

Surface Transportation System Funding Alternatives Phase II Evaluation: Washington State Transportation Commission Road Usage Charge Pilot

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APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
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in	inches	25.4	millimeters	mm
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yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in ²	square inches	645.2	square millimeters	mm ²
ft ²	square feet	0.093	square meters	m ²
yd ²	square yard	0.836	square meters	m ²
ac	acres	0.405	hectares	ha
mi ²	square miles	2.59	square kilometers	km ²
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft ³	cubic feet	0.028	cubic meters	m ³
yd ³	cubic yards	0.765	cubic meters	m ³
NOTE: volumes greater than 1,000 L shall be shown in m ³				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2,000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
ILLUMINATION				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m ²	cd/m ²
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
lbf/in ²	poundforce per square inch	6.89	kilopascals	kPa
APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm ²	square millimeters	0.0016	square inches	in ²
m ²	square meters	10.764	square feet	ft ²
m ²	square meters	1.195	square yards	yd ²
ha	hectares	2.47	acres	ac
km ²	square kilometers	0.386	square miles	mi ²
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m ³	cubic meters	35.314	cubic feet	ft ³
m ³	cubic meters	1.307	cubic yards	yd ³
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2,000 lb)	T
TEMPERATURE (exact degrees)				
°C	Celsius	1.8C+32	Fahrenheit	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m ²	candela/m ²	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	2.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in ²

*SI is the symbol for International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

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LIST OF ABBREVIATIONS

app	application
DOL	Washington State Department of Licensing
FAST	Fixing America's Surface Transportation
FHWA	Federal Highway Administration
FY	fiscal year
GPS	Global Positioning System
ID	identifier
MRM	mileage reporting method
NIST	National Institute of Standards and Technology
OBD-II	onboard diagnostics
ODOT	Oregon Department of Transportation
PII	personally identifiable information
RUC	road usage charge
STSFA	Surface Transportation System Funding Alternatives
USDOT	U.S. Department of Transportation
VLO	vehicle license office
WA RUC	Washington State road usage charge
WSDOT	Washington State Department of Transportation
WSTC	Washington State Transportation Commission

EXECUTIVE SUMMARY

This report presents the independent evaluation results of Washington State Transportation Commission's (WSTC) road usage charge (RUC) pilot. The pilot received fiscal year (FY) 2016 and 2017 funding under the U.S. Department of Transportation's (USDOT) Surface Transportation System Funding Alternatives (STSFA) program. The FY 2016 and FY 2017 funding and associated programs constituted phase I and phase II of the STSFA program, respectively. This report provides findings from phase II of WSTC's pilot, toward which the Washington State Department of Transportation (WSDOT) received \$4.6 million in Federal funds.¹ WSTC was one of 11 entities to engage in programs to demonstrate or implement user-based alternative transportation revenue mechanisms at the time of the award of the phase II grant.

BACKGROUND

As vehicles become more fuel efficient, the reliability and adequacy of the motor fuel tax as a primary source for transportation infrastructure funding continues to decline. Recognizing this trend, the Fixing America's Surface Transportation (FAST) Act² established the STSFA program to provide grants to States or groups of States to demonstrate user-based alternative revenue mechanisms that employ a user-fee structure to maintain the long-term solvency of the Highway Trust Fund. The objectives of the STSFA program are to:

- Test the design, acceptance, and implementation of two or more future user-based alternative mechanisms.
- Improve the functionality of the user-based alternative revenue mechanisms.
- Conduct outreach to increase public awareness regarding the need for alternative funding sources for surface transportation programs and to provide information on possible approaches.
- Provide recommendations regarding adoption and implementation of user-based alternative revenue mechanisms.
- Minimize the administrative cost of any potential user-based alternative revenue mechanisms.

Staff from the Federal Highway Administration (FHWA) Headquarters in the Office of Operations have the overall responsibility for administering the STSFA program. The FHWA Division staff provide direct support by overseeing the program in participating States.

The U.S. Congress and FHWA seek to understand whether a revenue mechanism that uses a user-fee structure could help maintain the long-term solvency of the Highway Trust Fund and be

¹Although WSDOT was the grant applicant and receiver of funds as per the requirements of the STSFA Program, the pilot initiative was executed and managed by WSTC.

²Public Law 114-94, H.R. 22, § 6020, H.R. 22, 114th Congress. (2015)

implemented nationally in the future. As part of this endeavor, the FHWA supported the independent evaluation of several grantee sites at key program milestones. The reports resulting from this process will allow the Secretary of Transportation and U.S. Congress to become aware of the progress that has been made, lessons learned from pilot and planning efforts, the role of education and outreach, the potential for any negative effects on constituents, and initial findings on administrative fees, among others.

WASHINGTON STATE ROAD USAGE CHARGE PILOT

As part of the 2017 STSFA grant cycle, WSTC tested key elements of an interoperable, multijurisdictional 12-month pilot. The Washington State road usage charge (WA RUC) pilot was launched in January 2018. It involved more than 2,000 drivers from around Washington State and a small pool of drivers from neighboring States. The pilot simulated a real-world RUC program by:

- Providing participants with several high- and low-tech options to collect and report their mileage data
- Providing participants with access to a help desk to respond to their queries
- Issuing mock invoices that included information about miles driven (by jurisdiction if a location-based device was used), gallons of fuel consumed, RUC and gas taxes paid, and RUC and gas taxes credited back to correct for double taxation
- Giving participants the opportunity to provide feedback at three points during the pilot: after enrollment, at the midpoint, and at the conclusion; this feedback, obtained through surveys and focus groups, formed the basis of analysis of public acceptance factors and a limited examination of equity concerns associated with the proposed concept

MAJOR FINDINGS

The evaluation assessed the effects of the STSFA-funded activities in a systematic manner across all pilot sites. The following are key findings of the WA RUC pilot based on the STSFA evaluation criteria:

- **Technical accuracy, precision, and repeatability of mileage reporting methods (MRM).** The Pilot provided a broad range of technology options to report mileage allows drivers to decide which tradeoffs to make according to their needs, preferences, abilities, and sensitivities. The following are key findings of the WA RUC pilot MRMs:
 - Manual MRMs had the highest implementation maturity but ranked low on usability and accuracy because they did not differentiate the taxable from the nontaxable miles.
 - The smartphone application (app) tested in the pilot could not reliably determine the specific vehicle being driven and driver/passenger roles because there was no straightforward solution to establish a connection between the smartphone and the vehicle without installing supplemental electronic tags or equipment.

- Manual MRMs required the most level of effort in activation and mileage reporting; the WA RUC pilot partnered with private businesses (i.e., vehicle license offices (VLO)) to support drivers who chose low- or no-technology MRMs and needed in-person assistance with mileage reporting.
- **Public outreach and communication.** Outreach conducted by WSTC and pilot recruitment efforts served to increase the level of knowledge and understanding of a potential RUC among the residents of Washington State through broad outreach and media engagement for recruitment.
- **Public perception and acceptance of RUC.** The pilot served to enhance the level of acceptance of RUC among the participant pool, as evidenced through surveys and focus groups. The pilot also served to provide feedback to Washington State about the RUC principles of key importance to residents. This information may help enhance an eventual program. The pilot and resulting program may benefit from surveying a greater diversity of constituents and using oversampling techniques to identify populations of interest stratified by income, education level, race, gender, and other demographic criteria.
- **Interoperability and reconciliation.** The WA RUC pilot successfully conducted a proof-of-concept demonstration of interoperability and funds reconciliation, in coordination with Oregon's OReGO pay-per-mile program, and in collaboration with neighboring jurisdictions. The proof-of-concept using WA RUC HUB was successful in demonstrating reconciliation of out-of-State miles and funds. However, for full-scale system interoperability, a range of issues would need to be resolved, including legal authority for collection and remittance of other States' RUC and ownership and governance of the clearinghouse. Washington State's *Road Usage Charge Assessment* final report (2020) concluded that with the HUB database, no additional effort was required by participants compared with a single jurisdiction RUC, aside from educating participants on the billing statement.
- **Privacy and data security.** The pilot concluded that although Washington State privacy laws provide some protection, an RUC system should be more strongly backed by law through legislating the model RUC privacy policy and mandating its specific privacy protections.
- **Ease of user compliance and transparency.** The pilot allowed Washington State drivers to directly experience a pay-per-mile system and share their opinions on what matters most—and what must change in any future system. In the WA RUC pilot, the ability for drivers to see their RUC charges in real time would depend on the specific MRM drivers used. While none of the automated MRMs had this feature, the flat fee used in the program and regular invoicing should give participants a clear understanding of the per-mile charges associated with driving. The pilot project help desk was an important connection for participants and nonparticipants to connect with the project and ask any questions, from customer service account questions to policy-level questions about RUC in Washington State. Participatory design also allowed improvements to invoices before they were sent to participants. The participants were invited to comment on invoice

prototypes during focus groups and surveys, which improved invoice content and displays and resulted in fewer help desk invoice inquiries.

- **Congestion mitigation.** Incorporating congestion pricing into RUC would potentially require the WA RUC system to delineate when a vehicle is traveling in a congestion-priced zone, in turn requiring MRMs with Global Positioning Systems (GPS) for all vehicle owners. The WA RUC Steering Committee found that limiting users to GPS-enabled MRMs would violate the principle of consumer choice in mileage reporting.

CHAPTER 1. INTRODUCTION

As vehicles are becoming more fuel efficient, the reliability and adequacy of the gasoline tax as a primary source for transportation infrastructure funding have come into question. The Fixing America’s Surface Transportation (FAST) Act³ of 2015 established the Surface Transportation System Funding Alternatives (STSFA) program. The purpose of this program is to provide grants to States to demonstrate user-based alternative transportation revenue mechanisms that employ a user-fee structure to maintain the long-term solvency of the Highway Trust Fund.

By funding road usage charge (RUC) pilots, the U.S. Congress and the Federal Highway Administration (FHWA) seek to understand whether a user-fee structure, such as RUC, could be implemented nationally in the future. As part of the endeavor, FHWA supported the independent evaluation of several grantee sites at key program milestones.

The evaluation reports will inform the Secretary of Transportation and the U.S. Congress of the progress made, lessons learned from pilot and planning efforts, role of education and outreach, potential for negative effects on constituents, and initial findings on administrative fees, among others.

In fiscal year (FY) 2016, the U.S. Department of Transportation (USDOT) awarded eight STSFA grants to seven States (California, Delaware, Hawaii, Minnesota, Missouri, Oregon—for both Oregon and RUC West’s program—and Washington), totaling \$14.2 million. This constituted phase I of the STSFA program. In subsequent phases—FY 2017, 2018, and 2019—\$15.5 million, \$10.3 million, and \$15.1 million, respectively, were awarded under the program. In addition to the sites that received funding in phase I, Colorado, New Hampshire, Utah, and Wyoming received funding in later phases. Figure 1 shows the grantee States that received funding under the STSFA program, from inception through FY 2019 for State or interstate or regional pilot efforts.

Staff from FHWA Headquarters in the Office of Operations has the overall responsibility for administering the program. FHWA division staff provide direct support by overseeing the program in participating States. The evaluation of the pilots was applied across all sites to assess the effects of the STSFA-funded activities conducted by each grantee in a systemic manner across all sites. The objective of the evaluation was to document applicability of, motivation for, and impediments to implementing user-based fee mechanisms as alternatives to the gas tax on a nationwide level in the future. This report documents the findings of the independent evaluation

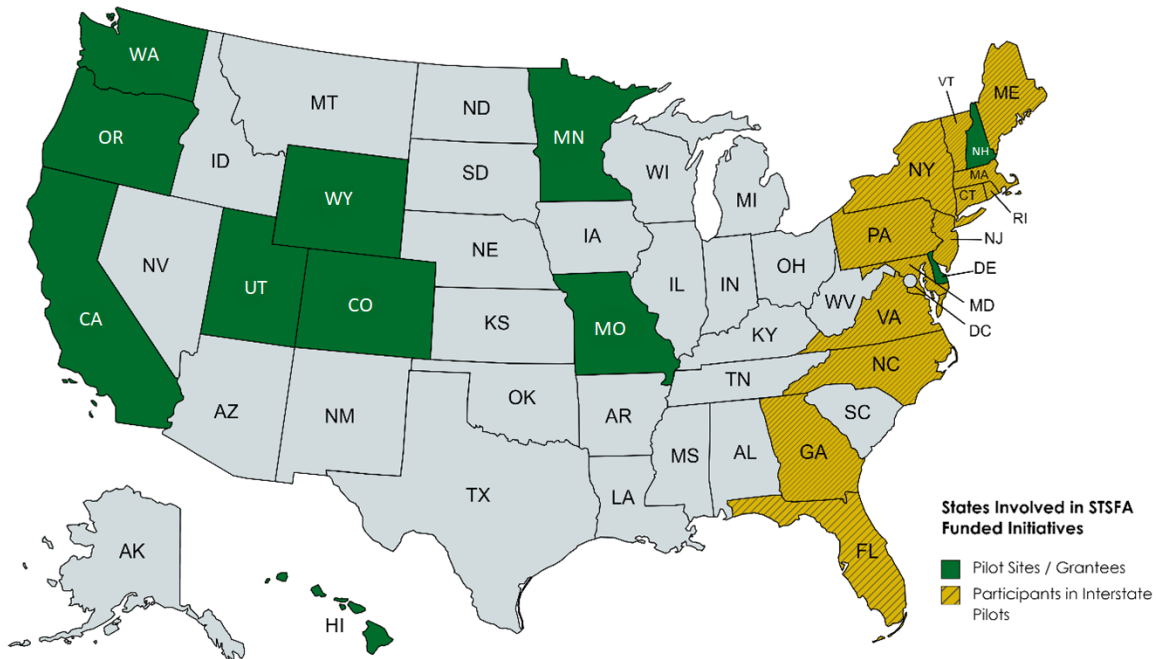
“Motor fuel tax receipts are projected to decline as vehicles become more fuel-efficient and the surge of new electric vehicles continues to spark interest among buyers. Given these two major pressures on the motor fuel tax, states have begun to actively study, explore and pilot road user charge (RUC) systems as the most likely long-term replacement for declining MFT revenue.”

Source: National Conference of State Legislatures, “Road Use Charges (RUC)” web page, accessed June 12, 2023, [State Road Usage Charge Series \(ncsl.org\)](https://www.ncsl.org/transportation/road-use-charges)

³Pub. Law 114–94, H.R. 22, § 6020, H.R. 22, 114th Congress. (2015)

of pilot activities executed and implemented by the Washington State Transportation Commission (WSTC) supported by 2017 STSFA grant funds.

The evaluation team adopted the terminology the specific grantee sites used in planning and executing their proposed programs. As such, same or similar concepts in different geographies may variably be referred to as mileage-based user fee, distance-based user fee, or RUC. Given the lack of a standard definition, these terms will be defined within the context of each grantee's vision and program activities.



Source: FHWA.

Figure 1. Illustration. States involved in initiatives funded by the Surface Transportation System Funding Alternatives (STSFA) program through fiscal year 2019.

ORGANIZATION OF THIS REPORT

Chapter 1 introduces the user-fee concept and the background and purpose of the pilot.

Chapter 2 details the activities planned and accomplished by WSTC under phase II of the STSFA grant program or the FY 2017 grant cycle.

Chapter 3 presents the evaluation framework developed for this effort, including key USDOT questions the evaluation seeks to address and the evaluation team's approach.

Chapter 4 provides the major findings from evaluation of phase II activities, including lessons learned, findings, and outcomes as observed by the evaluation team and suggestions for further exploration through the course of future efforts toward an alternative revenue program.

Chapter 5 summarizes the key takeaways from phase II activities and lessons learned that would be relevant for a national implementation of a mileage-based fee program.

CHAPTER 2. WASHINGTON STATE'S ROAD USAGE CHARGE PILOT

This chapter presents the STSFA phase II pilot activities undertaken by WSTC. As part of the 2017 STSFA grant cycle, WSTC received \$4.6 million in Federal funds to test elements of interoperable, multijurisdictional alternative user-based revenue collection systems. WSTC applied the funds, and the required 50-percent non-Federal funding match, to a 12-month deployment of the Washington State road usage charge (WA RUC) pilot.

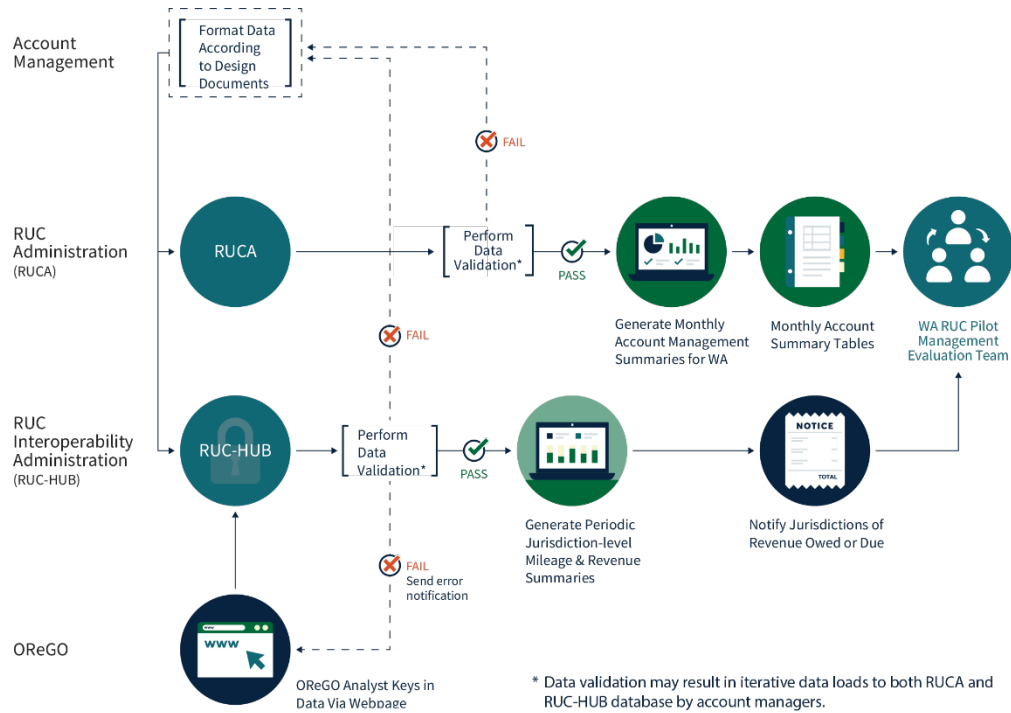
The WA RUC pilot launched in January 2018 and involved more than 2,000 drivers from around Washington State and a small pool of drivers from neighboring States.

The pilot simulated a real-world RUC program by:

- Providing participants with several high- and low-tech options to collect and report their mileage data
- Providing participants with access to a help desk to respond to their queries
- Issuing mock invoices that included information about miles driven (by jurisdiction if a location-based device was used), gallons of fuel consumed, RUC and gas taxes paid, and RUC and gas taxes credited back to correct for double taxation
- Giving participants the opportunity to provide feedback at three points during the pilot: after enrollment, at the midpoint, and at the conclusion; this feedback, obtained through surveys and focus groups, formed the basis of analysis of public acceptance factors and a limited examination of equity concerns associated with the proposed concept

The WA RUC system offered five MRMs, including three automated or high-technology MRMs and two manual MRMs. WSTC procured two private vendors to provide the mileage reporting technologies, mileage accounting, invoicing, and payment processing for the pilot. Participants could choose between two service providers and opt for automated methods with or without GPS at the beginning and during the pilot program. By providing choices, the WA RUC prototype system was able to meet participants' varying needs, constraints, preferences, and abilities.

WSTC procured the services of a specialized firm to develop customized software and systems to operate the WA RUC hub (HUB). The HUB was developed to test the Nation's first accounting and reconciliation of real funds through a central clearinghouse for distances driven and RUC charges paid across multiple jurisdictions. WSTC tested the HUB in coordination with the Oregon Department of Transportation (ODOT) by demonstrating payment reconciliation between Oregon's OReGO pay-per-mile program and the WA RUC pilot. Figure 2 illustrates the interoperability HUB tested in the WA RUC Pilot.



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RUC = road usage charge.

Figure 2. Diagram. Interoperability hub tested in the Washington State road usage charge pilot.

Table 1 shows the system components and roles of the WA RUC pilot.

Table 1. Components and roles of the Washington State road usage charge pilot.

System Component	Role
Account Management	<ul style="list-style-type: none"> Maintained database containing participants' monthly pilot travel reports with miles driven by State, chargeable and nonchargeable miles, and whether there were any errors/events Provided account setup, sent out invoices, and managed individual accounts Simulated State/provincial road usage charge (RUC) oversight agencies Provided participant data available to the State for which participant is registered Verified participant compliance Secured personally identifiable information (PII) storage and transmission
RUC Administration	<ul style="list-style-type: none"> Maintained database for participant data (name, address, phone) and vehicle data (vehicle identification number, license plate number) available to service providers and pilot help desk Provided the ability for pilot-wide single sign-on Ensured secure PII storage and transmission

System Component	Role
RUC Interoperability Administration (HUB)	<ul style="list-style-type: none"> • Maintained database that received and stored monthly aggregate travel reports from each participating jurisdiction (no PII) • Maintained database that produced monthly and quarterly reports summarizing travel data across jurisdictions in a matrix format • Exchanged real funds collected from Washington State and Oregon participants through a simulated HUB account based on the periodic HUB reports • Required each participating jurisdiction to report data monthly
Pilot Help Desk	<ul style="list-style-type: none"> • Assisted pilot participants with enrollment in the pilot, ongoing customer service during the pilot, and closeout support • Answered customer questions, solved customer-related issues, and passed feedback about the pilot to the project team • Supported participants by phone and email throughout the pilot

Mileage Reporting Methods

The WA RUC pilot provided participants the choice of manual and automatic MRMs.

Manual MRMs involved periodic odometer readings captured via an approved process, either directly by the participant or at a VLO. Two manual methods were specified in the pilot: mileage permit and odometer reading. Both methods used the same odometer-image capture MRMs as there was no location technology used to differentiate taxable from nontaxable miles with these options. The following manual MRMs were available to WA RUC participants:

- **Mileage permit.** The mileage permit MRM is based on a prepay system in which drivers pay in advance for a specific number or block of miles. In the case of the WA RUC pilot, the permit could be purchased for a block of 1,000 miles, 5,000 miles, or 10,000 miles.
- **Odometer reading.** The odometer reading MRM is based on a post pay system in which participants report official odometer readings every quarter and receive a quarterly invoice based on the mileage reported. Participants receive notifications to submit their initial and quarterly odometer readings.

Automated methods relied on technology to automatically measure and report actual miles traveled by a vehicle. Two types of automated methods were offered in the pilot: plug-in devices and a smartphone app. Both methods are based on a post pay system, in which miles driven are charged at the end of a mileage reporting period. The following automatic MRMs were available to WA RUC participants:

- **Plug-in device (with GPS and without GPS).** This device is plugged directly into a vehicle’s onboard diagnostic port to retrieve mileage. Participants choose between two variations of plug-in devices. Plug-in devices with GPS are capable of determining location and categorizing miles driven in identified locations as taxable (public roads) or nontaxable (private roads, off-road, out of State). Plug-in devices without GPS enable participants to use a fully automated MRM without sharing their location data.

- **Smartphone app (MileMapper).** The MileMapper app measures the vehicle's location through the smartphone's GPS-enabled location services and the vehicle's movement over a period of time supplemented through the smartphone's accelerometer. The app features a toggle switch that allows the participants to turn the GPS function on or off. Participants choose to use GPS either at all times or only when driving out of State or off public roads. The app also captures images of the vehicle's odometer and sends the reading to the account manager at periodic intervals. The GPS feature records out-of-State mileage so that it can be subtracted from the odometer reading to calculate taxable mileage.

Table 2 provides a summary of the features of the MRMs tested in the WA RUC pilot.

Table 2. Mileage reporting methods tested in the Washington State road usage charge pilot.

Reporting Option	User Actions/ Responsibilities	Other Features				
		Compatible With Manual Option?	Smartphone Required?	Works With All Vehicles?	In-Person Support Available?	Global Positioning System (GPS) Technology Used?
Mileage permit	Pay for block of miles—1,000 miles, 5,000 miles, or 10,000 miles. Submit a mileage report using a mobile phone, or in-person at select vehicle licensing office.	Yes	No	Yes	Yes. Vehicle licensing offices	No
Odometer reading	Submit photograph of odometer quarterly using mobile phone, or in-person at select vehicle licensing office.	Yes	No	Yes	Yes. Vehicle licensing offices	No
Plug-in device with GPS	Report mileage automatically (monthly).	No	Depends on provider	No. Vehicles after 1996 and a limited number of electric vehicles	No	Yes
Plug-in device without GPS	Report mileage automatically (monthly).	No	No	No. Vehicles after 1996	No	No
Smartphone application (app) (MileMapper)	Report miles quarterly using smartphone app.	No	Yes	Apple® iPhone® (iOS and higher)	No	Yes. Can be turned on/off

Source: Washington State Transportation Commission.

Multijurisdictional Collaboration

The WA RUC pilot collaborated with OReGO, Idaho Transportation Department, and the City of Surrey in British Columbia, Canada. The goal of collaboration was to recruit and enroll participants to test simulated charging and payments and the reconciliation of the RUC collected across jurisdictions through HUB.

The pilot featured about 20 drivers from British Columbia and seven drivers from Idaho. All mileage driven was reported successfully to RUC through DriveSync®, which allowed for theoretical calculation of the RUC due among these jurisdictions. For the Oregon-Washington collaboration, the interoperability test featured about 90 participants enrolled with Azuga in the OReGO program and 25 participants enrolled with DriveSync in the WA RUC program.

Road Usage Charge HUB Database

The HUB database created for this program was designed to allow cross-jurisdiction charges and payment reconciliation for out-of-State mileage driven. The HUB received data in various formats and stored monthly aggregate travel reports from each participating jurisdiction. For Oregon and Washington, the HUB required no changes in reporting format because both States had used existing open data standards that defined jurisdictions similarly. No personally identifiable information (PII) was collected in the reporting. The HUB was flexible to accept data, reports, and funds either directly from commercial account managers in an open system or from States. It was also designed with the capability to perform selected data management functions, and it had the potential to reduce administrative costs of participating States' RUC systems.

Vehicle License Offices

The WA RUC pilot partnered with VLOs to support drivers who chose low- or no-technology MRMs and needed in-person assistance with mileage reporting. VLOs provide a wide range of licensing services on behalf of the Washington State Department of Licensing (DOL), such as transferring ownership of vehicles, reporting and paying taxes owed on vehicle sales, licensing new vehicles, and renewing vehicle registrations. By recruiting VLOs, the WA RUC pilot was able to provide a statewide network of in-person assistance services and enabled the ease of use for low-technology options.

Eight VLOs strategically located around Washington State were selected, and they agreed to help pilot test drivers submit their quarterly mileage reports (figure 3). Prior to launch of the pilot, all VLOs received onsite training, a user manual, a transaction logbook, as well as a specially configured Apple® iPhone® to take the odometer photos and upload them to the RUC service provider for mileage processing. The WA RUC pilot compensated VLOs for approximately 2 hours of training time and a fixed fee of \$5 per mileage reporting service.



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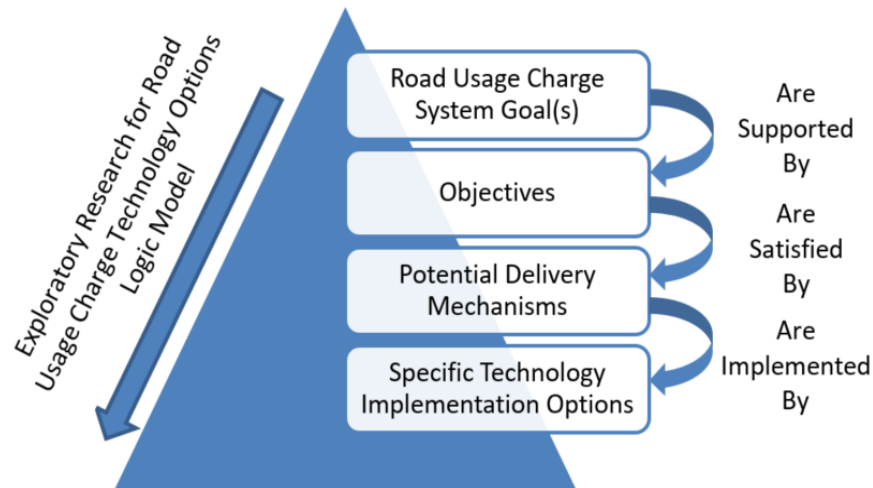
Figure 3. Illustration. Locations of participating vehicle licensing offices.

CHAPTER 3. INDEPENDENT EVALUATION METHODOLOGY

This chapter summarizes the independent evaluation approach and methodology. The study team completed this work in coordination with staff from the FHWA Office of Operations and Division office staff and representatives of the respective grantee sites. This chapter defines the evaluation framework and includes responses to key questions that USDOT expressed about RUC approaches and their viability and characteristics if implemented on a national scale.

EVALUATION APPROACH

The concept of an RUC is that users pay a direct charge for the use of a roadway. However, it is important to understand that both “use” and “user” can be defined in different ways, and the mechanism by which a charge is levied can also vary significantly. This is evident among the phase II grantee agencies, all of which are using different combinations of technologies and various paradigms and mechanisms to levy charges. Often, the fundamental objective of the RUC system is a significant factor in identifying technology options, data collection, and how fees are levied. Previous research⁴ has characterized this phenomenon through the use of an RUC logic model, as illustrated in figure 4.



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Figure 4. Diagram. Exploratory research for road usage charge technology options logic model.

One essential component of this evaluation was trying to understand the fundamental objectives of the RUC systems as deployed by the grantee sites. The objectives provided overarching insight into more detailed assessments and evaluations of the efficacy, costs, and scalability of

⁴HDR Inc. 2011. *Exploratory Research on Technology Options for Collection of Road Use Fees*. Unpublished technical memorandum developed under contract to the Federal Highway Administration.

the systems at a regional or national level. The “Evaluation Framework” section below provides a summary of how the study team conducted this evaluation.

EVALUATION FRAMEWORK

U.S. Department of Transportation Questions

Table 3 presents the key questions USDOT examined as part of this evaluation. To explore the USDOT questions within the context of the grantee sites’ proposed activities, the evaluation team elaborated on the questions and defined the relevant metrics for conducting the evaluation for the specific grant sites. While some questions were found to be highly applicable to WSTC’s phase II activities, others were marginally applicable. Table 3 provides the assessment framework. Table 4 provides the system attributes relevant to the evaluation. These attributes and their definitions are based on the description of the STSFA program in Section 6020 of the FAST Act (Pub. L. 114-94).⁵

Table 3. Road usage charge (RUC) assessment framework.

No.	U.S. Department of Transportation Evaluation Question	Relevant Site Question/Metrics	Applicability to Washington State’s Phase II Activities
Q1	What is the viability of implementing RUC on a nationwide scale?	What are the lessons learned from interjurisdictional pilot operations?	Medium
Q2	Would the fee assessment and collection mechanisms be scalable?	Not applicable (N/A)	Low
Q3	What is the efficiency of the fee assessment and collection relative to the fuel tax?	What are the costs of RUC collection for the pilot?	Medium
Q4	What are the attributes and characteristics of the RUC systems with respect to privacy, security, user acceptance, ease of use, ability to audit, charging accuracy, reliability, equity, ability for a user to circumvent the charge, and other factors?	See table 4 for the metrics and their definitions.	High
Q5	What are user and stakeholder perceptions of an RUC in general and of pilot activities?	What are some of the outcomes of public awareness campaigns? What input is provided by the Steering Committee?	High
Q6	What changes in institutional and financial setting, frameworks, models, and elements are required?	N/A	Low
Q7	What is the financial sustainability of each pilot deployment?	N/A	Low

⁵Public Law 114–94, H.R. 22, § 6020, H.R. 22, 114th Congress. (2015)

Table 4. System attributes relevant to the road usage charge evaluation.

Functional Parameter	Description
Primary Parameters	
Charging accuracy, precision, repeatability, and reliability	The system’s ability to assess the expected charge for each use of the roadway; the system’s ability to produce a consistent assessment of fees repeatedly for identical travel; reliability focusses on system uptime; technical accuracy also encompasses some of the secondary factors below such as ability to audit and flexibility
Public outreach and communication	Communication to the public at large and to specific interest groups (such as those representing the interests of the heavy-vehicle industry or electric vehicles) the shortcomings of the current motor fuel tax approach
Public acceptance	The degree to which the system use is straightforward and time that a participant needs to spend interacting with the installed system is minimized; the level of acceptance by the traveling public
Interoperability	Ability of the system to interact and exchange information across multiple jurisdictions
Privacy protection	Protection of personal information; privacy refers to nature of the information being collected as opposed to the integrity of the information
Use of independent and third-party vendors	Benefits of and concerns with the use of third-party vendors for the administration and operation of the system
Congestion mitigation	Ability to incorporate congestion reduction strategies in the program
Equity	How user costs and other outcomes will impact people in different income brackets and people of different races/ethnicities, gender, English proficiency level, and travel mode
Ease of compliance and enforcement; transparency; cost to user	How easily the system can be complied with or circumvented and the ability of law enforcement to identify travelers who have evaded the system; user awareness of what they are being charged; cost of equipment or installation to the end-user and cost of the per-mile (or other) charge
Security (including cybersecurity) of technology	Security refers to data source integrity and storage, transmission and access; cybersecurity refers to the extent to which the system is vulnerable to a cyberattack or release of private information
Secondary Parameters	
Ability to audit	Extent to which an individual can contest their charges and have visibility into how those charges were accrued and assessed
Flexibility and user choice	Ability of the technologies and systems to be upgraded or updated; choices of user-based alternative transportation revenue mechanisms, including the ability of users to select from various technology and payment options
System costs	The full spectrum of investment costs, including initial capital, operating, and maintenance costs

EVALUATION PROCESS

The evaluation team devised an approach centered on periodic interfaces with the grantee agencies. The scope of this evaluation did not include independent data collection or an audit of individual site programs. The process involved the collection of data and information from the grantee sites. Specifically, the evaluation team:

- Reviewed quarterly and annual reports submitted by grantee sites to FHWA

- Developed detailed questionnaires to collect information through interviews at periodic touch points, either virtually or onsite
- Facilitated meetings and information exchanges enabling pilot sites to share information, findings, and progress and for the evaluation team to ask questions
- Participated in the pilot to observe and document user experience, where possible and relevant
- Customized the evaluation framework in light of specific grantee goals and program aspects
- Facilitated roundtables with representatives from grantees site during Transportation Research Board annual meetings in 2018, 2019, and 2020; the purpose of the roundtables was to provide a forum for crosscutting discussion on USDOT goals of the STSFA program
- Conducted detailed review of the final reports prepared by grantee sites on pilot completion:
 - Typically, each grantee site prepared multiple reports to address various aspects of the pilot program, such as technological, public communication, and public perception, in addition to the overall evaluation report; where needed, the evaluation team sought additional data from the surveys conducted by grantee sites

Evaluation Process Key Milestones

The following are key milestones in the evaluation process:

- **Kickoff meeting.** At the start of the evaluation in 2017, the evaluation team conducted 90-minute kickoff meetings with each grantee site. The purpose was to introduce the goal and scope of the evaluation and obtain information about the pilot’s phase I goals, scope, and time line. The evaluation team requested program documents compiled up to that point and updated project management plans.
- **Onsite visit.** In August 2018, the evaluation team conducted an onsite visit to Washington to learn about the project’s progress, the initial findings from completed activities, and a time line for completing remaining activities. The evaluation team met with WSTC staff managing the RUC pilot and learned about the technical and business aspects of phase II activities. At the time of this visit, several activities had been ongoing while others had already been completed. The evaluation team submitted a request for documentation related to completed activities.
- **In-person meeting in Hawaii.** The evaluation team met with WSTC in person in October 2019 to discuss the progress of the pilot, the data needs for the evaluation, and the next steps planned by WSTC in the advancement of statewide RUC.

. CHAPTER 4. INDEPENDENT EVALUATION FINDINGS

This chapter presents the findings and lessons learned from the WA RUC pilot. The findings are presented in accordance with the framework described in chapter 3. These findings pertain to the phase II pilot performed with funds from the STSFA program, awarded in FY 2017. An evaluation of a prior phase of this initiative, which involved pilot planning activities supported with FY 2016 funds, is presented in a separate report.

TECHNICAL ACCURACY, PRECISION, AND REPEATABILITY

The legitimacy of an RUC system based on miles driven rests on the technical accuracy of the mileage reporting, and the reliability of the systems that record and convey data necessary for assessing fees. The system’s ability to assess the expected charge for each use of the roadway and repeatedly produce a consistent assessment of fees for identical travel is at the core of reliability. This section discusses findings regarding technical accuracy, precision, and repeatability of automated and manual MRMs. Because the WA RUC pilot provided participants multiple options for reporting mileage, discussion of user choice and the system’s flexibility are also included in this section. Table 5 presents the evaluation and site-specific questions about technical accuracy, precision, and repeatability.

Table 5. Evaluation and site-specific questions used to assess technical accuracy, precision, and repeatability of mileage reporting methods.

Evaluation Questions	Site-Specific Questions and Metrics
What options were available to participants to report miles driven data?	<ul style="list-style-type: none"> • What mileage reporting methods (MRM) were provided in the pilot? • What were pilot participants’ responses to these options? • What was the enrollment data for the different MRMs selected by pilot participants? • What was the pilot participants’ satisfaction level toward those MRMs options?
What is the technical accuracy of the MRMs used?	<ul style="list-style-type: none"> • What were the findings regarding technical accuracy of the MRMs provided to pilot participants? • What low-technology options were tested in the Washington State road usage charge (WA RUC) pilot? • What were the benefits and drawbacks observed of these options? • How did these options affect ease of use or interoperability?
Where were the findings regarding the WA RUC system’s flexibility to adapt?	<ul style="list-style-type: none"> • How was the system configured? Does this configuration allow the system to adapt? • Can the system accommodate various types of MRMs? Can the system include private vendors?

Mileage Reporting Methods and Public Response

What Mileage Reporting Methods Were Provided in the Pilot?

The WA RUC prototype system was designed to allow a range of MRM options, allowing customers a choice in which MRM approach and which service provider they could use. It was also designed to promote market competition and new technologies for RUC services. Of the

five options available to participants in the WA RUC system, the plug-in device with GPS was chosen by the highest percentage of program participants, while the mileage permit had the lowest selection among participants. A breakdown of participants enrolled by MRM option is shown in figure 5.

Mileage Reporting Method	Participant Use	Characteristics
Plug-in Devices (with or without GPS)	56% use (37% with GPS, 19% without GPS)	<ul style="list-style-type: none"> Automated mileage meter with GPS and non-GPS options. Plugs into OBD-II ports in vehicles 1996 or newer. GPS-enabled devices automatically deduct out-of-state miles.
Odometer Reading	28% use	<ul style="list-style-type: none"> Post-pay for miles reported quarterly. Report miles either electronically or in-person.
Smartphone App (MileMapper)	14% use	<ul style="list-style-type: none"> Records miles using a smartphone. Works with all vehicles. Navigational GPS can be turned on/off. Available only on iPhone iOS.
Mileage Permit	1% use	<ul style="list-style-type: none"> Pre-select a block of miles (1,000, 5,000, 10,000). Report odometer either electronically or in person every three months. Obtain additional miles as needed to keep mileage permit valid.

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Figure 5. Illustration. Participants’ choice of mileage reporting methods.

What Was the Pilot Participants’ Response to These Options?

Users indicated satisfaction with the number of reporting options. Only 2 percent felt they had too few choices. Of the more than 2,000 vehicles enrolled in the pilot, about 40 switched reporting devices during the pilot after receiving at least their first invoice. Most of the users who switched MRMs chose plug-in devices with GPS over other MRMs.

The ability to choose service providers and MRM approaches was found to be key to user acceptance. In the post pilot survey, 52 percent of users rated “User Option” as their priority, which was an increase of 9 percent from the prepilot survey. Providing a broad range of technology options to report mileage allowed drivers to decide which tradeoffs to make according to their needs, preferences, abilities, and sensitivities. Drivers who had privacy concerns could choose lower or no-technology options or non-GPS options, and drivers who wished to only pay for miles driven on taxable roads could use mileage reporting options with GPS. Drivers who needed in-person assistance to report odometer readings could rely on a network of walk-in service centers, such as VLOs located around Washington State.

Automated methods had the highest percentage (71 percent) of enrolled participants within the program. Plug-in methods with GPS were the most selected method, with 38 percent of participants, while mileage permits were the least selected, with only 1.3 percent participants. Figure 6 shows the MRMs chosen by the WA RUC pilot participants.

Service Provider	Mileage Permit	Odometer Reading	Smartphone App (MileMapper)	Plug-in Device (with GPS)	Plug-in Device (no GPS)
DriveSync (91%)	1%	22%	14%	35%	19%
Emovis (9%)	0.3%	6%	Not offered	3%	Not offered
Total	1.3%	28%	14%	38%	19%

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Figure 6. Table. Mileage reporting methods chosen by Washington State road usage charge pilot participants.

What Informed Participant Choice of Mileage Reporting Method?

WA RUC conducted three surveys of program participants enrolled in the demonstration to better understand the principles they most valued in the program. These responses help understand which characteristics may have been important in the selection of an MRM, as some MRMs have considerations on the principles identified. Privacy was consistently the most important principle for participants, identified as important by 83 percent of participants in the beginning of the demonstration, and rising to 89 percent by the end of the demonstration. Simplicity of the RUC system experienced a large jump, from 70 percent of participants identifying it as important at the start of the demonstration to 78 percent at the end. The ability for users to decide which MRM they could use in the demonstration allowed participants to determine the balance of principles would best represent their needs. The full survey results indicating the importance of each of the project principles can be seen in figure 7.

What Were the Low- or No-Technology Options Provided in the Pilot, and How Did Pilot Participants Respond to the Options?

Two low- or no-technology options (manual methods) were available in the pilot; the mileage permit and the odometer reading. Both methods used the same smartphone odometer-image capture mileage reporting mechanisms, and no GPS or other location technology was used to differentiate taxable from nontaxable miles. The MileMapper smartphone app also used odometer image capture, but with the added feature of GPS functionality that could differentiate out-of-State or nontaxable miles. Providing manual methods avoided precluding drivers who did not wish to install a plug-in device into the vehicle from distinguishing out-of-State mileage in the RUC pilot.

Principle	Definition	Survey 1	Survey 2	Survey 3	Change (1 to 3)
Privacy	My personal and driving information cannot be sold to any organization or shared with entities other than those directly administering a RUC system without my consent.	83%	90%	89%	+6%
Simplicity	A RUC system is easy to participate in and not time-consuming to comply with.	70%	79%	78%	+8%
Data Security	A RUC system provides the highest level of data security possible and drivers can obtain information that clearly outlines the security measures.	74%	77%	75%	+1%
Transparency	Clear information is available on the rate and how it is set, as well as RUC system operations.	75%	74%	70%	-6%
Cost Effectiveness	A RUC system is efficient for the State of Washington to collect, administer, and enforce.	62%	67%	65%	+3%
Equity	All drivers pay their fair share based on how much they use the roads regardless of vehicle type.	59%	60%	61%	+2%
Enforcement	A RUC system is easy to enforce, and costly to evade.	51%	57%	58%	+7%
User Options	A RUC system provides choices to drivers for how they report their miles.	43%	58%	52%	+9%
Charging Out-of-State Drivers	Visitors to the state pay for their use of Washington roads.	32%	43%	39%	+8%

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Figure 7. Table. Survey summary of system principles.

What Were the Benefits and Drawbacks of Manual Reporting Methods?

Providing manual methods avoided excluding drivers who did not want mileage reporting technology in the vehicle. Manual methods also had the highest implementation maturity, but they were low on usability and accuracy because they did not differentiate the taxable and nontaxable miles. In general, the lower technology options had a higher level of effort to report mileage.

How Did Manual Reporting Methods Affect Ease of Use or Interoperability?

For users, the low- or no-technology options involved the most level of effort to report mileage, such as periodically uploading images of the vehicle’s odometer or periodically visiting a license bureau to report mileage.

The MileMapper app allowed users to track out-of-State mileage via the device’s GPS location data, providing the potential for interoperability among States. The app uses image capture of the vehicle’s odometer to report the vehicle’s accumulated mileage, but also gives an indication to the number of miles driven out of State.

Technical Accuracy of Mileage Reporting Methods

What Were the Findings Regarding Technical Accuracy of the Mileage Reporting Methods Provided to Pilot Participants?

The WA RUC pilot included a variety of approaches for participants to choose from, each with their own level of maturity (figure 8). The team directed efforts to validate the off-the-shelf onboard diagnostics (OBD-II) device and the MileMapper app because they had not previously been used in an RUC pilot.

Mileage Reporting Method Characteristics	Mileage Permit	Odometer Reading	Manual Reporting Support (Vehicle Licensing Offices)	Smartphone App (MileMapper)	Plug-in Device (with & without GPS)	Automatic TM Plug-in Device (with GPS)
RUC Certified	Yes	Yes	No	No	Yes	No
Maturity	High	High	High	Low	High	Low
Accuracy	Medium	Medium	Medium	Low	High	Unknown
Usability	Low	Low	Low	Low	High	Unknown
Testing Effort (focus area)	Medium (odometer reporting)	Medium (odometer reporting)	Medium (participant identification to odometer reporting)	High (user interfaces, map-matching)	Low (app installation, user interfaces)	High (accuracy, integration, user experience)

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GPS = Global Positioning System; RUC = road usage charge.

Figure 8. Illustration. Comparison between mileage recording methods.

Vehicle odometer. Three of WA RUC’s mileage reporting approaches rely on the vehicle’s odometer: mileage permit, odometer charge, and the MileMapper app. The accuracy and precision of any mileage reporting that uses an odometer will be as accurate or precise as each vehicle’s odometer. There is no law in the United States holding vehicle odometers to a certain accuracy, although the National Institute of Standards and Technology (NIST) offers guidance on the level of tolerance that vehicle odometers should be within to be considered correct. The

NIST Handbook 44 (2008)⁶ recommends a tolerance of 4 percent under and over actual mileage for vehicle odometers. Many variables can affect these tolerances, including tire size (if different from what was original to the vehicle), tire inflation, tire wear, temperature, vehicle loading, and number of passengers.

MileMapper app. The MileMapper app uses a combination of GPS data and vehicle odometer data to measure taxable miles. The app uses image capture to measure accumulated vehicle miles from the odometer, then uses the smartphone’s GPS to measure miles driven out of State. The out-of-State mileage is deducted from the total mileage, resulting in the taxable miles. Because it uses the vehicle odometer to measure accumulated miles, it is subject to the same accuracy of the vehicle’s odometer. The pilot did not focus on testing the accuracy of the MileMapper app, which would be specific to measuring out-of-State miles.

OBD-II (non-GPS). The non-GPS OBD-II devices use data from the vehicle’s diagnostic system to determine miles driven. Vehicle OBD-II data do not include the cumulative miles driven as a vehicle’s odometer does. Rather, it calculates mileage from the data available while the device is installed, such as rotation of the wheels. Like the vehicle odometer, this method is subject to the same variables that affect the tolerance of the measurement.

OBD-II (GPS). OBD-II devices that use-GPS include another mechanism on top of the data available from the OBD-II to measure distance driven. As stated in the final report, “Devices used in the insurance industry had the most mature technology, previously shown to feature high accuracy rates in the Oregon and California RUC pilots, and in other applications. Tests mainly focused on consistency of the look and feel, and content displayed on the user interfaces”⁷

OBD-II (off-the-shelf with GPS). The WSTC final report does not indicate an expected or actual accuracy of the device tested. “In some cases of low confidence GPS signal, Automatic did not share GPS data from the device for a significant amount of time, resulting in missing miles. After diagnosing the problem, the teams developed a solution for determining chargeable miles in accordance with the standards for the pilot.”⁸

The WSTC final report provides a summary of the differences in accuracy, precision, and repeatability between odometer-based MRM options and GPS-based MRM options:

...to the extent there are minor discrepancies in actual versus recorded movement, with GPS those differences are only momentary, until the next signal plots the location along the roadway map. In this manner, any minor misreadings (for example, showing a vehicle traveling off the public roadway) are only momentary, until the next signal is received. By contrast, with odometer readings, very small variations in mileage are cumulative; if an odometer records very slightly more miles than actually traveled, these minor miscalculations are cumulative, continually recorded in the odometer reading, without the ability for correction. Such errors cause typical vehicle odometers to have inaccuracies

⁶United States Department of Commerce Technology Administration, National Institute of Standards and Technology. (2008). *Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices*. As adopted by the 92nd National Conference of Weights and Measures 2007. Section 5.53, Page 5-13.

⁷Washington State. 2020. Road Usage Charge Assessment Final Report. Vol. 2, Section 3.6.1, Page 39.

⁸Washington State. 2020. Road Usage Charge Assessment Final Report. Vol. 2, Section 3.6.1, Page 39.

ranging approximately +/- 2.5 percent or more; industry-developed targets for odometer accuracy are set at 4 percent margin of error.⁹

Flexibility to Adapt

How Was the System Configured? Does This Configuration Allow System Flexibility To Adapt?

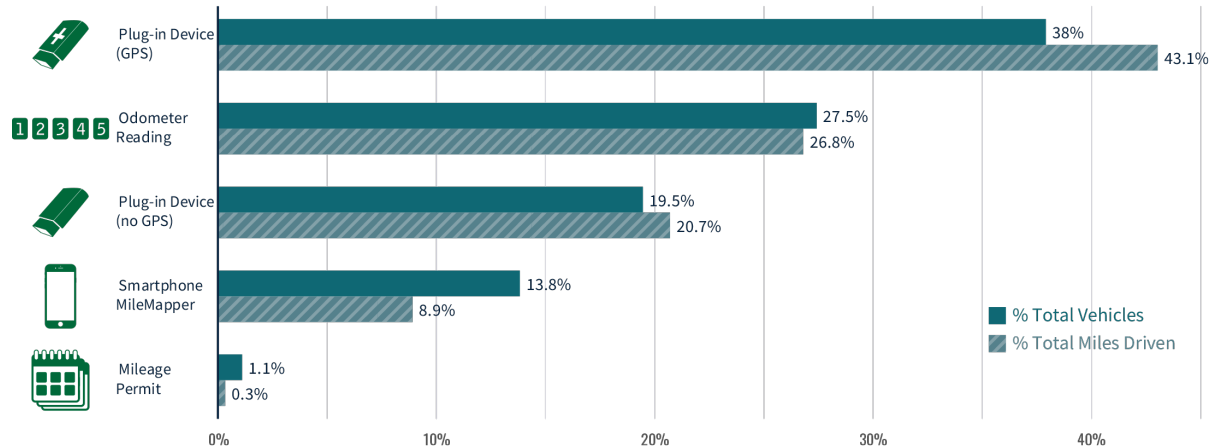
WA RUC's system was designed to ensure flexibility to accommodate an open system, adapt to policy changes by the legislature, innovate and technically evolve, scale to a large size, and enable transition to a full RUC application. Three system configurations were evaluated in determining the use of private-sector service providers to collect RUC (government agency, private sector, or a combination of both). System flexibility and the ability to adapt were evaluated as a guiding principle in the assessment process. The WA RUC pilot tested the open market delivery configuration (combination of government agency and private sector). The following are key characteristics of the open-market configuration:

- **Open to competing vendors.** The WA RUC pilot system provided participants with two private vendors and five MRM options. By procuring different private sector entities for account management, the system enabled competition and ensured the ability to adapt to commercial markets and new technologies. Competition among service providers also offered the potential to reduce cost and mitigate risks of operation while increasing the innovation and effectiveness of technologies and system flexibility.
- **Ability to innovate and evolve technology and business systems.** An open market enables the free flow of competitors into and out of the market to ensure the ability to adapt. Competition among private-sector providers for RUC customers in an open market is intended to provide real-time incentive for innovation and technical evolution of RUC systems. Service providers must meet system requirements and capabilities, and those who do not can fall out of the market, and its customers will shift to another private entity.

Can the System Accommodate Various Types of Mileage Reporting Methods? Can the System Include Private Vendors?

The WA RUC prototype system was designed to allow a range of consumer choice in RUC service providers, how miles would be reported, and MRM technology. It was also able to accommodate market competition and new technologies for RUC services. The pilot tested both high-technology (automated reporting methods) and low- or no-technology (manual reporting methods). Figure 9 shows the MRMs chosen by the WA RUC pilot participants.

⁹Washington State. 2020. Road Usage Charge Assessment Final Report. Vol. 3, Section 3.8.3, Page 62.



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Figure 9. Illustration. Mileage reporting methods chosen by Washington State road usage charge pilot participants.

The WA RUC pilot included two service providers available to participants, each offering a different suite of value-added services and their own bundle of MRM options. Both firms partnered with system providers and technology providers to deliver WA RUC services, and they offered the latest technology in mileage reporting options for the time when the pilot program was operated.

Account manager 1 supported the eight VLOs that participated in the pilot. Participants who used either the odometer reading or the mileage permit reporting options but lacked a smartphone or preferred not to use their own phone, could go to any of the eight participating VLOs to complete their mileage reporting. Account manager 2 utilized the first use of a retail off-the-shelf plug-in device in an RUC pilot. The device provided a range of value-added services to participants, and once linked with an account manager, provided data for mileage reporting as well.¹⁰

Participants' enrollment data showed that 91 percent of the volunteers chose account manager 1, and the remaining 9 percent used account manager 2, based on the fact that account manager 1 offered all MRM options and started in the program 3 weeks before account manager 2. Participants were allowed, and were made aware of, the possibility of switching MRMs or service providers halfway through the pilot (during the second enrollment period held in August), but only 1 percent of all participants changed their service provider, and only 4 percent changed their MRM.

Participatory design, which involved users participating in the design of the end product, was shown to be beneficial through the WA RUC pilot. Using a participatory approach allowed the pilot team to develop and operate a stable version of a smartphone app in less than a year. The development team used feedback from users to continually refine and release improved versions of the app throughout the pilot.

¹⁰*Steering Committee Final Report of Findings for the WA RUC Assessment & Pilot Project. 2019. Volume 2, Chapter 3, Section 3.3.3.*

The MileMapper prototype measured location using iPhone location services (i.e., GPS) and the movement of a vehicle over a period of time using the iPhone accelerometer. The app featured a toggle switch that allowed the participant to turn the GPS function on or off. The function of the GPS was to distinguish between miles driven within Washington State (taxable) and miles driven out of the State or the country. By default, the GPS function was set to the off position, which meant that all miles driven were considered taxable unless participants deliberately turned on the GPS function. Participants could choose to use GPS as they saw fit—either at all times or only when they were driving out of State or off public roads.

One key finding was that MileMapper could not reliably determine the specific vehicle being driven and driver/passenger roles. This was because there was no straightforward solution to establish a connection between the smartphone and the vehicle without installing supplemental electronic tags or equipment.¹¹ To address this issue, the MileMapper app included an odometer image-capture function that reminded participants to capture and submit odometer readings at the start and end of each month. The need to report periodic odometer readings meant that MileMapper was not fully automated. Therefore, MileMapper was categorized as beta version of smartphone reporting method and would require further improvement.

Key Findings on Technical Accuracy, Precision, and Repeatability of Mileage Reporting Methods

Providing a broad range of technology options to report mileage allows drivers to decide which trade-offs to make according to their needs, preferences, abilities, and sensitivities. The following are key findings of the WA RUC pilot regarding MRMs:

- Manual methods had the highest implementation maturity but ranked low on usability and accuracy because they did not differentiate the taxable and nontaxable miles
- The smartphone app tested in the pilot could not reliably determine the specific vehicle being driven and driver/passenger roles because there was no straightforward solution to establish a connection between the smartphone and the vehicle without installing supplemental electronic tags or equipment
- Many of the MRMs tested in the pilot rely on the vehicle odometer to measure miles and inherit the accuracy and precision of the odometer

PUBLIC OUTREACH AND COMMUNICATION

This section analyses recommended practices and key findings resulting from WSTC's efforts to communicate the RUC concept to the public and to specific interest groups. WSTC conducted public outreach to recruit pilot participants but also to enhance the level of public of education. Table 6 presents the evaluation and site-specific questions about public outreach and education.

¹¹*Steering Committee Final Report of Findings for the WA RUC Assessment & Pilot Project. 2019. Volume 2, Chapter 11, Section 11.3.4.*

Table 6. Evaluation and site-specific questions used to analyze road usage charge public outreach strategies.

Evaluation Questions	Site-Specific Questions and Metrics
What strategies were used to recruit participants for the pilot?	<ul style="list-style-type: none"> • What strategies were used to inform, educate, and build support among the general public about the pilot and the road usage charge concept? • How effectively did these strategies succeed in recruiting pilot participants and increasing public awareness and acceptance?

Outreach Strategies Used to Recruit Participants for the Pilot

What Strategies Were Used To Inform, Educate, and Build Support Among the General Public About the Pilot and the Road Usage Charge Concept?

The prepilot communications assessed public perception and understanding of RUC are summarized in the phase I evaluation report.

The following are key points from that report:

- Recruitment and enrollment of volunteers as pilot test drivers
 - Media strategies aimed at recruiting pilot participants included earned media strategies, paid digital media ads, paid social media ads, a pilot project website with frequently asked questions, presentations, and fact sheets
 - Washington State took the approach of over recruitment of potential participants (recruiting close to 5,000 volunteers for 2,000 spots in the pilot.), which enabled a balance of participants that reflected demographics (race, ethnicity, gender, income basis) of the State and geographic and vehicle type diversity
- Outreach during live test
 - Media engagement focused on responding to media inquiries and requests, as well as preparing for the pilot’s completion
 - The operational help desk was staffed by individuals who developed content for the pilot website, frequently asked questions, presentations, fact sheets, and other outreach and communication strategies; the help desk was staffed with individuals with deep knowledge of the pilot and reduced staff training time

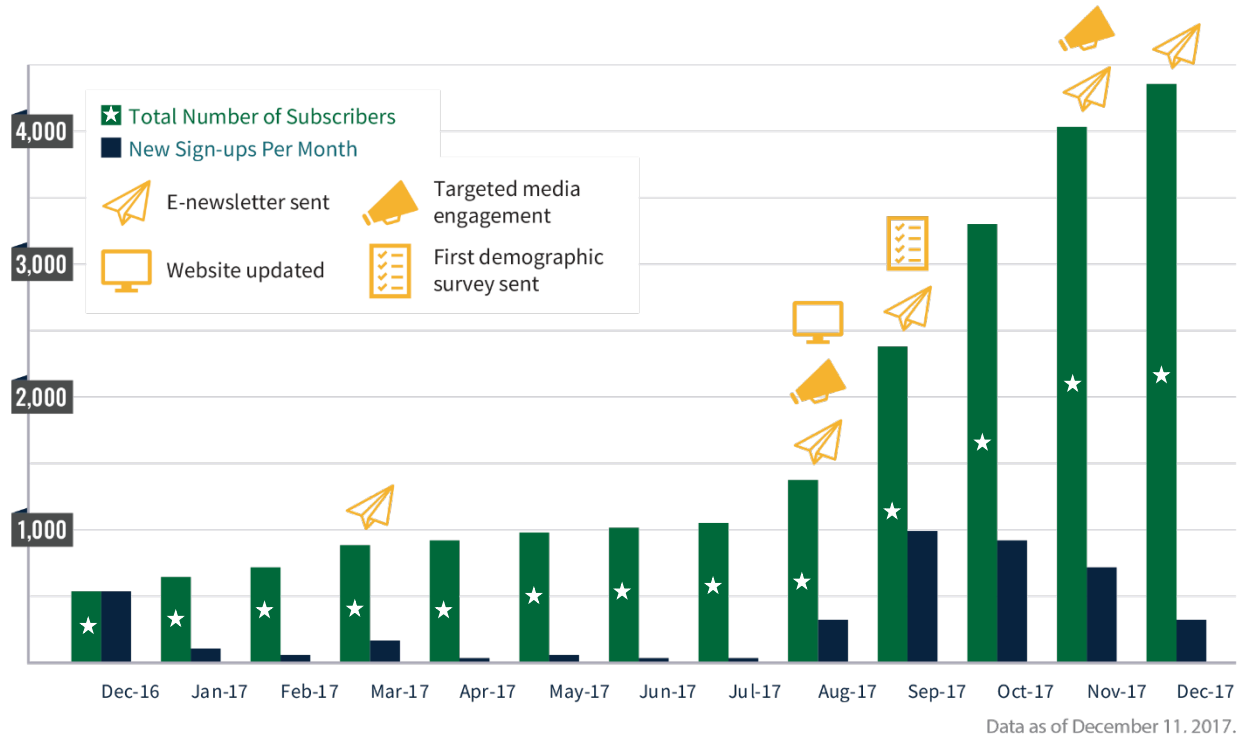
How Effectively Did These Strategies Succeed in Recruiting Pilot Participants and Increasing Public Awareness and Acceptance?

The outreach strategy involved seeking potential participants to sign up for the project’s email list and requesting those interested in participating to fill out a demographic survey to understand their vehicle type, driving habits, and demographics. Figure 10 shows the efficacy of various media strategies used to drive up the number of subscribers to the WA RUC pilot interest list.

“The pilot project help desk was an important connection for participants and nonparticipants to connect with the project and ask any range of questions from customer service-oriented account questions to policy-level questions about road usage charging in Washington.”

Key Findings on Public Outreach and Communication

Outreach conducted by the WSTC and pilot recruitment efforts increased the level of knowledge and understanding of RUC among Washington State residents through broad outreach and media engagement.



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Figure 10. Chart. Washington State road usage charge pilot project interest list growth (n = 4,364).

PUBLIC PERCEPTION AND ACCEPTANCE OF ROAD USAGE CHARGE

This section presents findings regarding public acceptance and opinions of the RUC concept as a transportation funding mechanism before, during, and after the pilot. WSTC’s research methods provided insight into public perception and acceptance of RUC as a transportation funding

mechanism as well as into specific concerns related to the pilot program and implementation aspects of a potential live program.

Table 7 presents the evaluation questions and WA RUC-specific questions regarding public perception and acceptance of RUC.

Table 7. Evaluation and site-specific questions used to evaluate public perception and acceptance of road usage charging.

Evaluation Questions	Site-Specific Questions and Metrics
What research methods were used to assess public perception and acceptance of road usage charging (RUC)?	<ul style="list-style-type: none"> • What research methods were used to collect public opinion data? <ul style="list-style-type: none"> ○ What was the timing of the data collection? Were data collected prior to, during, and after the pilot? ○ From whom was the data collected (pilot participants, the general public, and/or targeted groups of the public?) • Did the research methods permit analysis of groups of special concern, such as low-income or non-English-speaking residents?
What were the findings regarding public awareness and support for RUC?	<ul style="list-style-type: none"> • Was the public aware of the RUC concept in general and the State’s pilot in particular? Did people support the RUC concept in general and the pilot approach in particular?
What were the findings regarding public understanding about key RUC aspects?	<ul style="list-style-type: none"> • What opinions did people hold on specific matters related to the RUC concept? <ul style="list-style-type: none"> ○ The need to transition to a more sustainable funding source than the current gas tax. ○ Flexibility and user choice in a potential RUC system. ○ Privacy and security of data in a potential RUC system. ○ Equity and progressivity of a potential RUC system. ○ Confidence that users will comply (versus evade) an RUC. • What opinions did people hold on specific matters listed above about the version of the RUC that was piloted? • Did they have other concerns about an RUC? Did they see other benefits to an RUC?

Public Awareness, Perception, Acceptance, and Support for Road Usage Charge

What Research Methods Were Used To Collect Public Opinion Data?

- What was the timing of the data collection? Was data collected prior to, during, and after the pilot?
- From whom was the data collected (pilot participants, the general public, and/or targeted groups of the public)?

Washington State conducted the following surveys as part of pilot implementation (as summarized in Table 8):

- A statewide telephone poll prior to pilot launch to gauge initial public reaction to a potential RUC and to help better understand public concerns and sources of confusion
- Three separate participant surveys: one at the launch of the 12-month test drive period, one at the midpoint, and one at the conclusion of the pilot; changes in the responses to the

same questions were analyzed to evaluate the impact the pilot had on public perception of RUC:

- Surveys 1 and 2 collected information on participants’ driving habits, perspectives on how the pilot is impacting them, and views on a potential RUC
- Survey 3 collected information on participants’ experience with the pilot and their perspectives about a potential RUC; the results were reported separately for the entire participant pool and low-income individuals who reported a household income of \$30,000 or lower
- Six focus group sessions held throughout the State at the midpoint of the pilot, in September and October 2018:
 - Explored certain aspects of RUC more deeply with special focus groups composed of people who drive electric vehicles, people who drive commercial vehicles, individuals with low and moderate incomes, people who drive higher-than-average miles per year, and people who are rural residents
 - The focus group participant pool was convened to represent diversity in demographics (age, gender, race, income), perspective (support for or against an RUC), vehicles, and driving behavior (vehicle type, number of miles driven)

Table 8. Road usage charge survey timing, methods, and target group for public opinion research.

Target Group	Prepilot	During Pilot	Post pilot
Pilot participants	Survey	Survey	Survey
Pilot participants	Not applicable (N/A)	Six focus groups with targeted groups (electric vehicle drivers, rural residents, etc.)	N/A
General public	Phone survey (statewide)	N/A	N/A

N/A = not applicable.

Did the Research Methods Permit Analysis of Groups of Special Concern, Such as Low-Income or Non-English-Speaking Residents?

Broad-based data collection or analysis of public perception and acceptance of RUC among distinct groups of special concern was not a key focus of the pilot initiative.

Was the Public Aware of the Road Usage Charge Concept in General, and the State's Pilot in Particular? Did People Support the Road Usage Charge Concept in General, and the Pilot Approach in Particular?

- **General public.** According to a 2017 statewide poll of Washingtonians, most residents opposed RUC but asked more information about how it would impact their lives and expressed a willingness to participate in research on the topic. The telephone survey conducted as part of this poll found that only 18 percent of Washingtonians were familiar with RUC and 41 percent judged RUC less fair than the gas tax.
- **Pilot participants.** Although representative of the State geographically and along most demographic dimensions, pilot participants had different views than the general public

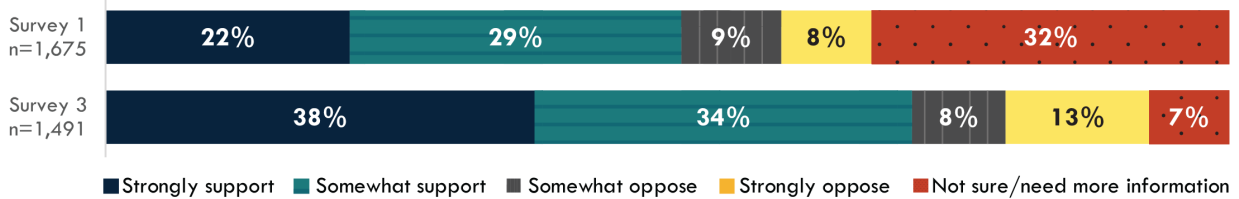
when comparing the results of the prepilot research to the survey data gathered from participants alone.

The following are relevant findings regarding public level of acceptance based on the focus group and surveys:

- Over the course of the pilot, participants became more supportive of RUC (from 50 to 65 percent) and less uncertain. There was a stable cohort who opposed an RUC (17–20 percent in the surveys and 21 percent in the focus groups).
- Of the survey respondents who identified as being much more supportive of RUC based on the pilot experience, the following were the key reasons (in order of popularity):
 - The pilot proved informative of their individual use of roads, how transportation is funded in Washington State, how much it costs to maintain the system, and how an RUC might work.
 - Participants understood that RUC is a fairer method because of pilot participation and agree that electric vehicles and hybrids should pay for the use of roads as well.
 - The pilot helped people see how much they were driving per day. After seeing how and where their money goes, and gaining knowledge of how they impact the roads, they are more supportive of RUC.
 - Their outlay for RUC was less than what they paid as gas tax.
- Of the respondents who identified as “a lot/little less supportive of RUC”:
 - Their primary concern was that RUC would penalize or discourage electric vehicles and hybrids.
 - Their outlay for RUC would be higher than what they pay as gas tax.
 - General government politics or tax concerns.
 - Issues with technology, devices, or reporting.

Key indicators about the impact of pilot participation are presented in figure 11A, B, and C.

57. At this point, how do you feel about implementing a road usage charge as a replacement to the gas tax in Washington to fund transportation infrastructure?



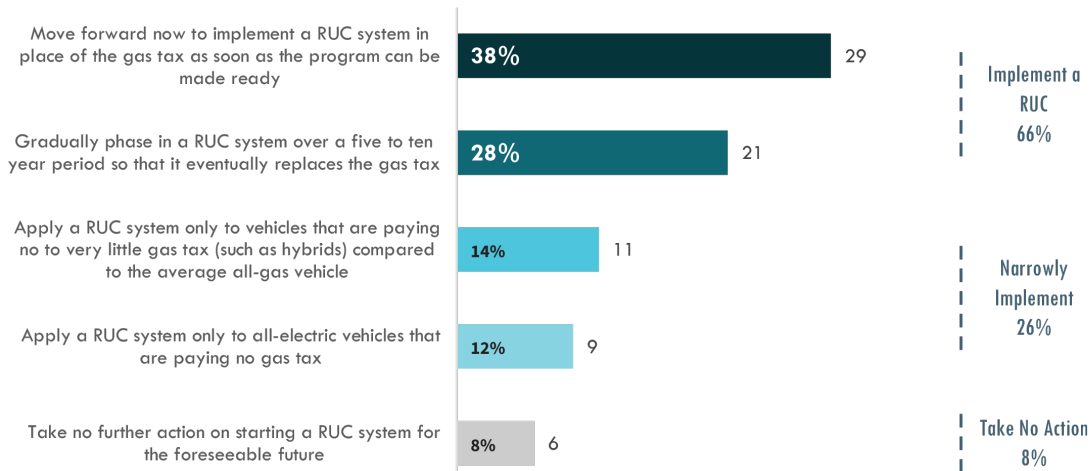
A. Support for road usage charge.

Based on your experience in the pilot, how has your attitude towards a road usage charge system changed? (n=1,491)



B. Impact of the pilot on attitudes towards road usage charge (RUC).

78. Which of the following best represents your advice to elected officials as they consider the next steps in implementing a road usage charge system statewide:



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C. Advice to elected officials regarding next steps in implementing road usage charge (RUC).

Figure 11. Chart. Indicators of participant attitude toward road usage charge during the course of the pilot.

As noted in figure 11C, toward the end of the pilot, most survey respondents supported moving forward to implement an RUC or gradually phasing it in. One-third supported a gradual phase-in, and nearly 30 percent advised moving forward to implement an RUC as soon as it is ready. Only 10 percent of respondents recommended no action.

Public Opinions About Key Program Aspects

What Opinions Did People Hold on Specific Matters Related to the Road Usage Charge Concept?

WSTC asked survey takers about RUC guiding principles in all three surveys. Figure 12 shows the findings from this question for respondents who selected “very important” for respective guiding principles.

- Privacy was the most important principle across surveys. Participants, primarily concerned with privacy, had questions about how and with whom the U.S. government might share their data.
- In general, the relative importance of the guiding principles increased among the participant pool, potentially indicating an increased understanding of the various aspects of an RUC. Only the share of people selecting transparency as a very important guiding principle went down over the course of the pilot.

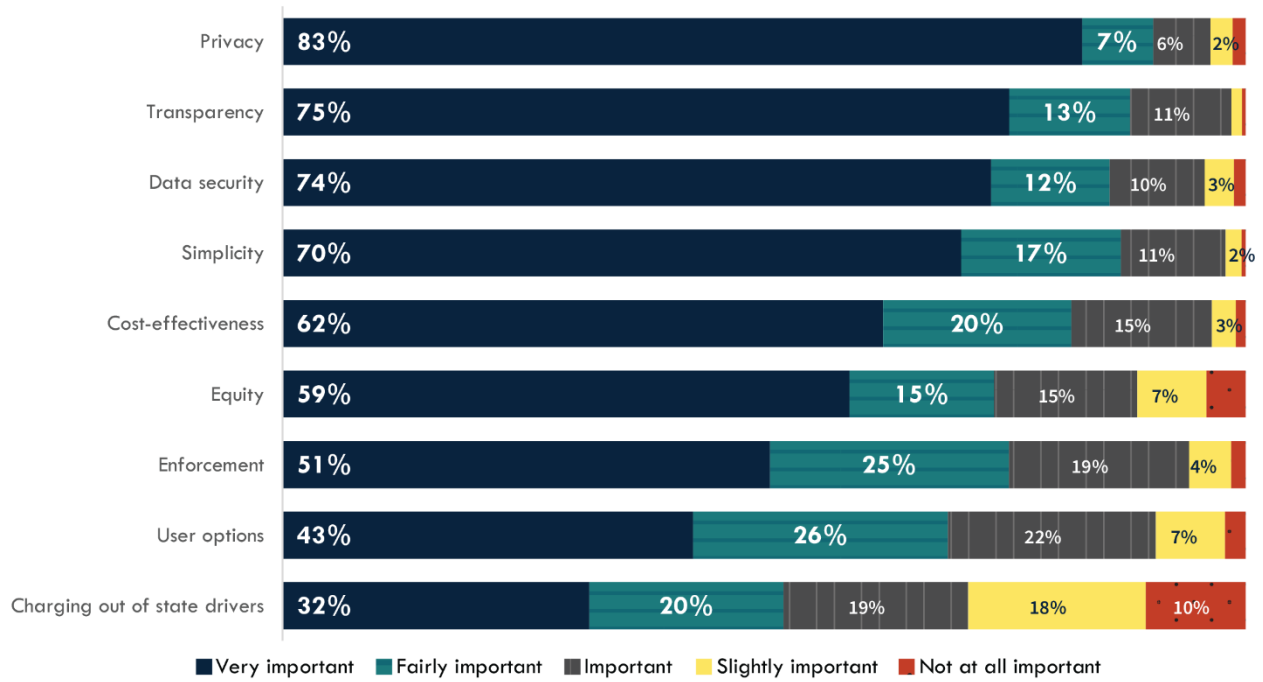
Other key survey findings regarding public attitude towards RUC aspects include:

- Participants had mixed opinions about how electric vehicles and hybrids should pay for transportation. Some felt strongly that electric vehicles and hybrids should pay the same rate for their use of roads, and others felt strongly that they should be incentivized or rewarded for being fuel-efficient.
- Regarding funding, participants were concerned about factors that may disproportionately affect costs or factors that result in misalignment between payers and users. Participants mentioned the relationship among income, geography, and driving distance as an important equity-related concern.

Fairness and equity were key themes in the focus group exercises. Equity-related concerns centered around the following aspects:

- **Vehicle-type.** RUC is fairer between gas and electric/hybrid vehicles because it separates fuel consumption from road usage. However, some worry that an RUC may discourage drivers from purchasing electric or hybrid vehicles because drivers would save less on gas tax.
- **Low- or moderate-income individuals.** Low- and moderate-income individuals and households are priced out of certain communities and therefore drive farther for work, to reach services and to run errands.
- **Vehicle weight and studded tires.** Vehicle weight should be a factor in determining an RUC, as heavier vehicles or those with studded tires cause more damage to the road.

8. How important to you are the following issues for a potential road usage charge system? (n=1,675)



A. Survey 3 responses.

PRINCIPLE	DEFINITION
Privacy	My personal and driving information cannot be sold to any organization or shared with entities other than those directly administering a RUC system with my consent
Transparency	Clear information is available on the rate and how it is set, as well as RUC system operations.
Data security	A RUC system provides the highest level of data security possible, and drivers can obtain information that clearly outlines the security measures.
Simplicity	A RUC system is easy to participate in and non-time-consuming to comply with.
Cost-effectiveness	A RUC system is efficient for the State of Washington to collect, administer, and enforce.
Equity	All drivers pay their fair share based on how much they use the roads regardless of vehicle type.
Enforcement	A RUC system is easy to enforce, and costly to evade.
User options	A RUC system provides choices to drivers for how they report their miles.
Charging out of state drivers	Visitors to the state pay for their use of Washington roads.

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B. Responses to surveys 1–3.

Figure 12. Table. Survey respondent attitude toward key principles of a potential road usage charge through the pilot.

What Opinions Did People Hold on Specific Matters Related to the Road Usage Charge Pilot?

Public opinions collected through a variety of reporting mechanisms, including surveys and focus group discussions, uncovered the following significant opinions about the RUC pilot approach:

- **Privacy.** The surveys found that pilot participants were largely satisfied with the privacy of their information during the pilot. The “Privacy Protection and Security of Technology” section of this report presents more detailed findings.
- **Simplicity.** Most users found the account and device setup process simple and easily achievable. The biggest motivations for reporting device selection were simplicity, ease, and convenience, with almost 70 percent choosing their reporting methods for those reasons.
- **Data security.** Participant surveys indicated uncertainty about the RUC pilot account setup process and whether information collected during the pilot would be protected from unauthorized use.
- **Transparency.** Participants’ understanding of their “fair share” of transportation taxes was higher under an RUC compared with under a gas tax, and their understanding increased over the course of the pilot.

“This pilot has shown me that it would be more work to report monthly odometer readings than to just pay gas tax at the pump.”
 – WSTC Road Usage Charge Final Report, Vol. 2. (2020)

- **Cost-effectiveness.** Many drivers were concerned about the potential complexity and the cost of an RUC system that would apply to all registered vehicles in Washington State. Survey respondents who became less supportive of the RUC noted concerns about how difficult it would be for the program to scale up to statewide implementation.
- **Equity.** At the end of the pilot, 61 percent felt that between the gas tax and an RUC, an RUC was more fair.
- **Enforcement of RUC (especially since compliance and enforcement was not tested in the pilot project).** Some felt the mileage reporting system would be subject to cheating or people gaming the system to avoid payment, while others expressed concern about how drivers from out of State would be required to pay.
- **User options.** Users were satisfied with the number of reporting options.
- **Charging out-of-State drivers.** People did not want to be charged for their own out-of-State miles. However, some want visitors to Washington State to pay for their use of Washington roads.

Most people participated in the pilot to understand how a road usage charge may impact them personally. At the end of the pilot, 91 percent said they were satisfied or very satisfied with their overall pilot experience.

Key Findings on Public Perception and Acceptance of Road Usage Charge

The pilot demonstration enhanced the level of acceptance of RUC among the participant pool, as evidenced through surveys and focus groups. The pilot also provided input and feedback to the State regarding the RUC principles of key importance to residents. The pilot and resulting program may benefit from surveying a greater diversity of constituents and using oversampling techniques to identify populations of interest stratified by income, education level, race, gender, and other demographic criteria.

INTEROPERABILITY AND RECONCILIATION

This section presents WA RUC pilot findings related to cross-jurisdiction interoperability and funds reconciliation. Table 9 details the evaluation questions and WA RUC-specific questions regarding cross-jurisdiction interoperability and funds reconciliation.

Table 9. Evaluation and site-specific questions used to evaluate road usage charge pilot interoperability and reconciliation.

Evaluation Questions	Site-Specific Questions and Metrics
Did the system support interoperability across jurisdictions?	<ul style="list-style-type: none"> • How was interoperability tested?
Where were the findings regarding the system’s interoperability?	<ul style="list-style-type: none"> • What mileage reporting methods support interoperability? • How were funds reconciled across jurisdictions?

Aspects of the Pilot Program Demonstrating Interoperability

How Was Interoperability Tested?

WSTC collaborated with Oregon's OReGO program, Idaho Transportation Department, and the City of Surrey in British Columbia, Canada, to test cross-jurisdiction interoperability (figure 13). The WA RUC pilot recruited and enrolled participants from neighboring jurisdictions in the Pacific Northwest to test simulated charging and payments, as well as reconciliation of the RUC collected across different jurisdictions through the interoperability HUB. The pilot recruited about 115 drivers from Oregon, 20 drivers from British Columbia, and seven drivers from Idaho. Participants were required to use the plug-in OBD-II device with GPS to be eligible for the interoperable portion of the pilot. All mileage driven was reported to WA RUC through the account manager. The mileage data collected allowed for calculation of the RUC payments due among jurisdictions based on State of residence and jurisdiction in which miles were driven. For the Oregon-Washington collaboration, the interoperability test featured about 90 participants enrolled in the OReGO program and 25 participants enrolled in the WA RUC program.

WA RUC developed an interoperability database called HUB to facilitate charges and payments among jurisdictions. The HUB successfully processed four quarters of multijurisdictional driving data from Washington, Oregon, Idaho, and British Columbia. It also demonstrated a real-money multijurisdictional reconciliation of RUC funds between Oregon and Washington. While the OReGO is a live program involving real money transactions between volunteer participants and the State based on miles driven, the WA RUC pilot did not involve any real money transactions between participants and the State. Oregon participants who opted to participate in the WA RUC interoperability test continued their participation in OReGO without interruption but were charged for miles driven in Washington State at the WA RUC rate of 2.4 cents per mile. Likewise, a select group of Washington State participants opted in to pay real funds. Each month, they were charged the net RUC due for Washington State miles (2.4 cents per mile) and Oregon miles (1.7 cents per mile).



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Figure 13. Illustration. Pacific Northwest regions that participated in testing road usage charge cross-jurisdiction interoperability and reconciliation.

Since OReGO participants used prepaid accounts, the charges corresponding with Washington State miles were funded by the participants’ Oregon account manager to the State of Washington. The WA RUC pilot team created funded participant accounts to allow Washington State participants to pay their OReGO fees through their own WA RUC account manager without imposing out-of-pocket costs on participants. Through the HUB, RUC account managers reliably and accurately charged participants for mileage traveled in multiple jurisdictions.¹² The Road Usage Charge Assessment Final Report (2020) concluded there was no additional effort required by the participants compared with a single jurisdiction RUC, aside from educating participants on the billing statement. As shown in figure 14, although the net transfer of funds between the jurisdictions was small, it demonstrated the feasibility of an interstate reconciliation as a proof-of-concept.

Quarter	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Miles driven in Oregon by Washington drivers	2,406	11,191	10,483	7,906	31,986
Amount owed by Washington to Oregon	\$2.79	\$42.77	\$49.35	\$29.28	\$124.19
Miles driven in Washington by Oregon drivers	2,855	14,692	13,142	13,489	44,178
Amount owed by Oregon to Washington	\$11.84	\$77.47	\$81.42	\$47.58	\$218.31
Net transferred from → to	\$9.05 OR → WA	\$34.70 OR → WA	\$32.07 OR → WA	\$18.30 OR → WA	\$94.12 OR → WA

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RUC = road usage charge.

Figure 14. Table. Road usage charge pilot reconciliation between Washington and Oregon by fiscal quarter.

Findings Regarding the Pilot System’s Interoperability

What Mileage Reporting Methods Tested Support Interoperability?

Interoperability is highly dependent on the particular MRM selected by a participant; only the MRMs with location-measuring features can distinguish between miles driven in other jurisdictions. To be eligible for the Oregon-Washington interoperability test, participants had to choose the plug-in device with GPS option. This was the most reliable MRM used in the pilot for distinguishing miles driven by jurisdiction.

¹²Steering Committee Final Report of Findings for the WA RUC Assessment & Pilot Project. (2019). Volume 2, Chapter 3. Section 3.5, Page 36.

How Were Funds Reconciled Across Jurisdictions?

The HUB database created for this program was designed to allow cross-jurisdiction charges and payment reconciliation for miles driven out of State. The HUB received data in various formats and stored monthly aggregate travel reports from each participating jurisdiction. For Oregon and Washington, the HUB required no changes in reporting format because both States had used existing open data standards that defined jurisdictions similarly. No PII was collected in the reporting. In addition, the HUB itself was flexible to accept data, reports, and funds either directly from commercial account managers in an open system or from States. It was also designed with the capability to perform select data management functions, and it had the potential to reduce administrative costs of participating States' RUC systems.

The HUB successfully processed four quarters of multi-jurisdictional driving data from Washington, Oregon, Idaho, and British Columbia. Participating jurisdictions were required to report data on a monthly basis. States that plugged their RUC systems into WA RUC's HUB came to an agreement on the basic data standards, but this did not require numerous bilateral agreements.

Key Findings on Interoperability and Reconciliation

Interoperability and reconciliation with other jurisdictions worked efficiently and effectively when utilizing the WA RUC HUB form developed for the pilot. However, a range of issues would still need to be resolved for full-scale system interoperability. These issues include the legal authority for collection and remittance of other States' RUC, ownership and governance of the HUB itself, and the structure of the HUB entity so that other States also agree to use the HUB for interoperability. The Road Usage Charge Assessment Final Report (2020) concluded that, with the HUB database there was no additional effort required by the participants compared with a single jurisdiction RUC, aside from educating participants on the billing statement.

PRIVACY PROTECTION AND SECURITY OF TECHNOLOGY

This section discusses data privacy and technology security aspects of the WA RUC pilot. Table 10 provides the evaluation questions and WA RUC-specific questions about privacy protection and technology security. The key aspects related to this topic include:

- Identification of privacy-related RUC data collected and managed in the WA RUC pilot
- Key findings regarding public perception of RUC privacy
- Key goals for a model RUC privacy policy, including a comparison of Washington State's privacy laws with the model RUC privacy policy developed by WA RUC

Table 10. Evaluation and site-specific questions used to assess road usage charge data privacy and security aspects.

Evaluation Questions	Site-Specific Questions and Metrics
What types of data were required to be collected as part of the pilot?	<ul style="list-style-type: none"> • Types of sensitive participant information collected in comparison with data already collected by the Washington State Department of Licensing system
How is the public perception of privacy and data security of road usage charging (RUC)?	<ul style="list-style-type: none"> • What was the general public’s perception on privacy in an RUC program? • How important was privacy as a consideration to the RUC participants? • How concerned were pilot participants about unauthorized use of their data? • How important was data security as an RUC principle? • What opinions did users of an automatic mileage reporting device have concerning privacy?
What are the pilot’s findings on legal protections of privacy in an RUC system?	<ul style="list-style-type: none"> • What are the key goals and recommendations of WA RUC’s Model RUC Privacy Policy? • What were the gap analysis findings of Model RUC privacy policy against existing privacy protections in Washington State?

Types of Data Collected

What Types of Data Were Required to Be Collected as Part of Washington State’s Road Usage Charge Pilot?

The WA RUC pilot required collecting identifying information, financial and accounting information, and distance traveled information including when and where the distances were traveled. Table 11 presents the data type collected as part of the WA RUC pilot and if those data types are currently collected by the DOL system. While most of the information overlap with typical data fields required for financial accounting systems, the data type of greatest concern is the correlation in time of one’s location and routes of travel in the case of GPS-enabled MRMs.

Table 11. Data types collected for the road usage charge pilot and their presence in existing Washington State Department of Licensing systems.

Data Type Collected for the Pilot	Collected in Washington State Department of Licensing System
Vehicle registration license plate number	Yes
Vehicle identification number	Yes
Owner/lessee name	Yes
Owner/lessee contact information	Yes
Distance traveled data (e.g., odometer readings, latitude/longitude information, travel pattern data)	No
Travel data records	No
Financial information	Potentially
Billing and payment records	Yes
Mileage meter identifier (ID) code	No
Road usage charge (RUC) enforcement record	No
RUC account ID	No

Public Perception of Privacy in the Road Usage Charge System

One means to address privacy concerns about the information collected in the pilot is to give participants the choice of several MRMs. The next section summarizes key findings from three surveys about public perception of RUC data privacy.

What Was the General Public’s Perception on Privacy in a Road Usage Charge Program?

Privacy concerns before and during the WA RUC pilot were varied. A phone survey conducted with Washingtonians prior to the pilot found that nearly one in three respondents considered the collection of personal information a good reason to oppose an RUC policy. The public survey conducted before the RUC pilot began showed that 20 percent of respondents ranked privacy as the most important issue in an RUC.

How Important Was Privacy as a Consideration to the Road Usage Charge Participants?

Out of nine RUC concerns identified in the survey, respondents ranked RUC data privacy as the most important. This topic maintained the highest response in each of the three sequential participant surveys, with 83 percent, 90 percent, and 89 percent of respondents indicating RUC data privacy was a very important principle to them.

How Concerned Were Pilot Participants About Unauthorized Use of Their Data?

The surveys conducted during the pilot uncovered the following concerns about unauthorized use of private data:

- Nearly half of the respondents indicated they were satisfied that information collected from the pilot would be protected from unauthorized use
- In a working group study, participants who were concerned about privacy had questions about how and with whom the U.S. Government might share the data and wanted the ability to control the data (i.e., not share it); participants did not want their data shared

with car insurance companies and law enforcement, and they were worried about public disclosure laws

How Important Was Data Security as a Road Usage Charge Principle?

In surveys conducted during the pilot, data security had the third most important guiding principle for WA RUC participants. In the three surveys conducted, 74 percent, 77 percent, and 75 percent of respondents indicated RUC data security was a very important principle. Data security concerns did not appreciably change during the course of the pilot.

What Opinions Did Users of Automatic Mileage Reporting Device Have Concerning Privacy?

Many participants considered automatic mileage reporting an invasion of privacy, while others were comfortable with it. The following are user opinions about data privacy of automatic mileage reporting devices:

- Some participants considered automatic MRMs an invasion of privacy, while others were comfortable with it; a concern common to both groups were whether the device would rely on GPS and who/what would receive and own the data
- Among participants for whom privacy was paramount, there was a preference for choosing manual methods such as a mileage permit or self-report their miles
- Despite the high rating of privacy in an RUC system, a device plugged into the vehicle was still the most popular MRM; participants by and large preferred simplicity over privacy when choosing their mileage reporting option

Gaps in Legal Protections of Privacy

The WA RUC Steering Committee identified legal protection gaps in the Washington State's current privacy laws. For instance, there is currently no exemption of RUC data in public disclosure laws. Thus, the Steering Committee suggested that RUC-related data should be afforded protections similar to tolling data in the State. WA RUC developed a model RUC privacy policy to address RUC-specific data and data privacy needs. The Road Usage Charge Assessment Final Report (2020) concluded that the State's law needs to be augmented with the proposed model RUC privacy policy in order to support a full deployment of RUC.

What Are the Key Goals and Recommendations for a Model Road Usage Charge Privacy Policy?

A key activity of the WA RUC pilot was developing a model RUC privacy policy to address known privacy concerns. Table 12 lists the WA RUC Steering Committee's key recommendations for a model road usage charge privacy policy.

Table 12. Washington State’s recommendations for a model road usage charge privacy policy.

Model Road Usage Charge (RUC) Privacy Policy Aspect	Recommendation
Purpose	Clearly state the purpose of the model RUC privacy policy as protecting personal information collected under an RUC program from disclosure.
What information to protect	Identify the RUC information to be protected in the model privacy policy.
Definition of personal information	Define personal information that should be protected from disclosure as anything related to an RUC payer. Provide exceptions for anonymized information that is well safeguarded.
Responsibility of protecting personal information	Designate a responsible agency for protecting personal information in an RUC program. Responsibility should reside with whoever holds the information with adequate oversight for the task.
Whether responsible agency can operate as service provider	Provide drivers a government service as against commercial service provider choice by designating a State government agency to operate as an RUC collection provider. Surveys indicate that some individuals inherently trust commercial providers more than government whereas others trust government more.
Nature of protection	Address the nature of the protections afforded RUC data in the State. Address the specific requirements, limitations, and prohibitions directly related to protection of personal information collected for an RUC program and direct service providers and the authorized agency to establish, publish, and adhere to an organizational usage and privacy policy available in writing.
RUC personal information as a public record	Categorize RUC information as a public record according to a State’s public records laws but explicitly exempted it from disclosure.
Exceptions to nondisclosure of RUC data	Exempt from nondisclosure: operators of the RUC and RUC payment systems, personal exemptions the RUC payer has made to his/her own data, and law enforcement activities with probable cause.
Rights that should be afforded an RUC payer	Provide the RUC payer the right to access, examine, and rectify errors in personal information and the erasure of location and metered use data after the data are no longer needed after a specified period. Exceptions may include consent of the RUC payer, anonymized aggregated information used for research, and monthly summaries for accounting purposes.

Table 12. Washington State’s recommendations for a model road usage charge privacy policy. (continuation)

Model Road Usage Charge (RUC) Privacy Policy Aspect	Recommendation
Informing RUC payer of their rights	Provide payers information at first engagement about their rights and how to exercise them.
Responding to a request for exercise of rights	Mandate that service providers must never refuse a request for the exercise of one’s rights.
Consent	Define consent as “freely given, specific, informed, unambiguous indication of the RUC payer’s wishes.” Provide for express approval for sharing of personal information. Provide for the RUC payer to be able to withdraw consent of approval.
Treatment of RUC payers	Prohibit service providers from discriminating against RUC payers when they exercise their rights. Different pricing should be allowed only when the difference is directly related to the value provided. (Note: Some service providers provide value-added services related to the telematics data collected from the vehicle.)
Security measures	Require the service provider to implement measures to protect personal information to a level commensurate with the risk of disclosure.
Security breach notices	Require the service provider to notify the authorized agency upon a breach occurring. Information should address the nature and impact of the breach.
Compliance	Require a service provider to designate a personal information officer as the contact individual for RUC payers for compliance purposes.
Certification	Require an authorized agency to establish certification mechanisms and means for service providers to demonstrate compliance.
Remedies	Adopt a variety of remedies that RUC payers may utilize when their rights are violated. Address the nature of the remedies, including penalties.
Choice of reporting methods	There is no need to provide such a policy as this topic should be addressed in the State’s authorizing legislation for an RUC.
Preemption	In most States it is unnecessary to include a clause about State preemption of local laws and is therefore not needed in an RUC privacy policy.
Anonymization of information and data	Require anonymization of location and metered use data “if an RUC payer consents to retention of the data beyond the 30-day erasure period following the later of payment, dispute resolution or noncompliance investigation.”
Record of access	Ensure the policy requires service providers to maintain a record of access to personal information the service provider holds.

What Were the Gap Analysis Findings of the Model Road Usage Charge Privacy Policy Against Existing Privacy Protections in the State of Washington?

Given the historic and pilot-specific privacy concerns of RUC data, the WA RUC Steering Committee performed an analysis of Washington State’s existing privacy laws to determine gaps in its protection of RUC data; table 13 lists key observations and takeaways.

Table 13. Washington State’s observations and takeaways about gaps in existing data privacy protections.

Topic	Observation	Takeaway
Differences in protected information	Road usage charge (RUC) data unique to RUC includes distance traveled data, travel data record, RUC account identifier (ID) information, mileage meter IDs, and RUC enforcement records. Much of the existing privacy-protected data in current State systems are not present in an RUC system.	Applying the model RUC privacy policy to Washington State would require an RUC-specific definition of personal information.
Territorial scope	Washington State used only commercial service providers in the RUC pilot.	Either type of service provider (government or commercial) can be promoted, however both must comply with privacy protection provisions.
Personal information processing principles	Protections on the disclosure of private information are different than existing Washington State Department of Licensing (DOL) systems; current law is less specific about who can use protected information	Application of the model privacy policy should provide for specific requirements on data use, who can use it and requirements for data security auditing.
Statutory Rights	The laws governing DOL do not establish the statutory rights for data-related rights as defined in the model RUC privacy policy.	Establishment of statutory protection of data-related rights should be required before implementing an RUC program.
Data security	Current laws are less specific on security and provide flexibility for the DOL to customize such provisions in contracts.	Security provisions in an RUC system will likely need to be clarified in order to meet needs of privacy advocates.
Use of personal information officer	DOL does not currently require such an officer but could if needed.	The model RUC privacy policy is much more robust with a requirement for a personal information officer whose duties address the establishment and compliance with organizational usage and privacy policies.
Remedies available to users of RUC system	DOL only requires subsequent denial of access to personal information in case of a violation of a nondisclosure contractual requirement; Federal Driver’s Privacy Protection Act of 1994 (Public Law No. 103-322) provides strong remedies for disclosure of protected information; civil cause of action remedies are available to drivers.	Model RUC privacy policy is much more specific and robust about remedies available to drivers whose private information is compromised.

Key Findings on Privacy and Data Security

The pilot concluded that while Washington State privacy laws provide some protection, an RUC system should be backed up more strongly by enacting the model RUC privacy policy in legislation and mandating its specific privacy protections.

CONGESTION MITIGATION

The WA RUC pilot did not explore the possibility of incorporating technologies that support congestion pricing.

Key Findings on Congestion Mitigation

The Steering Committee determined that the vision of combining congestion pricing with the WA RUC system was not feasible. Incorporating congestion pricing with RUC would potentially require the WA RUC system to determine when a vehicle is traveling within a congestion-priced zone, in turn requiring MRMs with GPS for all vehicle owners. The Steering Committee found that limiting all users to GPS-enabled MRMs would violate the principle of consumer choice in mileage reporting.¹³ Of the participants enrolled, 89 percent stated in the post pilot survey that privacy was their top concern. To protect personal privacy, especially with respect to location, the WA RUC system was designed, tested, and evaluated to reflect the fundamental design principles of privacy protection and consumer (or user) choice in mileage reporting.

EASE OF COMPLIANCE AND TRANSPARENCY

This section presents findings from the WA RUC pilot regarding ease of compliance, transparency, and user awareness of cost in accordance with the questions outlined in table 14. Ease of compliance refers to how easily the system can be complied with or, conversely, circumvented and the ability of program managers or law enforcement to identify instances of evasion. Transparency refers to user awareness of what they are being charged and the basis for the charge.

¹³Steering Committee Final Report of Findings for the WA RUC Assessment & Pilot Project. 2019. Volume 2, Chapter 9, Page 140.

Table 14. Evaluation and site-specific questions used to analyze the ease of road usage charge system compliance and the transparency of cost information.

Evaluation Questions	Site-Specific Questions and Metrics
What compliance mechanisms were explored in the pilot?	<ul style="list-style-type: none"> • How did the system enforce compliance? • Were any attempts to circumvent the system observed?
Was it easy for users to comply with the system?	<ul style="list-style-type: none"> • What level of effort was required of users? • Were differences were observed in the mileage reporting approaches tested?
What information was communicated to the driver and at what frequency?	<ul style="list-style-type: none"> • Did the mileage reporting methods collect and communicate information (fee, mileage, cumulative trip mileage/fee, or cumulative period mileage/fee) to the driver in real time? • What were pilot participants' perceptions regarding transparency and ease of compliance?
Where were the findings regarding the Washington State road usage charge system's transparency?	<ul style="list-style-type: none"> • Can drivers understand where and when fees were accrued after driving has occurred? • Did the participants know before a trip starts about how much the fee rate and the total fee for trip? • Can drivers easily understand and access their cumulative fee?

Compliance Mechanisms

Because the pilot was a volunteer effort, the enforcement of participant compliance was not a focus. The team conducted a tabletop exercise to identify how system avoidance or evasion could be attempted. Two key areas identified include:

- Odometer rollback on vehicles that are not serviced by a licensed mechanic
- Users having two identical vehicles and submitting odometer images from one-another

The team developed the following list of potential approaches to combating noncompliance and evasion:¹⁴

- Policy/legal:
 - Make RUC prepay
 - RUC applies to the vehicle
 - No refunds for fuel taxes (this would stop refunds for fuel purchased and taxed out of State)
 - Limit mileage exemptions on manual methods (no credits for out-of-State or nonpublic miles)
 - Charge for the time a vehicle is not enrolled in RUC or an MRM is not plugged in
- Operational approaches:
 - Education campaign
 - Special payment options for drivers with financial limitations
 - Promote automation, such as auto-pay
 - Flag certain behaviors for audit, such as frequent unplugging of devices, dramatic decreases in miles traveled, and recurring suspicious odometer readings

¹⁴Washington State. 2020. Road Usage Charge Assessment Final Report. Vol. 2, Section 11.4, Page 165.

- Implement penalties for noncompliance
- Ensure account managers have clear and concise terms and conditions
- Ensure account managers use rigorous information technology standards
- Technology approaches to combat RUC avoidance:
 - Validate the vehicle's vehicle identification number and license plate number at sign-up
 - Always store the most recent odometer record within a database for all mileage reporting options
 - Require annual odometer photo for all mileage reporting options, even the plug-in devices
 - Require quarterly odometer submissions for manual methods
 - Require the app to capture images in near real time (not use stored images)
 - Require the app to detect suspect images
 - Require the account manager to detect correct vehicle and simple GPS jamming

Ease of Compliance

The WA RUC pilot found the MRMs that were simpler for participants to use had the highest level of compliance, and those that required more effort for participants to use had lower levels of compliance. Figure 15 shows the relative level of effort for each MRM. The odometer reading required users to submit a photo of the odometer every quarter. The account manager would send notices to the participants, who would then go to the vehicle, capture the odometer image with a phone or a camera, and upload the image to the account manager. This approach had a 35-percent compliance rate for the vehicle enrolled. Although the smartphone app required participants to capture an image of the odometer, it saw a higher compliance level, which the WA RUC team attributed to availability of a direct link to the odometer-capture function embedded in the app.

The plug-in devices had an 80-percent compliance rate and required little effort from the participants once installed in the vehicle. The pilot found that noncompliance usually resulted from devices becoming unplugged or faulty devices that required replacement. The off-the-shelf device did require more effort for setup, as an additional account needed to be created and linked to the account manager's account, which caused issues for some participants.

Level of effort and time	Mileage Permit	Odometer Reading	Smartphone App (MileMapper)	DriveSync Plug-in Device	Off-the-Shelf Plug-in Device
Enroll	Low	Low	Low	Low	Low
Create Account	Low	Low	Low	Low	Low
Enroll Vehicle	Low	Low	Low	Low	Medium
Set-up method	Low	Low	Medium	High	High
Activate method	High	High	Medium	Low	High
Drive and Report Mileage	High	High	High	Low	Low

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Figure 15. Table. Level of effort and time required to start actively reporting mileage.

Communication of Information to Driver

Did the Mileage Reporting Methods Collect and Communicate Information (Fee, Mileage, Cumulative Trip Mileage/Fee, or Cumulative Period Mileage/Fee) to the Driver in Real Time?

The per-mile fee of 2.4 cents was established for all mileage in the program, aside from those users participating in the inter-State portion of the pilot. Participants were aware of this fee from the beginning of their involvement and were reminded of this fee at the time of invoicing. None of the MRMs tested in the pilot actively showed the fee amount that had been charged, but users were able to reference invoices and the program literature at any point.

What Was the Perception of the System’s Transparency Among Pilot Participants?

Seventy percent of pilot participants rated transparency as their top priority in the post pilot survey, which was 6 percent lower than the prepilot survey. A majority of participants (53 percent) stated their understanding of RUC was better after the program.

Did the Participants Know Before a Trip Starts About How Much the Fee Rate and the Total Fee for Trip?

Participants did not know the total fee for the trip, but the per-mile fee of 2.4 cents was communicated to them from the beginning of their involvement. The mileage permit MRM was a prepay option, which gave participants a set number of miles to expend under their permit. Because the fee is prepaid, drivers had already paid the cost for the set number of miles covered under the permit.

Can the Driver Understand Where and When Fees Were Accrued After Driving Has Occurred?

Users who chose the GPS-enabled OBD-II device had access to a log of their trips, and users of the MileMapper smartphone app had a record of the mileage driven out of State. Any MRM that did not utilize GPS did not provide users with a per-trip basis of their mileage accumulation. The WA RUC pilot used invoices as the main tool of communicating with participants, and the pilot team devoted resources to designing user-friendly invoices.

The following are lessons learned from WA RUC’s invoice design:¹⁵

- It is important to have a prominent “No Activity” message. This message was used to inform participants that they had submitted no mileage data for a given invoicing period. By sending a “No Activity” message, participants were encouraged to report mileage in a future invoicing period.
- Invoices should be kept concise and clear and kept to as few pages as possible to convey the information. Former vehicles should be omitted from invoices where they had no driving activity.
- A range of unique cases required different handling of invoices. Different MRMs had different monthly or quarterly invoicing cycles. Participants who switched service providers or reporting methods stated that they were confused by the variation in formats. To mitigate the risk of confusion and processing errors, WA RUC set up a monthly process to review samples of invoices for each case and MRM before distributing invoices to participants. It is anticipated that in future large-scale implementation, invoices will be generated, processed, and distributed on a rolling basis instead of synchronizing them with a calendar month to ensure management efficiency.

Figure 16 shows a participant's driving invoice for differentiated mileage between jurisdictions.

Key Findings on Ease of Compliance and Transparency

The pilot allowed Washington State drivers to directly experience a pay-per-mile system and share their opinions on what matters most—and what should change in any future system. In the WA RUC pilot, the ability for drivers to see their RUC charges in real time would depend on the specific MRM used. While none of the automated MRMs had this feature, the flat fee and regular invoicing used in the program should give participants an understanding of the per-mile charges associated with driving. The pilot project help desk was an important connection for participants and nonparticipants to ask a range of questions, such as customer account questions and policy-level questions about RUC in Washington State. Participatory design also allowed improvements to invoices before they were sent to participants. Users were invited to comment on the invoice prototypes during focus groups and surveys. Their feedback improved the invoice content and displays, which should have resulted in fewer invoice inquiries to the help desk.

¹⁵Washington State. 2020. Road Usage Charge Assessment Final Report. Vol. 2, Section 6.3.3, Page 82.

Odometer Reading

Day	Odometer Reading (mi.)	Reading Type	Distance Driven (mi.)
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Charges

Jurisdiction	Distance Charged (mi.)	Distance Not Charged (mi.)	RUC Rate (\$/mi.)	Road Usage Charge (\$)	Gas Consumption (gal.)	Gas Tax Rate (\$/gal.)	Gas Tax Credit (\$)	Net RUC (\$)
OR	286.1	3.8	0.017	4.86	13.79	0.340	(4.70)	0.16
All other miles	48.8	0.0	0.024	1.18	2.39	0.494	(1.16)	0.02
BC	154.6	8.5	0.000	0.00	9.75	0.000	0.00	0.00
WA	1,524.5	6.5	0.024	36.60	56.74	0.494	(27.95)	8.65

8.83

Total (\$)

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Figure 16. Illustration. A participant’s driving invoice for differentiated mileage between jurisdictions in the Washington State road usage charge pilot.

EQUITY ANALYSIS

This section examines the equity-related findings regarding RUC and the opinions and understating of populations of special concern, such as low-income and minority residents.

Table 15 presents the evaluation questions and WA RUC-specific questions regarding equity.

Table 15. Evaluation and site-specific questions used to analyze road usage charge program equity.

Evaluation Questions	Site-Specific Questions and Metrics
Was there analysis conducted regarding equity considerations of the proposed road usage charge (RUC) program?	<ul style="list-style-type: none"> • Do the users pay a fair share based on road usage? • How do user costs impact people in different income brackets and of different background (ethnicities, gender, English proficiency, etc.)? • Does the program include measures to mitigate inequities?
What were the opinions/understanding of populations of special concern, such as low-income and minority residents?	<ul style="list-style-type: none"> • What opinions did minority residents hold on specific matters related to the RUC concept? • What opinions did minority residents hold on specific matters listed in above about the version of the RUC that was piloted?

The WA RUC pilot defined equity as a guiding principle for RUC implementation with a focus on fairness or user-pays principle. In the prepilot surveys described in the “Public Perception and Acceptance of Road Usage Charge” section, 59 percent of participants rated equity as “very important,” placing it sixth among the nine principles identified in the survey questionnaire. When participants were asked if RUC or the gas tax was fairer for funding roads, 44 percent chose RUC, 8 percent chose the gas tax, and 13 percent said both were equally fair. Rural participants were less likely to prefer the gas tax over RUC and urban and suburban participants were equally likely to choose RUC. These figures did not appreciably change over the course of the pilot. Detailed and extensive analysis of equity implication of road usage charging was not part of this phase of the WA RUC pilot.

“The dimension of equity that stood out most in the open-ended comments was the notion of paying for use, with 39 percent of respondents alluding to that definition of fairness, and over 80 percent citing similar concepts such as paying for road impact, damage, and upkeep; paying for distance traveled; paying your share; or paying for benefits received from the roads.”

~ Washington State’s Road Usage Charge Assessment Final Report (2020)

AUDIT ANALYSIS

This section examines the findings regarding RUC and the ability of external entities to audit the proposed system. Table 16 presents the key evaluation and site-specific questions on this topic. Since the ability to audit the system was not a significant focus of this phase of Washington’s RUC explorations, some evaluation questions were not relevant to the current scope of work.

Table 16. Evaluation and site-specific questions used to analyze the ability to audit the road usage charge program.

Evaluation Questions	Site-Specific Questions and Metrics
What were the findings regarding the Washington State road usage charge system’s ability to audit?	<ul style="list-style-type: none"> • What data were collected to test the system’s ability to audit? Did the mileage reporting methods produce data that could be used for auditing purpose? • What methods were used to gather information about system’s ability to audit?

Ability to Audit

A project help desk was established to ensure that participants could call or email the WA RUC project team to ask questions about the pilot. The help desk assisted pilot participants for any ongoing customer service during the pilot, including questions on charges. No charges dispute procedure was specified in the Road Usage Charge Assessment Final Report (2020).

Did the Mileage Reporting Methods Produce Data That Could Be Used for Auditing Purpose?

The organizational design for WA RUC required the RUC authority to collect large quantities of data from end users or service providers on a regular basis. This function covers handling data that includes conducting audits of service providers or agency divisions responsible for data to ensure compliance with content, privacy, and security requirements.¹⁶ However, the WA RUC pilot did not test enforcement, since a voluntary activity offered little value for assessing the effectiveness of enforcement measures. Despite the limited ability to employ enforcement measures, the pilot program conducted an RUC avoidance tabletop exercise to determine all possible ways to avoid RUC, including both deliberate (evasion) and accidental (negligence).\

What Methods Were Used To Gather Information About the System's Ability To Audit?

Three measures to address evasion behavior were identified in the tabletop exercise: policy/legal, operational, and technological. Examples of key measures included requiring prepayment of RUC, requiring outstanding RUC obligations to follow the vehicle (not the owner), not allowing net refunds for fuel taxes (or not applying RUC to vehicles that already pay more per mile in fuel taxes), developing smart algorithms for initiating audits of motorists, applying escalating civil penalties for noncompliance, and applying the time permit as a backstop for vehicles that fail to comply.¹⁷ The tabletop exercise also suggested to flag certain behaviors for audit, such as: frequent/long unplugging of plug-in devices, dramatic decreases in miles traveled, and recurring suspicious odometer images.

SYSTEM COSTS

As stated in the Road Usage Charge Assessment Final Report (2020), the demonstration was too small to accurately reflect the potential cost of collection for the MRM approaches tested. The report outlines the potential variables that would affect cost, such as the number of vehicles enrolled, the types of mileage reporting options available, and the per-mile rate. A financial assessment model conducted during the assessment estimated cost of collection to be between 4 and 18 percent. For comparison, the current motor fuel tax, which is collected at the wholesale level, is estimated to be approximately 1 percent collection cost.

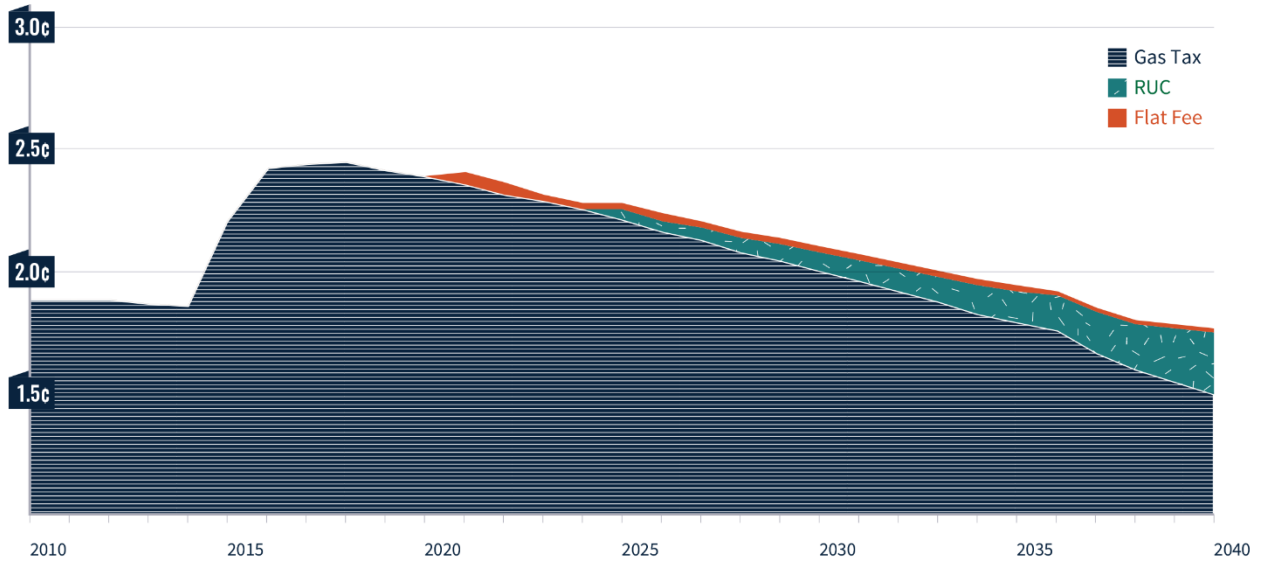
The report states the cost of collection should be measured against additional revenue that the fee generates, and while the RUC collection cost is certain to be higher than the motor fuel tax collection cost, the higher cost is offset by the additional revenue that RUC could generate. A

¹⁶Steering Committee Final Report of Findings for the WA RUC Assessment & Pilot Project. 2019. Volume 3.

¹⁷RUC Evasion Tabletop Exercise. 2019. Materials presented at May 2, 2019, Washington State Road Usage Charge Steering Committee meeting, SeaTac, WA.

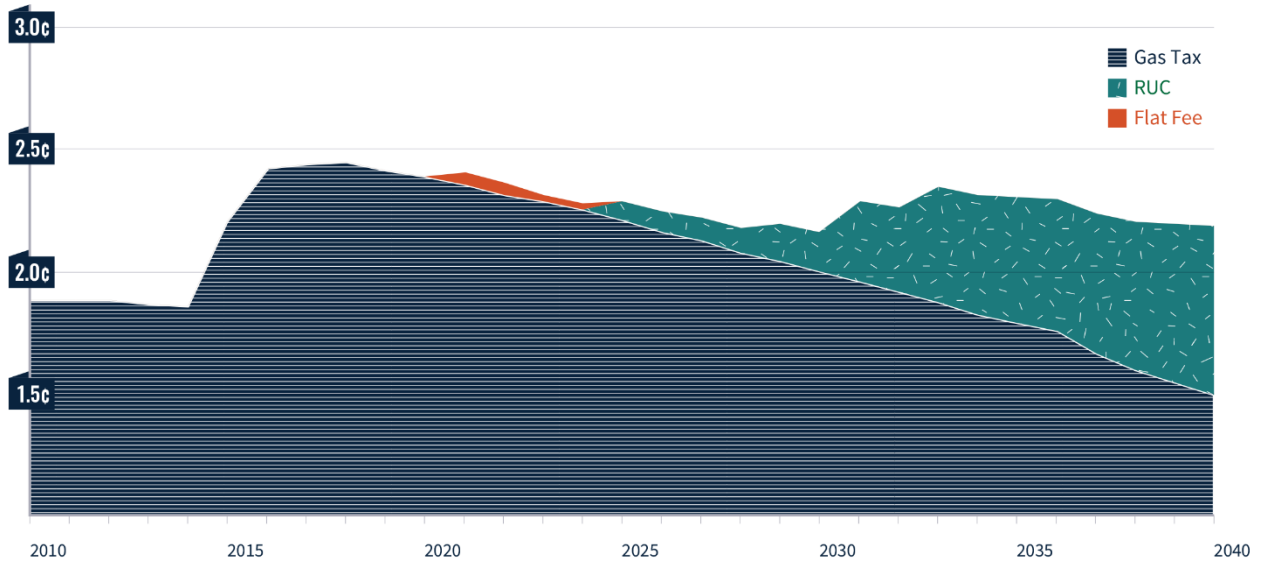
series of revenue models show the potential impact of different applications of RUC and how they affect the overall revenue on a per-mile basis, assuming a 10-percent RUC collection cost and a continually more efficient fleet that starts at 20 miles per gallon in 2020 and nearing 30 miles per gallon in 2040.

Figure 17 shows the revenue impact if RUC was only applied to electric vehicles. Figure 18 shows the per-mile revenue impact if RUC was gradually applied to vehicles based on fuel efficiency. Figure 19 shows the per-mile revenue impact if RUC was applied on all new vehicles starting in the year 2025.



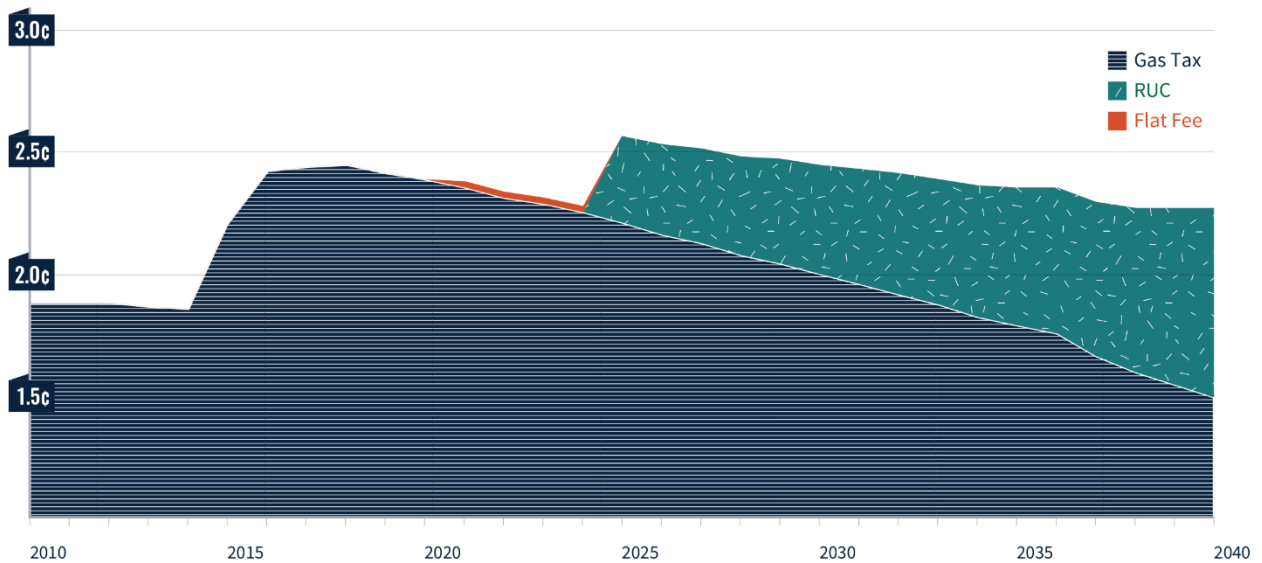
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Figure 17. Graph. Revenue impact of applying road usage charge (RUC) to electric vehicles only.



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Figure 18. Graph. Revenue impact of gradually applying road usage charge (RUC) by vehicle mile per gallon (MPG) rating, from 50+ to 30+ MPG over the course of a decade.



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Figure 19. Graph. Revenue impact of applying road usage charge (RUC) for all new vehicles sold in 2025 and later.

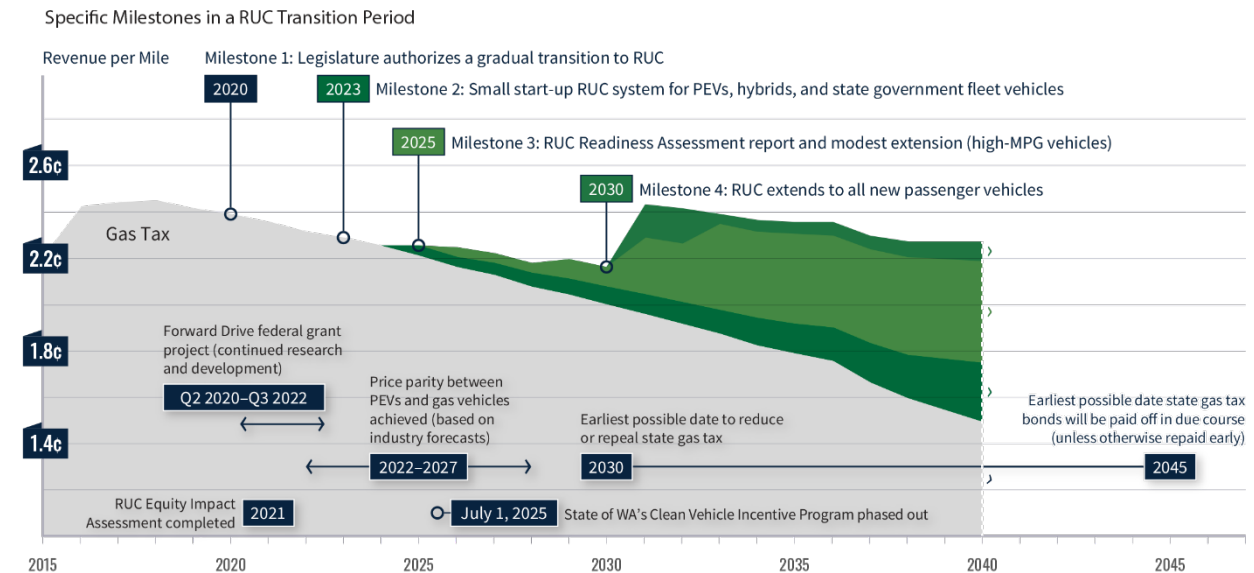
Transition to Road Usage Charge in Washington State

Washington State’s Road Usage Charge Assessment Final Report (2020) presented a plan for gradually transitioning to a statewide RUC for legislative consideration that allows for continued research and testing through the initial start-up phases. This transition plan also identified

research and testing that could continue through the phased approach. The report lists the following transition recommendations:

- Begin a gradual, narrow transition to RUC now; full implementation could take 10–25 years
- Create a small start-up phase to include vehicles that pay little or no gas tax (plug-in electric vehicles and hybrids) and State agency vehicles
- Continue research and testing before and during this start-up phase, including assessing potential equity effects of RUC and identifying possible mitigation:
 - Identifying performance and efficiency measures that can be tested during the start-up phase
 - Exploring new MRMs
 - Identifying ways to improve RUC operations, increase compliance, reduce administrative costs, and accurately determine and efficiently manage cross-border travel challenges

The report identified key milestones in the transition to RUC (figure 20), with each milestone marking a new stage in the transition away from gas tax through incremental increase in the number of vehicles enrolled in an RUC system.



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MPG = miles per gallon; PEV = Plug-in Electric Vehicle.

Figure 20. Graph. Milestones identified by Washington State Transportation Commission in a proposed road usage charge (RUC) transition period.

CHAPTER 5. SUMMARY AND CONCLUSIONS

The independent evaluation assessed the effects of STSFA-funded activities in a systematic manner across all sites. The following are key findings of the evaluation, using FAST Act evaluation criteria, of Washington State's phase II initiatives:

- **Technical accuracy, precision, and repeatability of MRMs.** Providing a broad range of technology options to report mileage allows drivers to decide which trade-offs to make according to their needs, preferences, abilities, and sensitivities. The following are key findings of the WA RUC pilot MRMs:
 - Manual MRMs had the highest implementation maturity but ranked low on usability and accuracy because they did not differentiate the taxable and nontaxable miles
 - The smartphone app tested in the pilot could not reliably determine the specific vehicle being driven and driver/passenger roles because there was no straightforward solution to establish a connection between the smartphone and the vehicle without installing supplemental electronic tags or equipment
 - Manual MRMs required the most level of effort in activation and mileage reporting; the WA RUC pilot partnered with private businesses (i.e., VLOs) to support drivers who chose low- or no-technology MRMs and needed in-person assistance with mileage reporting
- **Public outreach and communication.** Outreach conducted by WSTC and pilot recruitment efforts served to increase the level of knowledge and understanding of a potential RUC among the residents of Washington State through broad outreach and media engagement for recruitment.
- **Public perception and acceptance of RUC.** The pilot served to enhance the level of acceptance of RUC among the participant pool, as evidenced through surveys and focus groups. The pilot also served to provide feedback to Washington State about the RUC principles of key importance to residents. This information may help enhance the program. The pilot and resulting program may benefit from surveying a greater diversity of constituents and using oversampling techniques to identify populations of interest stratified by income, education level, race, gender, and other demographic criteria.
- **Interoperability and reconciliation.** The WA RUC pilot successfully conducted a proof-of-concept demonstration of interoperability and funds reconciliation, in coordination with Oregon's OReGO pay-per-mile program, and in collaboration with neighboring jurisdictions. The proof-of-concept using WA RUC HUB was successful in demonstrating reconciliation of out-of-State miles and funds. However, for full-scale system interoperability a range of issues would need to be resolved, including legal authority for collection and remittance of other States' RUC and ownership and governance of the clearinghouse Washington State's Road Usage Charge Assessment Final Report (2020) concluded that with the HUB database, no additional effort was required by participants compared to a single jurisdiction RUC, aside from educating participants on the billing statement.

- **Privacy and data security.** The pilot concluded that while Washington State privacy laws provide some protection, an RUC system should be more strongly backed by law through legislating the model RUC privacy policy and mandating its specific privacy protections.
- **Ease of user compliance and transparency.** The pilot allowed Washington State drivers to directly experience a pay-per-mile system and share their opinions on what matters most—and what must change in any future system. In the WA RUC pilot, the ability for drivers to see their RUC charges in real time would depend on the specific MRM drivers used. While none of the automated MRMs had this feature, the flat fee used in the program and regular invoicing should give participants a clear understanding of the per-mile charges associated with driving. The pilot project help desk was an important connection for participants and nonparticipants to connect with the project and ask any questions, from customer service account questions to policy-level questions about RUC in Washington State. Participatory design also allowed improvements to invoices before they were sent to participants. The participants were invited to comment on invoice prototypes during focus groups and surveys, which improved invoice content and displays and should have resulted in fewer help desk invoice inquiries.
- **Congestion mitigation.** Incorporating congestion pricing into RUC would potentially require the WA RUC system to delineate when a vehicle is traveling in a congestion-priced zone, in turn requiring MRMs with GPS for all vehicle owners. The WA RUC Steering Committee found that limiting users to GPS-enabled MRMs would violate the principle of consumer choice in mileage reporting.

The scope of this phase of the pilot did not include significant exploration of system cost, equity, and the system’s ability to audit. Washington State’s Road Usage Charge Assessment Final Report (2020) lists some of these areas for detailed exploration in future phases.

IMPLICATIONS FOR NATIONAL IMPLEMENTATION

WSTC provided for legislative consideration a gradual, phased approach to transitioning to a full user-charge based system in Washington State. A similar inference may be drawn about a national RUC. Apart from the policy, legal, technical, and public acceptance considerations in an RUC implementation, the details of account management, business models, data security, and privacy protection would need to be further explored through limited, statewide, regional, or national pilots before a user-charge based system is eventually rolled out as an alternative to the current motor fuel tax approach.

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