, rubbish collection along corridors;
- ▶ Replacement of assets of relatively low value (e.g. lightbulbs, fixed signs);
- ▶ Minor repairs (e.g. shoulder and median barrier repairs, road furniture repairs, drainage system clearance);
- ▶ Structural repairs (e.g. reinforcement of bridge superstructure, repairs to tunnel lining); and
- ▶ Road surface patching (e.g. potholing, localized resurfacing).

A.4.3 Forecast traffic volumes

Traffic volumes are forecast for coming years based on existing volumes, and inputs regarding population growth, economic growth, and other trends in economic development and transport use. These are applied to each category of vehicles to enable allocation of forecasted capital and operating costs to vehicle categories on a per vehicle-kilometer basis.

A.4.4 Cost responsibility

Both capital costs and operating costs are subject to cost responsibility principles to determine how costs can be allocated according to the following factors:

- ▶ Non-vehicle specific costs (costs that are overheads not attributable to any specific vehicle type or road use);
- ▶ Vehicle type specific costs (costs that can be attributed to specific types of vehicles, such as heavy or light vehicles, because they are the primary beneficiaries of specific assets, such as truck parking bays);
- ▶ Vehicle size specific costs (costs that can be attributed based on vehicle road space occupancy, such as projects to increase road capacity); and
- ▶ Mass related costs (costs that can be attributed to the weight of a vehicle, such as the design standards for a bridge or wear and tear on a road surface).

Non-vehicle specific costs are divided among all types of vehicles by an equal amount on a per-vehicle-kilometer basis. Vehicle-type-specific costs are only divided among the vehicles that they can be attributed to, on a per-vehicle-kilometer basis. Vehicle-size-specific costs are divided according to road space occupancy. Typically, a private car has a value of 1, motorcycles have a value of $\frac{1}{2}$, and trucks and buses have values of 2-3 depending on size. Mass-related costs are divided according to the average mass of vehicles of different categories on an equivalent standard axle mass basis, and are only applied to heavy vehicles.

A.4.5 Develop charge rates

Once the costs are allocated to all vehicle categories, charge rates can be readily calculated on an annual basis, taking into account demand elasticities of the impacts of rates on traffic demand. These charge rates are typically set for a multi-year period, so that there is some rate certainty for at least three years, but with regular revisions based on actual traffic levels to ensure that revenue targets are being reached and not exceeded.

In recent years, EU law has been amended to allow countries to apply environmental factors to RUC rates, but only on objectively defined criteria (e.g., emissions from specific ratings of EURO engines). These factors may be added to charge rates designed to recover infrastructure costs, and might also include higher charges for peak time road use to reduce congestion (e.g., Czechia applies higher charges for Friday afternoon use of the motorway network, due to high demand).

Each country has its own national process for approving rate changes, which may be done by Parliament, by Ministers, or by the relevant national highway company¹⁴ for later political ratification.

¹⁴ All of Austria's motorways are owned and operated by a Federal company called ASFINAG, which is required to raise all of its revenue from road users through types of RUC, and to borrow its own capital to pay for capital projects. It recommends RUC rates which are ratified by the Federal Government, but are all collected by ASFINAG itself.

A.5 Nebraska Fuel Tax: a small step towards a forward-looking cost basis

Outside of Oregon, no state conducts a regular cost allocation or cost responsibility study.

However, Nebraska has taken a small step toward a forward-looking (needs-based) cost basis in its transportation funding approach. Nebraska's fuel tax has three components, described by Open Sky Policy¹⁵ as follows:

- ▶ A **fixed tax** set by the Legislature, currently 16.3 cents/gallon
- ▶ A **wholesale tax** based upon five percent of the average wholesale cost of fuel in the previous six-month period, currently 10.7 cents/gallon
- ▶ A **variable tax**, which is set by the Department of Transportation Director at an amount to meet the appropriations made from the Highway Cash Fund by the Legislature, currently 2.6 cents per gallon

To the extent that the legislature's choices are forward looking / needs-based, the third component of the tax is forward-looking and needs-based. However, it currently represents about 9% of the total fuel tax, limiting the scope of the needs-based approach.

¹⁵ <https://www.openskypolicy.org/policy-brief-lb-941-and-nebraskas-gasoline-tax>