Surface Transportation System Funding Alternatives Phase I Evaluation

Pre-Deployment Activities for a User-Based Fee Demonstration by the Minnesota Department of Transportation

December 2020

U.S. Department of Transportation
Federal Highway Administration

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16. Abstract

This report presents the independent evaluation results of pre-deployment activities for a user-based fee demonstration by the Minnesota Department of Transportation (MnDOT), which received fiscal year 2016 funding from the U.S. Department of Transportation's Surface Transportation System Funding Alternatives (STSFA) Program. MnDOT is one of eight entities to engage in pilots or pre-pilot planning and development activities to explore a variety of options to demonstrate user-based alternative revenue mechanisms.

The U.S. Congress and the Federal Highway Administration (FHWA) seek to understand whether user-based alternative revenue mechanisms that utilize a user fee structure can help maintain the long-term solvency of the Highway Trust Fund and can be implemented nationally at some time in the future. As part of this endeavor, FHWA is conducting evaluations of the eight grantee sites that received funding in Federal fiscal year 2016. The evaluation reports resulting from this process will make the Secretary of Transportation and U.S. Congress aware of the progress that has been made, lessons learned from initial pilot and planning efforts, the role of education and outreach, the potential for any negative impacts on constituents, and initial findings on administrative fees, among other issues.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
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 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 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 (2000 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	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the 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 ACRONYMS

ConOps	concept of operations
DBUF	distance-based user fee
FAST (Act)	Fixing America's Surface Transportation
FHWA	Federal Highway Administration
FY	fiscal year
MaaS	mobility-as-a-service
MFT	motor fuel tax
MnDOT	Minnesota Department of Transportation
PII	personally identifiable information
RUC	road usage charge
STSFA	Surface Transportation System Funding Alternatives
TRB	Transportation Research Board
USDOT	U.S. Department of Transportation
VMT	vehicle miles traveled

EXECUTIVE SUMMARY

This report presents the Federal Highway Administration (FHWA) independent evaluation results of Minnesota's Road Usage Charge (RUC) Program Enhancements to Improve Functionality, Public Acceptance, and Interoperability initiative. The State received fiscal year (FY) 2016 funding from the U.S. Department of Transportation's (USDOT's) Surface Transportation System Funding Alternatives (STSFA) program. There were seven project awards to State Departments of Transportation in California, Delaware, Minnesota, Missouri, Oregon (two), and Washington. The FY 2016 funding and associated grantee programs constitute the first phase of the STSFA program and are referred to throughout the document as "Phase I." The Minnesota Department of Transportation (MnDOT) is one of seven entities to engage in pilots that represent enhancements of independently funded pilots, or pre-pilot planning and development activities to explore options to demonstrate user-based alternative revenue mechanisms. In this instance, the term 'alternative revenue mechanism' represents income generated from a source other than the gas tax that sustains the Highway Trust Fund.

BACKGROUND

As vehicles are becoming more fuel efficient, the reliability and adequacy of the motor fuel tax (MFT) as a primary source for transportation infrastructure funding continues to decline. Recognizing this trend, the Fixing America's Surface Transportation (FAST) Act[1] 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 this STFSA program are to:

- Test the design, acceptance, and implementation of two or more future user-based alternative revenue mechanisms.
- Improve the functionality of the user-based alternative revenue mechanisms.
- Conduct outreach to increase public awareness of 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.

The FHWA Office of Operations headquarters staff have the overall responsibility for administering the STSFA program and overseeing the independent evaluations. The FHWA Division office staff provide direct support by overseeing the program in participating States.

[1] Federal law that provided long-term funding for surface transportation infrastructure planning and investment. Public Law 114–94, H.R. 22, § 6020, H.R. 22, 114th Congress. 2015.

The U.S. Congress and the FHWA seek to understand whether a revenue mechanism that utilizes a user fee structure can help maintain the long-term solvency of the Highway Trust Fund and be implemented nationally in the future. As part of this endeavor, the FHWA conducted evaluations of the seven grantee sites that received funding in FY 2016.[2] The evaluation reports will inform the U.S. Secretary of Transportation and U.S. Congress of the progress that has been made, lessons learned from initial pilot and planning efforts, the role of education and outreach, the potential for any negative impacts on constituents, and initial findings on administrative fees, among others.

MINNESOTA PRE-DEPLOYMENT ACTIVITIES FOR A USER-BASED FEE DEMONSTRATION

MnDOT, along with the University of Minnesota's Humphrey School of Public Affairs (hereinafter "Minnesota"), proposed to design and ultimately deploy a user-based fee mechanism by partnering with a mobility-as-a-service (MaaS) provider (e.g., car-sharing services). Minnesota's concept is based on the premise that the future of personal travel is captured in the new and evolving MaaS business model, which is rapidly redefining personal transport around the world. MaaS includes a range of new travel forms that promise greater efficiency, safety, and mobility. It provides a platform to explore a practical and implementable path toward wider deployment of distance-based user fees (DBUFs). Additionally, this platform and model may be transferable to other fleet applications in the future.

The goal of Minnesota's DBUF project is to design and demonstrate a viable model to collect user-based fees on shared mobility provider fleets. Embedded technology onboard these fleets is becoming the standard on new vehicles and enables the efficient administration and collection of user fees while maintaining user privacy and data security. The project assumes retention of the fuel tax, but will demonstrate a means to backfill revenue lost due to increasing fleet efficiency.

Minnesota's foundational assumptions defined their STSFA Phase I efforts. The Minnesota project suppositions include the following:

- A DBUF should operate in parallel to existing surface transportation revenue collection mechanisms and not seek to replace currently efficient methods.

- The Minnesota DBUF approach should take advantage of the trend toward increasingly available onboard telematics in new vehicles, which is particularly true for the shared mobility fleet of vehicles. Telematics refers to remote communications that allow information from the vehicle to be transferred to another source.

- Electric, hybrid, alternatively fueled, and other highly efficient vehicles should be charged a proportionate share for use of the roads. Minnesota believes that, under the current fuel tax approach, these vehicles are not paying their fair share towards the maintenance and upkeep of the transportation system.

[2] The Phase I evaluation for the eighth pilot site, Hawaii, is delayed due to delays in pilot start.

Phase I Vision and Goals

The vision for the Phase I activities was to strive to achieve broad public and consumer support; explore options for mileage fee rate setting to be rational and equitable, and capable of being adjusted to address vehicle type, roadway design, jurisdiction, time-of-day, and other factors; and for the model to be scalable to multiple service segments and exportable to other agencies.

Most critically, Minnesota's approach is to plan a migration to the new system that will be incremental, equitable, ensures privacy, and is cost effective.

MAJOR FINDINGS

The independent evaluation assessed the impacts of the STSFA-funded activities systematically across all sites. The key findings of the evaluation are summarized below.

Key Findings of the Minnesota Approach

Minnesota is approaching a user fee structure focused on efficiency. The Minnesota approach suggests that the fuel tax, despite its advantages and deficiencies, is likely to continue for a long time, primarily because of its simplicity and efficiency. The cost of collecting the fuel tax in Minnesota is less than 0.5 percent of the fees collected. Structuring a DBUF approach around the MaaS business model may afford a comparable level of efficiency to existing tax collection systems in the market, because onboard technology embedded in the MaaS vehicles is already used to collect trip and mileage data for the MaaS business. Minnesota aims to have DBUF collection costs fall between that of the fuel tax and sales tax.

Administrative costs. The expectation is that technology, operations, compliance, and enforcement costs will be lower in the Minnesota approach in comparison to some of the other pilot approaches. Several categories of potential changes to administrative costs attributable to the unique nature of distance-based fee collection processes will need to be accounted for in further research and exploration.

The user fee structure is premised on the convergence of potentially disruptive technologies, either in the market or on the horizon. Minnesota's proposed DBUF system is not a single technology or strategy but rather a series of agreements to collect mileage fees from commercial mobility operators. While the future of mobility remains uncertain, this approach allows for a high level of flexibility to adapt and expand. The DBUF system is a simple fee collection from a limited number of commercial mobility service operators and is neutral to the specific technologies deployed to measure vehicle mileage.

Minnesota's approach has the potential to enhance privacy and minimize security issues typically associated with RUC data collection by leveraging collected data using available technology. Minnesota conducted a survey of car-share members; 40 percent of the respondents had concerns related to DBUF, particularly regarding how their data will be protected. However, collecting mileage fees directly from the car-share company for the mileage driven for each vehicle does not necessitate the data or information collection about which driver has made a trip. The data collected can be based solely on the qualifying, fee-generating mileage for each specific vehicle, regardless of driver.

CHAPTER 1. INTRODUCTION

As vehicles become more fuel efficient, the motor fuel tax (MFT) has become less reliable as a primary source for transportation infrastructure funding. Recognizing this trend, the Fixing America's Surface Transportation (FAST) Act[3] of 2015 established the Surface Transportation System Funding Alternatives (STSFA) Program, which provides grants to States or groups of States to demonstrate user-based alternative revenue mechanisms to maintain long-term Highway Trust Fund solvency.

The Federal Highway Administration (FHWA) Office of Operations headquarters staff have the overall responsibility for administering the program. The office was also directed to conduct an independent evaluation of pilots deployed. FHWA Division office staff provide direct support by overseeing the pilots in participating States.

> ***"As States struggle to keep pace with increasing funding shortfalls and maintenance backlogs, lawmakers are exploring innovative approaches to increase revenues for transportation...A [road usage charge] goes one step further, potentially eliminating the need for a gas tax altogether, by charging drivers on a per-mile-driven basis. Proponents see this as a way to increase transportation revenues even as fuel purchases decrease and vehicle miles traveled increases, due to improved vehicle efficiency."***
>
> Source: National Council of State Legislatures, "Road Use Charges (RUC)" Web page. Available at: <http://www.ncsl.org/research/transportation/road-use-charges.aspx>. Last accessed April 5, 2019.

By funding road user charge pilots, the U.S. Congress and FHWA seek to understand whether a user fee structure, such as a road usage charge (RUC), could be implemented nationally in the future. The FHWA conducted an evaluation of seven of the eight grantee sites that received funding in Federal fiscal year (FY) 2016, which will be referred to as Phase I of the STSFA grant program throughout this report.[4] The evaluation reports will inform the U.S. Secretary of Transportation and U.S. Congress of the progress that has been made, lessons learned from initial pilot and planning efforts, the role of education and outreach, the potential for any negative impacts on constituents, and initial findings on administrative fees, among others.

It is important to note here that the evaluation team adopted the terminology used by the specific grantee sites in planning and executing their proposed programs. Similar concepts in different geographies may be referred to as "mileage-based user fee," "distance-based user fee" (DBUF), or RUC. Vehicle miles traveled (VMT) is also a term used to describe this strategy. Given the lack of a standard definition, these terms will be defined within the context of each grantee's program vision and activities.

[3] Public Law 114–94, H.R. 22, § 6020, H.R. 22, 114th Congress. 2015.
[4] The Phase I evaluation for the eighth pilot site, Hawaii, is delayed due to delays in pilot start.

BACKGROUND OF ALTERNATIVE TRANSPORTATION REVENUE EXPLORATIONS

For decades, economists and transportation experts have studied the potential for user-based revenue mechanisms, including various forms of RUC as an alternative to the fuel tax. A mileage-based fee falls within a class of innovative funding mechanisms that the States and the Federal government are considering using to help fund improvements and maintenance of the Nation's surface transportation infrastructure.

Oregon was the first State to explore a user fee mechanism based on mileage beginning in 2001. Since that time, several States have studied the potential for similar programs with fee structures based on VMT, with a few establishing pilots. In previous years, States either funded these efforts themselves, or they received grants under the U.S. Department of Transportation (USDOT)-sponsored Value Pricing Pilot Program. Additionally, previous authorization bills included language recommending VMT-related studies.

In 2010, FHWA released a broad agency announcement about a program entitled, "Exploratory Research on Technology Options for Collection of Road User Fees." The National Surface Transportation Policy and Revenue Study Commission was created in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)[5] in 2008, and recommended a RUC mechanism as an infrastructure funding source. The majority of the Policy Commission recommended that the next transportation authorization bill find alternatives to the fuel tax to fund surface transportation programs.[6] Further recommendations by the Commission suggested 2020 for the adoption of a RUC-based funding mechanism.

In 2011, the University of Iowa Public Policy Center conducted a 2-year field study, the National Evaluation of a Mileage-Based Road User Charge. The study evaluated technical feasibility and user acceptance of mileage-based charging as a potential replacement for the fuel tax.

The Moving Ahead for Progress in the 21st Century Act, a funding and authorization bill to govern United States Federal surface transportation spending, did not include dedicated funding to study RUC.[7] In 2013, several western States formed a coalition (Western Road User Charge Consortium) to share resources and explore innovative transportation funding solutions. Today, many of these States are represented as grantees in the current STSFA grant program. The formulation and rise of the STSFA grant program represents a new beginning and an opportunity for the USDOT and States to determine the applicability of RUC systems to help maintain the long-term solvency of the Highway Trust Fund.

[5] Public Law 109–59, H.R. 3, § 732, 109th Congress. 2005.
[6] U.S. National Surface Transportation Policy and Revenue Study Commission. 2007. *Report of the National Surface Transportation Policy and Revenue Study Commission: transportation for tomorrow*, Washington, DC. p. 53. Available at: <https://lccn.loc.gov/2008612699>, last accessed April 5, 2019.
[7] Public Law 112–141, H.R. 4348, 112th Congress. 2012.

MINNESOTA DEPARTMENT OF TRANSPORTATION'S PHASE I PROGRAM

Minnesota's concept is based on the premise that the future of personal travel is captured in the new and evolving Mobility-as-a Service (MaaS) business model, which is rapidly re-defining personal transport around the world.

This report presents the results and the evaluation of the Minnesota Department of Transportation's (MnDOT's) STSFA Phase I (FY 2016 grant cycle) pre-deployment activities for a user-based fee demonstration. MnDOT, along with the University of Minnesota's Humphrey School of Public Affairs (hereinafter "Minnesota"), propose to design and ultimately deploy a user-based fee mechanism by partnering with a mobility-as-a-service (MaaS) provider (e.g., car-sharing businesses). Minnesota's concept is based on the premise that the future of personal travel is captured in the new and evolving MaaS business model, which is rapidly redefining personal transport around the world. MaaS includes a range of new travel forms that promise greater efficiency, safety, and mobility. It provides a platform to explore a practical and implementable path toward wider deployment of DBUF.

Minnesota developed a document that outlines its approach to creating a pilot that represents a transferable and scalable model that is sustainable and fair. Minnesota's approach includes their following foundational assumptions:

- **Minnesota believes that the DBUF should operate in parallel to existing surface transportation revenue collection mechanisms and not seek to replace currently efficient methods.** The *Foundational Assumptions* document states:

  "the program should not risk collecting less revenues under a [vehicle-miles-traveled, or VMT] model than is now collected under the motor fuel tax (MFT) or collecting these fees in a manner that has greater risk or instability."

  This approach focuses on the efficiency of revenue collection with the proposed alternative approach.

- **According to Minnesota, the DBUF approach should take advantage of the trend of increasing availability of onboard telematics in new vehicles, which is particularly true for the shared mobility fleet of vehicles.** The *Foundational Assumptions* document states:

  "New vehicles are arriving factory-equipped to communicate with the cloud. DBUF collection model must be flexible to communicate to a diverse line of equipment and technologies for efficient data transmittal and for effective billing purposes. Today, the shared mobility environment has the capacity to seamlessly collect and transmit data sufficiently for the purposes of collecting DBUFs."

- **Electric, hybrid, alternatively fueled, and other highly efficient vehicles should be charged a proportionate share for use of the roads.** Under the current fuel tax approach, Minnesota believes these vehicles do not pay their fair share towards the maintenance and upkeep of the transportation system.

According to MnDOT's STSFA program manager, the foundational assumptions of the DBUF concept are a living document and are likely to evolve throughout the development and demonstrations of the concept. As the trials develop, the team plans to continue testing the legitimacy of these assumptions.

The key components of the Minnesota's Phase I activities include:

- Recruiting MaaS providers and determining policy requirements that take into account customer needs, data privacy, security, and enforcement requirements.

- Modeling pricing strategies as a surcharge calculated per mile (varying by vehicle types) or as a fixed percentage of MaaS charges.

- Designing back office operations, protocols, and software, including:

    - Addressing technology and processing needs specifications.

    - Identifying and resolving user compliance concerns.

    - Meeting reliability and security specifications.

    - Developing tests to ensure data accuracy.

    - Developing processes for participant account reconciliation and business rules.

- An important element of stakeholder interaction was to determine how to use findings and recommendations effectively and to develop measures of support. Conducting stakeholder analysis and outreach to explore concepts such as:

    - Equity analysis.

    - Decision maker input.

    - Market research.

- Exploring multimodal pricing options to investigate the feasibility of creating the opportunity for customers to make a combined trip that involves multiple transportation modes; for example, ridesharing or car-sharing to a park-and-ride, taking transit, and riding a shared bike for one single payment.

- Developing and executing legislative strategies at the State and local level.

- Planning and design development in preparation for deployment in Phase II demonstration.

ORGANIZATION OF THIS REPORT

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

Chapter 2 provides background on the STSFA grant program, including legislative authority, program goals, and approach.

Chapter 3 details the activities planned and accomplished by MnDOT under Phase I of the STSFA grant program for the FY 2016 grant cycle.

Chapter 4 presents the evaluation framework as proposed under the 2016 Notice of Funding Opportunity, the key USDOT questions that the evaluation seeks to address, and the evaluation team's approach.

Chapter 5 provides the major findings from evaluation of Phase I activities, including lessons learned, findings and outcomes as observed by the evaluation team, and suggestions for further exploration through the course of future efforts towards an alternative revenue program.

Chapter 6 summarizes the key takeaways from Phase I activities and lessons learned that would be relevant for a national implementation of a mileage-based fee program.

Chapter 7 presents the references that are used in this report.

CHAPTER 2. SURFACE TRANSPORTATION SYSTEM FUNDING ALTERNATIVES PROGRAM

Fixing America's Surface Transportation (FAST) Act of 2015[8] authorizes the U.S. Secretary of Transportation "to establish a program to provide grants to States to demonstrate user-based alternative revenue mechanisms that utilize a user fee structure to maintain the long-term solvency of the Highway Trust Fund." The FAST Act provides that $15 million in fiscal year (FY) 2016 and $20 million annually from FY 2017 through FY 2020 be made available for grants for demonstration projects. Section 6020 provides express authority to enter into a grant agreement with a State or groups of States, with no more than 50 percent of total proposed project costs being Federal funds and the remainder coming from non-Federal sources.

The stated goals of the Surface Transportation System Funding Alternatives (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.

PROGRAM PURPOSE

The real power and importance of the STSFA program is that it funds States that will deploy a pilot of an alternative revenue mechanism. Deployments allow the U.S. Department of Transportation (USDOT) to gather information on what works and what does not, and to identify important lessons learned.

PROGRAM APPROACH

Per the SFTSA application requirements, the candidate projects must address or describe how the proposed demonstration addresses the following:

- **Implementation, interoperability, public acceptance, and potential hurdles to adoption of the demonstrated user-based alternative revenue mechanism:** A number of logistical, technological, and societal issues will need to be addressed in any alternative to the current user fee structure. These range from potential additional

[8] Public Law 114–94, H.R. 22, § 6020, 114th Congress. 2015.

logistical burdens imposed by the mechanism to explaining to the public why the current fuel tax is no longer a sustainable funding source. While, to date, some demonstrations of the effectiveness of alternative funding mechanisms have focused on light vehicles, the consideration of the impacts on heavy vehicles is also of interest.

- **Privacy protection:** The current system provides almost total privacy protection. Any new mechanism would have to provide the same level of protection, either perceived or real, or employ mitigating strategies that reduce the risk to acceptable levels. This extends into the area of data security and access beyond the requirements of the user fee collection.

- **Use of independent and private third-party vendors:** The use of private-sector third-party vendors to administer and operate a system could reduce such costs, offset administrative costs by offering value-added services, or alleviate privacy concerns generated by government administration of the user fee collection process. However, other concerns could be raised, depending on the degree of private sector involvement envisioned.

- **Congestion mitigation impacts:** To the extent market forces or governmental incentives under the mechanism might positively or negatively impact roadway congestion or be used to leverage congestion reduction strategies, those impacts should be addressed in the proposal.

- **Equity concerns (including impacts on differing income groups, various geographic areas, and relative burdens on rural and urban drivers):** The implementation of alternative user-based revenue mechanisms may alter the distribution of cost burdens among different classes of users relative to those imposed by current mechanisms for funding surface transportation. Those burdens could result from both changes in the basis of assessing user fees (such as from fuel consumption to miles traveled) and new administrative processes for collecting fees (such as purchasing the necessary technology and reporting vehicle use). Of particular concern are changes that could increase the relative cost burdens on economically disadvantaged populations, who would be least able to afford such a change. New mechanisms could also shift the relative costs paid by drivers in different regions of a State, particularly between urban and rural areas.

- **Ease of user compliance:** The current collection system for fuel taxes (the predominant source of highway user-based fees) is almost completely transparent to the user, does not require any additional action beyond fuel purchasing, and is relatively invulnerable to avoidance by consumers. Any new mechanism would need to carefully consider and evaluate how compliance can be enforced without imposing undue costs or other burdens on different classes of users.

- **Reliability and security on the use of technology:** Threats to the success of the mechanism can be both malicious (e.g., hacking attacks) and non-malicious (e.g., equipment failures). Any system should address the robustness of the technology and processes to withstand and/or recover from such events.

The application may also address:

- **Flexibility and user choice:** Providing multiple payment and fulfillment paths for the user may mitigate a number of issues previously stated, increase public acceptance, and ensure better compliance. For example, providing various mechanisms and technologies for data collection and method or timing of payment.
- **Cost of administering the system:** The cost of the current approach of collecting the Federal user fee at the bulk storage facility through other existing tax collection processes is minimal in comparison to the amount of revenue that is raised. As a result, alternatives to the current collection system would be expected to increase these costs. The mechanism proposed should identify these additional costs, methods to minimize and offset them, and the impact on funds generated to support surface transportation investment. There is interest in capital and operating costs as well as costs associated with the initial deployment and the long-term implications of those costs.
- **Auditing and compliance/enforcement:** Part of public acceptance of any strategy is the perception that the majority of users are complying. The mechanism should, by design, contain the ability to audit and disclose results, assure a high level of compliance, and provide effective and reasonable enforcement approaches.

If a State has previously proved the viability of an alternative revenue mechanism in a limited capacity through its own research, it may still be a candidate for funding under the STSFA program. Applications from such States could include methods for improving on the approach through such features as:

- Improving the functionality of the existing system.
- Expanding the demonstration in terms of numbers of vehicles involved or jurisdictions (e.g., other States).
- Enhancing public acceptance.

ELIGIBLE ACTIVITIES

Through this grant program, Congress is most interested in funding larger scale pilots rather than smaller scale proof-of-concept projects. It is also interested in awarding funds to both single State and multi-State pilots. However, States wishing to pilot projects of any size and scope may seek funding. Further, the 2016 Notice of Funding Opportunity[9] clarified that States that had not initiated a demonstration pilot project or were not prepared to advance a working alternative revenue mechanism were also eligible to submit applications for pre-deployment activities, such as:

- Defining in detail the mechanism to be demonstrated.
- Pursuing necessary enabling legislation.

[9] U.S. Department of Transportation. 2016. Notice of Funding Opportunity Number DTFH6116RA00013, "Surface Transportation System Funding Alternatives." Available at: <https://www.fhwa.dot.gov/fastact/nofo_stsfa_20160322.pdf>, last accessed March 14, 2019.

- Defining in detail the issues to be addressed.
- Planning the deployment timeline and milestones.
- Budgeting for deployment and identifying non-Federal funding sources.
- Organizing partnerships internally within the State, externally with other States, and with other external partners such as private third-party vendors.

The independent evaluation assessed the impacts of the STSFA-funded activities in a systematic manner across all sites. The objective was to document the applicability, motivation, and impediments to implementing alternative user-based fee mechanisms such as RUC in the future at a regional and potentially national level.

CHAPTER 3. PRE-DEPLOYMENT ACTIVITIES FOR A MINNESOTA USER-BASED FEE DEMONSTRATION

This chapter presents the Minnesota Department of Transportation's (MnDOT's) pre-deployment activities as proposed in their grant application and a summary of activities conducted as part of Phase I of the Surface Transportation System Funding Alternatives (STSFA) grant program, or the fiscal year (FY) 2016 grant cycle.

According to Minnesota's FY 2016 grant proposal (see figure 1), the ultimate purpose of the demonstration is to test and prove a user-based fee structure that will ensure the long-term solvency of the Federal Highway Trust Fund through a revenue collection mechanism that pairs with emerging transportation system and societal trends, specifically that of mobility-as-a-service (MaaS).

As part of Phase I, Minnesota's approach was designed to achieve the following:

- Broad public and consumer support.
- Rate setting that would be rational, equitable, and capable of being adjusted to address vehicle type, roadway design, jurisdiction, time-of-day, and other factors.
- A model that is scalable to multiple service segments and exportable to other agencies.
- A migration approach to the new system that will be incremental, painless, and cost effective.

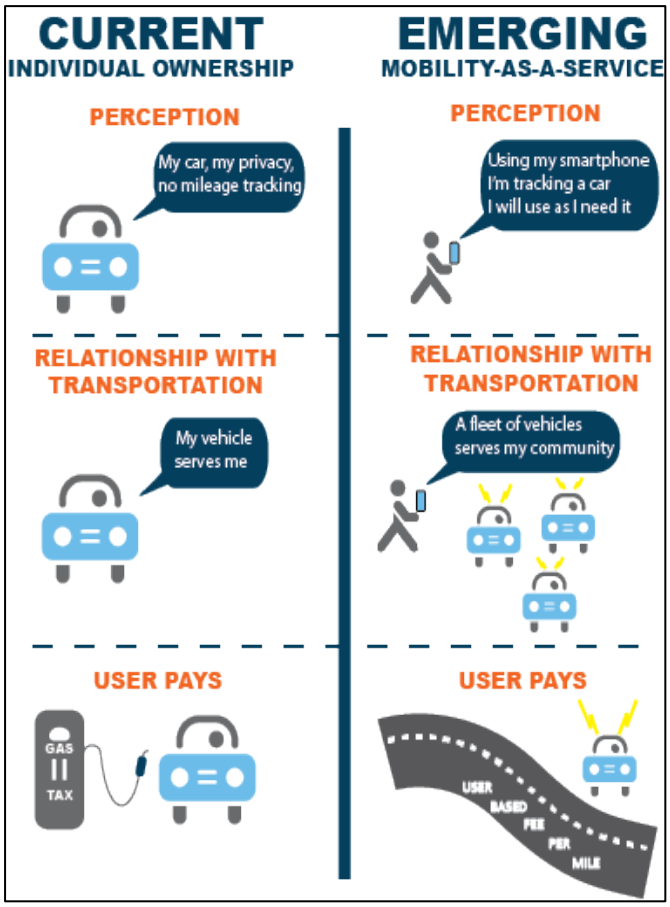


Figure 1. Illustration. Minnesota's proposed distance-based fee concept.(10)

The premise for the Minnesota approach is that: "...the future of personal travel will be captured in the new and evolving Shared Mobility (SM) business model which includes a range of new travel forms that promise greater efficiency, safety, and enhanced mobility."[10]

[10] Minnesota Department of Transportation with the University of Minnesota Humphrey School of Public Affairs. 2016. "Proposal to Conduct Pre-Deployment Activities for a Minnesota Distance-based User Fee Demonstration," p.1.

DISTANCE-BASED USER FEE PROGRAM GOAL AND OBJECTIVES

Minnesota's vision is to design a revenue mechanism that is responsive to the projected convergence of shared mobility, vehicle electrification and vehicle automation.

As stated in Minnesota's FY 2016 STSFA grant proposal, the goal of this pre-deployment demonstration is to "… design a highway user based fee system that will be focused on the future of personal travel and will create an efficient and affordable path toward broader deployment."[11] The objectives of this system are to:

- Anticipate where technology, cooperative mobility, electrification, and computing will be in the coming decades and create partnerships to take advantage of developing opportunities.
- Design a user-based fee system that leverages existing onboard telematics and the capabilities of auto manufacturers and MaaS providers consistent with the needs of the transportation system.
- Incorporate into the system design efficient operations, collections, enforcement, equity considerations, privacy and verification protocols, and transparency and ease of user fee collections.
- Create an opportunity for the Phase II demonstration and the ultimate deployment of the Minnesota MaaS user-based fee system trial that is publicly and politically supported.

As part of Phase I, Minnesota aimed to demonstrate that a partnership can be forged with MaaS providers to conduct a demonstration with the above attributes. According to the Draft Concept of Operations (ConOps):

> "Phase I – the project will explore how DBUF-related data could be accurately and securely transferred between a SM provider and MnDOT or the Minnesota Department of Revenue to understand how a DBUF would technically impact SM providers. In other words, is the transmission of data from a SM operated fleet vehicle to MnDOT even possible."[12]

The key strengths of the Minnesota approach are presented in Table 1.

[11] Minnesota Department of Transportation with the University of Minnesota Humphrey School of Public Affairs. 2016. "Proposal to Conduct Pre-Deployment Activities for a Minnesota Distance-based User Fee Demonstration," p.1.
[12] Minnesota Department of Transportation. 2018. *Minnesota Distance-based User Fee Demonstration Plan, Concept of Operations, 90% Draft Final*, St. Paul, Minnesota, p.5.

Table 1. Key features of the Minnesota approach.

Pilot Program Aspect	Details of Minnesota's Approach
Recognition of efficiency of fuel tax	Minnesota's approach recognizes the unsurpassed efficiency of the fuel tax and its long and durable history. Using the mobility-as-a-service (MaaS)-based revenue collection structure is proposed to operate in parallel to the fuel tax rather than as a replacement.
Recognition of the need for differentiating tax based on vehicle type and time of day	The Minnesota approach recognizes that to be truly equitable, user-based fee alternatives will need to include sophisticated features such as consideration of vehicle weight, time-of-day, and indexing to inflation, even though some these approaches may not be politically viable at first.
Ease of user/stakeholder acceptance, equity, public opinion	Migration to user-based fees is likely to be publicly and politically acceptable because the new form of revenue collection does not involve personal vehicles.
Low system/administrative costs	Utilization of existing onboard technology and communications in MaaS vehicles will result in greatly reduced administrative costs—no need to create new and expensive technology and back office systems.
Privacy, data security, enforcement	Unlike other attempts at user-based fees, issues associated with personal privacy, data security, and enforcement will diminish with the Minnesota MaaS model.
Flexibility to expand/ nationwide applicability	A highly portable model will be developed that can be expanded easily and quickly around the nation and could be applied to other fleet operations.

Source: FHWA

The following section summarizes the key components of the Minnesota pre-deployment activities as planned and conducted.

KEY COMPONENTS OF THE MINNESOTA PRE-DEPLOYMENT APPROACH

Collaboration With and Recruitment of Mobility-as-a-Service Providers

At the time the State submitted its grant application, MnDOT had established relationships with two local MaaS providers: HourCar and car2go, with 2,000 and 26,000 members, respectively, in the Minneapolis-St. Paul metropolitan area. Both providers had expressed interest in partnering in the demonstration. At the time, Minnesota was also working to engage other MaaS providers. However, soon after starting the program, car2go left the Minneapolis market.

According to updates shared by MnDOT in September 2018, MnDOT has had advanced discussions with two shared mobility service providers, HourCar and Zipcar, and is in the process of negotiating an agreement. Minnesota is planning for a third entity, Vision Systems Intelligence, to support the research data repository, including collecting anonymized per-trip data from test vehicles and providing that data to MnDOT's partner, Minnesota, where researchers will conduct analyses.

Planned outcome: Determining interest and value proposition for MaaS providers and getting some providers onboard with the proof-of-concept and demonstration.

Key considerations at the outset of planned activities included:

- Determining potential interest and articulating value proposition for MaaS provider participation.
- Addressing privacy concerns through the use of telematics. As user-based fees would be applied to a shared vehicle and not necessarily an individual, and privacy concerns would be greatly reduced or removed all together. This approach is made possible by the MaaS platforms, which are embracing telematics technologies.

Key achievements of Minnesota's Phase I activities towards collaboration with and recruitment of MaaS providers include:

- Developed communications plan and conducted interviews with MaaS providers to assess their feasibility and willingness to support the demonstration.
- Developed role sheets for each MaaS provider identifying potential roles and responsibilities to support both the initial proof of concept as well as the potential future demonstration.
- Initiated negotiations (currently underway) (now completed with HourCar) with MaaS providers to participate in development of the proof of concept. Minnesota is working to establish data use agreements related to how data would be safeguarded and used during both the proof of concept as well as the future demonstration.

Modeling Pricing Strategies and Exploring Multimodal Pricing Options

The Minnesota team worked with MaaS providers to explore multiple pricing schemes for user-based fees, which MaaS providers will be charged during the trial period in Phase II. In exchange, the providers would receive fuel tax rebates in addition to other necessary trial financial incentives. Each pricing scheme was evaluated based on multiple criteria, including:

- Effectiveness in changing travel behavior in a way that leads to more efficient use of roadway infrastructure.
- Ability to recover fuel tax revenues that are forgone through rebates.
- Extent and types of incentives created for participation by MaaS providers.
- Cost of implementing the scheme both from an administrative perspective (for MnDOT) and from a compliance perspective (for MaaS providers and customers).
- Other possible policy concerns.

Several options that are considered viable were planned to be applied later in the trial deployment period, when empirical data could be collected to analyze actual outcomes.

Additionally, MnDOT planned to conduct a study to investigate the feasibility of creating an opportunity for customers to make a combined trip that involves multiple transportation modes; for example, ridesharing or car-sharing to a park-and-ride, taking transit, or riding a shared bike for one single payment.

Planned outcome: Research reports by Minnesota on modeling pricing strategies and multimodal pricing options.

A key consideration at the outset of planned activities was that, to be truly equitable, user-based fee alternatives will need to include sophisticated features, such as consideration of vehicle weight, time-of-day, and indexing to inflation, even though some these approaches may not be politically viable at first.

Key achievements of MnDOT's Phase I activities towards exploring pricing strategies include:

- Developing the University of Minnesota report "A Framework of Pricing Schemes."[13]
- Continuing work on modeling appropriate pricing strategies based on the shared mobility approach.

Stakeholder Outreach and Developing and Executing Legislative Strategies

A key planned outcome of the pre-implementation phase was to develop a demonstration plan that has support and commitment from all participants. This included MaaS providers, the department of transportation, State and local government leaders, and others. As part of this effort, stakeholders were identified and brought into the conversation to clarify their role, determine their interest, and incorporate their needs into the Phase II deployment. The models for the pricing strategies were to incorporate these variables and help determine the most viable options and partners for implementing them.

Through this effort, MnDOT worked to develop public awareness regarding the need for a user-based fee system. The focus of the effort was to address the "value proposition" of user-based fee systems for the public and to develop persuasive arguments as to why such systems are better than the current system(s). This included symposiums on user-based fees, other stakeholder meetings, and website support for the project. Concepts and issues discussed included:

- Conducting an equity analysis.
- Gathering decision makers' input.

[13] Minnesota Department of Transportation and University of Minnesota Humphrey School of Public Affairs. 2018. *Task 3 Report, Distance-based User Fee: A Framework for Pricing Schemes*, St. Paul, Minnesota.

- Performing market research.
- Determining effective applications for findings/recommendations.
- Developing measures of support.

Planned outcome: Inputs to the demonstration plan that have support and commitment from all participants needed to make it happen.

Key achievements of MnDOT's Phase I activities towards stakeholder outreach include conducting interviews with stakeholders.

Planning and Design for Deployment in Phase II Demonstration Including Designing Back Office Operations

The main goals for this aspect of the Minnesota program was to execute an agreement with a MaaS provider(s) and to create a system architecture and back office design to efficiently collect user-based fees. In this phase, Minnesota planned to develop the ConOps and system requirements suitable for further design, building, testing, and operation with careful attention to completion of the subtasks identified below. The structured concept will include specific performance measures, targets, and capabilities associated with performance monitoring and performance management.

In this phase, the pilot deployment concept was designed in detail through the development of a Comprehensive Pilot Deployment Plan, which includes the following elements:

- Project management plan, milestones, budget and timeline.
- MaaS agreements.
- ConOps and system requirements.
- System architecture and system design and development.
- Back office setup and operations.
- Verification and reconciliation protocol.
- Data collection plan and analysis of results.
- Evaluation and monitoring of fee collection and operations costs.
- Pilot deployment and system build out cost estimation.
- Partner and customer support.
- System testing and security operations interface.

- Reporting plan/findings and recommendations.

Key achievements of MnDOT's Phase I activities towards planning and designing the Phase II demonstration include:

- Drafting a ConOps.
- Developing a risk worksheet along with mitigation strategies and responsibilities.

Table 2 provides an overview of key Phase I program activities conducted by Minnesota.

Table 2. Key Minnesota Phase I program activities at a glance.

Program Component	Key Achievements of Phase I activities	Lessons Learned
Collaboration with and recruitment of mobility-as-a-service providers	• Negotiations (underway) with shared mobility providers to participate in development of the proof of concept. Finalizing non-disclosure agreements and memoranda of understanding with shared mobility providers.	• Articulate value proposition for car share companies' participation. • Achieve agreement on issues of data privacy and customer expectations.
Modeling pricing strategies and exploring multimodal pricing options	• Developed framework for modeling appropriate pricing strategies based on the shared mobility approach.	• To be truly equitable, user-based fee alternatives will need to include sophisticated features such as consideration of vehicle weight, time-of-day, and indexing to inflation, even though some these approaches may not be politically viable at first.
Stakeholder outreach and developing executing legislative strategies	• Completed interviews with stakeholder panel, which explored Minnesota's DBUF concept viability, assumptions, advantages/disadvantages, and the political landscape. • Completed interviews with shared mobility providers.	• Issue of where any money is raised and spent is important. Funding should be dedicated to transportation-related projects and not spent elsewhere. • Several interviewees brought up the need for current recipients of fuel tax revenue to continue to receive funds even if a distance-based user fee is implemented.

Table 2. Key Minnesota Phase I program activities at a glance (continued).

Program Component	Key Achievements of Phase I activities	Lessons Learned
Gauging public interest and acceptance of a distance-based fee approach	• Developed and conducted survey for current car-share members to determine baseline attitudes of this population, to compare with general public perspectives recorded in other studies, as well as to measure possible changes in Phase II.	• Chapter 5 includes key survey findings.
Researching state-of-the-art in distance-based fee collections	• Developed white paper on those mileage-based user fee projects completed or underway. Paper addresses the project design objectives, operations, and outcomes, among other considerations.	• Technology, privacy, and data security aspects need to be further developed and explored through pilots. Public acceptance is growing, but will continue to be a key barrier. • There does not appear to be any easy solution to the problem of scaling demonstration projects into full implementation.
Planning and design for deployment in Phase II demonstration	• Drafted Concept of Operations	Not applicable

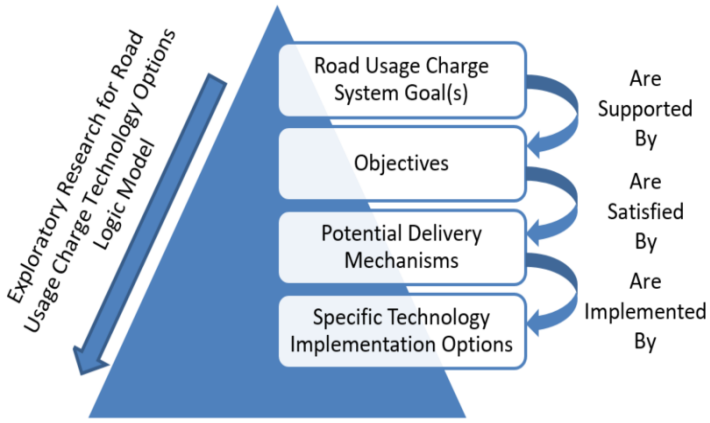
Source: FHWA

CHAPTER 4. INDEPENDENT EVALUATION METHODOLOGY

This chapter summarizes the independent evaluation approach and methodology employed by the study team in coordination with staff from the Federal Highway Administration (FHWA) headquarters in the Office of Operations and the FHWA Division office representatives of the respective grantee sites. The chapter defines the evaluation framework and includes responses to key questions that the U.S. Department of Transportation (USDOT) expressed interest in knowing about road usage charge (RUC) approaches and their viability and characteristics if implemented on a national scale.

EVALUATION APPROACH

As its name suggests, the fundamental concept of 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 several different ways, and the mechanism by which a charge is levied can also vary significantly. The seven grantee agencies are all using different combinations of technologies and various paradigms and mechanisms to levy charges. Often the fundamental objective or goal of the RUC system is a significant factor in identifying the technology options, data collection, and how fees are levied. Previous research has characterized this phenomenon through the use of a RUC logic model, as illustrated in Figure 2.



Source: HDR Inc.

Figure 2. Diagram. Exploratory research for road usage charge technology options logic model.

One critical component of this evaluation included trying to understand the fundamental objectives of the RUC systems as deployed by the grantee sites. In particular, the team attempted to determine the primary objective of the Phase I implementation. Determining the objective provided overarching insight into more detailed assessments and evaluation of the efficacy, costs, and scalability of the systems at a regional or national level. Please see the discussion in the evaluation process section below for a summary of how the study team conducted this evaluation.

EVALUATION FRAMEWORK – U.S. DEPARTMENT OF TRANSPORTATION QUESTIONS

The key questions that USDOT intends to examine as part of this evaluation are presented in Table 3. To explore these questions within the context of the grantee sites' proposed activities, the evaluation team elaborated on the questions and defined relevant metrics for conducting the evaluation. While some questions were found to be highly applicable to Phase I activities, others

were marginally applicable. Table 3 provides the assessment framework and Table 4 provides the system attributes relevant to the evaluation.

Table 3. Assessment framework.

	USDOT Evaluation Question	Relevant Site Question/ Metrics	Applicability to Minnesota's Phase I Activities
Q1	What is the viability of road usage charge (RUC) on a nationwide scale?	Not applicable	Low
Q2	Would the fee assessment and collection mechanisms be scalable?	What considerations for scalability are you including in developing the agreements with shared mobility providers?	High
Q3	What is the efficiency of the fee assessment and collection relative to the fuel tax?	What are your initial findings on the efficiency of a mobility-as-a-service-based user fee system?	Medium
Q4	What are the system 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 detailed metrics in Table 4.	Medium
Q5	What is the user and stakeholder perception of mileage-based user fees in general and of pilot activities?	What are the findings of the stakeholder outreach conducted as part of Phase I?	High
Q6	What changes in institutional and financial setting, frameworks, models, and elements are required?	What are some of the lessons learned on internal processes and workflows from with the Department of Revenue and the legal department?	Moderate
Q7	What is the financial sustainability of each pilot deployment?	Have you conducted an analysis of funding needs for future phases of the demonstration?	Low

Source: FHWA.

Table 4. System attributes.

Functional Parameter	Description
User-orientated parameters	
Privacy	Privacy relates to the *nature* of the information being collected as opposed to the *integrity* of the information.
Equity	Equity relates to 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.
Potential for Value-Added Services	Value-added services refer to the ability to add other transportation-related applications or software to the system to enhance system performance, reduce congestion, and improve mobility.
Ability to Audit	Extent to which an individual can contest their charges and have visibility into how those charges were accrued and assessed.
Ease of Use/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.
Transparency	User awareness, specifically in real time, of what they are being charged.
Cost to User	Cost of equipment or installation to the end-user and cost of the per-mile (or other) charge.
System-orientated parameters	
Data and Communications Security	Data source integrity and storage, transmission and access.
Charging Accuracy	The system's ability to assess the expected charge for each use of the roadway.
Charging Precision/ Repeatability	The system's ability to produce a consistent assessment of fees repeatedly for identical travel.
System Reliability	System "up-time."
Flexibility to Adapt	Ability of the technologies and systems to be upgraded or updated.
Flexibility to Expand	Ability of the system to respond to increased demand/system capacity and add technological capabilities.
Interoperability	Ability for the system to interact and exchange information across multiple jurisdictions.
Compatibility with Low Tech	Assessment based on the system's ability to accommodate users that cannot utilize the technology.
Evasion	Evaluation of how easily the system can be circumvented.
System Costs	Understanding of the full spectrum of investment costs, including initial capital, operating, and maintenance costs.
Ease of Enforcement	Ability of law enforcement to identify travelers that have evaded the system.
Cyber Security	Extent to which the system is vulnerable to a cyber-attack or release of private information.
Ability to Reallocate Revenue	Extent to which the system collects information that can be used to inform allocation of revenue.

Source: FHWA

EVALUATION PROCESS

The evaluation team devised an approach centered on periodic interfaces with the grantee agencies, including a site visit with a subset of grantees conducting pilot deployments to better understand the rationale and outcomes for Phase I activities.

Kick-Off Meeting

At the start of the evaluation, the evaluation team conducted 90-minute kick-off meetings with each of the grantee sites. The primary purpose of this call was to introduce the goal and scope of the evaluation and obtain information about the pilot's Phase I goals, scope and timeline. The evaluation team requested program documents compiled up to that point and updated project management plans.

Transportation Research Board Annual Meeting Workshops

The Surface Transportation System Funding Alternatives (STSFA) evaluation team facilitated two workshops during the Phase I evaluation. These workshops were held concurrently with the 2018 and 2019 Transportation Research Board (TRB) Annual Meeting in Washington, D.C. At the time of the 2018 workshop, most grantee sites were either just starting on their Phase I activities or planning to begin shortly. The first segment of the 2018 workshop was intended to address one or more "big questions" that each project was designed to answer. The questions in this workshop were structured to underscore a hypothesis that would be either supported or not supported as a result of the Phase I activities. Table 5 lists the specific questions posed during the 2018 TRB workshop, and Table 6 summarizes Minnesota Department of Transportation's (MnDOT's) responses.

It is important to note that, at the time of the 2018 workshop, several grantee sites were either just starting or preparing to start their Phase I activities. The information shared during this session was thus primarily based on prior RUC endeavors or based on very early activities.

Table 5. 2018 Transportation Research Board workshop questions.

Q1	What is the "one big question" that your project is best positioned to answer?
Q2	If you could tell your counterparts in fellow States looking to implement some form of road usage charge system, what would be your most important piece of advice to them?
Q3	What is the most important thing you have learned to date?
Q4	What is the biggest challenge you have faced, or expect to face with this project?

Source: FHWA

Table 6. Minnesota's Phase I summary as articulated at the 2018 workshop.

Field Deployment (Y/N) Using 2016 Funds	The "one big question" at the start of Phase I	Other Focus Areas of Phase I	Lessons and Challenges
No	Can mobility-as-a-service be an early applicant of a road usage charge?	Can we find a solution at the convergence of shared mobility and connected and autonomous vehicles and prove that, with better technology and the car-sharing platform, we have a solution that can be implemented widely?	Retain motor fuel tax on those vehicles that it makes sense to collect motor fuel tax on. New vehicles will likely have technology embedded in them providing the conditions for a scalable, efficient system that can be seamlessly integrated. We will understand this better when we undertake the demonstration.

Source: FHWA

At the time of the 2019 workshop, most grantee sites had either completed or substantially completed Phase I activities. This workshop also focused on lessons learned from Phase I and the reactions to a potential national RUC pilot. The MnDOT representative shared the following lessons:

- The pilot should articulate a clear goal and remain consistent.
- The fuel tax is efficient and should remain.
- A distance-based user fee (DBUF) would backfill revenue lost from the motor fuel tax (MFT).
- In the future, vehicle ownership is likely to decline. Consequently, Minnesota will experience reduced revenue generation from registration fees in addition to the loss in MFT revenue due to higher fuel efficiency and electric vehicles.
- The equity issue has to be resolved. In any model, someone is subsidizing someone else.
- A win for Minnesota is that mobility-as-a-service (MaaS) providers are onboard. The proof of concept with 70 vehicles; 4,633 unique trips; and 103,550 miles recorded showed that MnDOT can download the data and put it on a secure data repository and generate simulated invoices.

Conference Call Update

In September 2018, the evaluation team, in conjunction with Federal Highway Administration (FHWA) staff, conducted a conference call update with MnDOT to learn about the project progress, initial findings from the activities completed, and the timeline for completion of remaining activities. This conference call update was in lieu of a site visit given that MnDOT did not implement a pilot or have demonstration underway at the time of the planned site visits for Phase I evaluations.

CHAPTER 5. MAJOR FINDINGS

This chapter presents an overview of Minnesota Department of Transportation's (MnDOT's) proposed distance-based user fee (DBUF) system and summarizes key findings and lessons learned resulting from their Phase I efforts. The findings are presented in accordance with the evaluation framework provided in chapter 4 that is based on the Surface Transportation System Funding Alternatives (STSFA) grant evaluation criteria as provided in the notice of funding opportunity.[14] It is important to note that, since MnDOT's Phase I scope included pilot planning and set up activities (pilot to be implemented in Phase II), several evaluation criteria were not directly addressed within the scope of grant-funded activities. These are anticipated to be addressed with future phases of MnDOT's alternative transportation revenue explorations. As such, this chapter only discusses the attributes of the proposed system that were explored, examined, or tested in some detail during Phase I.

MINNESOTA'S PROPOSED SYSTEM OVERVIEW

This chapter presents the major findings of the Phase I evaluation of Minnesota's proposed DBUF concept (Figure 3). The key features of Minnesota's Phase I efforts were:

- Designing an affordable DBUF program linked to the mobility trends of the future, particularly shared mobility.
- Creating partnerships that will be leveraged to demonstrate how existing onboard technologies can be used to collect a DBUF.
- Conducting a limited proof-of-concept demonstration of data transfer between shared mobility providers and MnDOT.

The key Phase I deliverables of Minnesota's program include the Concept of Operations (ConOps), stakeholder outreach and summary, and the 2-week proof of concept. The major findings included in this chapter are reflections of the concept developed and initial findings from the proof-of-concept demonstration.

Minnesota's DBUF concept is based on leveraging inherent efficiencies of linking the road usage charge (RUC) concept with the shared mobility model, most significantly:

- Taking advantage of the availability of vehicle telematics already capable of collecting mileage data in a secure manner that is the key to assessing and collecting mileage fees.
- Mimicking the efficiency of fuel tax collection by designing a system that is based on data exchange with a handful of shared mobility providers instead of millions of individual drivers. In addition to efficiencies in collection cost, MnDOT expects the proposed model to afford better data security and system reliability because these aspects are an integral part of the shared mobility providers' business model.

[14] USDOT Notice of Funding Opportunity Number DTFH6116RA00013, issued on March 22, 2016. Available at: <https://www.grants.gov/custom/viewOppDetails.jsp?oppId=282434>.

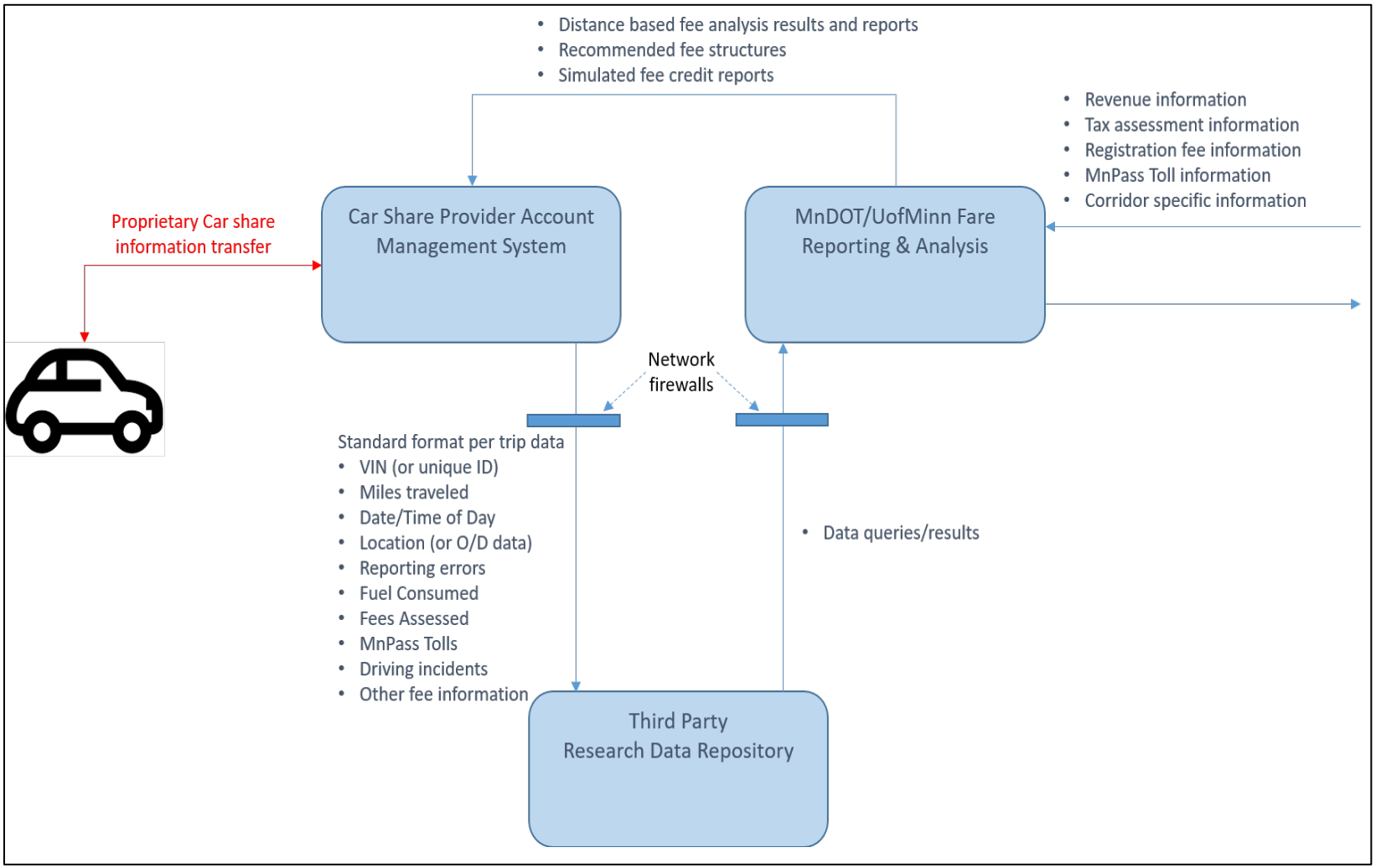


Figure 3. Diagram. Minnesota mileage-based user fee demonstration proof of concept functional architecture.

SUMMARY OF SYSTEM-ORIENTED PARAMETERS

The following sections describe some of the system-oriented aspects of Minnesota's proposed DBUF model.

Data Security

Data security refers to the system's data source integrity and storage as well as secure transmission and access. Collecting mileage fees directly from the shared mobility provider for the mileage driven for each vehicle does not necessitate the collection of data or information for what particular driver has made a trip. The data being collected can be based solely on the qualifying, fee-generating mileage for each specific vehicle, regardless of driver and passenger.

The MnDOT system proposes to use a private third-party data repository where analysis of trip data can be used, with some data being available to MnDOT. Ultimately, the responsibility for data scrubbing will be in the hands of the mobility provider prior to turning it over to the Department of Revenue and the third-party data repository.

Cybersecurity relates to the protection of information confidentiality, integrity, authenticity, non-repudiation, and availability. The following proof-of-concept provisions set the basis for sound cybersecurity that will be tested with the proof-of-concept demonstration:

- All data used in the proof of concept were sanitized, removing any personally identifiable information (PII).
- The shared mobility partners were responsible for ensuring that all data provided to the research data repository are sanitized.
- Firewalls and other network protection systems were incorporated to ensure that all proof of concept data are safeguarded against unauthorized dissemination.
- All data provided for the proof of concept were in comma-separated value or Excel spreadsheet format.
- All revenue reports provided by the University of Minnesota were in comma-separated value or Excel spreadsheet format.
- All data used for the proof of concept were considered research data and planned to be destroyed within 30-days of the completion of the proof of concept.

Charging Accuracy, Precision, and Repeatability

This parameter refers to the system's ability to produce a consistent assessment of fees repeatedly for identical travel. Car-sharing companies assess fees based on the time and mileage for each trip taken by a traveler. The data are already being collected using location technology that is embedded into each vehicle. In the case of a car-sharing company, the mileage and location of each trip is known and measurable. It is in the car-sharing company's best interest to collect accurate data on mileage and location.

It is unknown if the location accuracy is high enough to distinguish between public and private roadways, and the accuracy may be contingent upon the sophistication of the technology being deployed by the car-share company. However, it may not matter if the fee is being defined in the same way that the fuel tax is issued, which cannot distinguish the difference between public and private roadways.

Flexibility to Adapt and Expand

Flexibility refers to the ability of the technologies and systems within the proposed method to be upgraded or updated. However, the Minnesota DBUF system is not a single technology or system, but rather a series of agreements to collect mileage fees from commercial shared mobility operators.

The flexibility to expand is dependent on the technology deployed by these providers. An important distinction to make is the type of mobility provider that is being incorporated into the pilot. The Minnesota project is set to use a car-sharing service, which in essence allows somebody to rent a car for a short period of time. These services typically charge users for time and mileage without regard to the location and roadways that are being used.

Currently operating transportation network companies use location technologies to access additional fees for increased demand. This technology currently exists and presents an opportunity to expand how fees are assessed in different locations throughout different times of the day. While not part of Minnesota's 2016 STSFA grant activities, a fee system that applies to transportation network companies would give the opportunity to integrate demand pricing as a component of the price of the service.

While the future of mobility remains uncertain, this approach allows for a high level of flexibility to adapt and expand. The DBUF system proposed is a simple mechanism for collecting fees from a limited number of commercial operators that provide a mobility service. It is neutral to the specific technologies deployed to measure the mileage driven by a vehicle.

The flexibility of the system to adapt or expand is contingent on the expansion of shared mobility or mobility-as-a-service (MaaS) as a share of overall miles traveled. MnDOT's ConOps notes:

> *By some predictions, [shared mobility] will account for 35 percent of all personal travel by 2030 and perhaps as much as 90 percent by 2040*[15].

Regardless of the growth of shared mobility services, the Minnesota approach is likely to develop a road map for engaging with mobility providers and other potential intermediaries such as original equipment manufacturers that will provide the direct points of mileage data collection from individual travelers.

Key Finding: **For the users of shared mobility services, the approach for mileage data collection and payment is likely to be flexible and adaptable. However, the adaptability of the overall approach is tied to the growth of shared mobility services.**

[15] Navigant Research. 2013. "Autonomous vehicles: self-driving vehicles, autonomous parking, and other advanced driver assistance systems: global market analysis and forecasts."

Enforcement and Compliance

This parameter deals with the ability of law enforcement to identify travelers that have evaded the system. MnDOT reasonably projects that the enforcement of the system would be as straightforward as the current fuel tax collection. The system's focus on commercial operators rather than individual drivers removes a significant enforcement challenge that is present with other RUC systems.

The operating model of the car-sharing companies provides little opportunity for individual drivers to evade the system. The operation of the vehicle is contingent on a driver having an account set with the vehicle operator and that vehicle operator maintaining vehicle operation for each trip. To state it succinctly, these vehicles are constantly monitored by the company, and their mileage and location is always known.

System Cost

According to the Congressional Research Service, one of the advantages of the Federal motor fuel tax (MFT) is that nearly all of the revenue is collected from roughly 850 registered taxpayers when the fuel is removed from the refinery or tank farm.[16] In the State of Minnesota, the per-gallon State fuel tax is collected from petroleum distributors.[17] The total State tax rate is 28.5 cents per gallon for gasoline, diesel, and some gasoline blends.

Based on the stakeholder outreach conducted by MnDOT as part of Phase I activities, the high administrative cost of a distance-based fee structure was a key concern. As such, Minnesota's approach of collaborating with and limiting points of fund collection to shared mobility providers versus a multitude of individual customers found significant support within the stakeholder community.

MnDOT's ConOps states:

> *Minnesota's approach suggests the motor fuel tax, with all its advantages and deficiencies, is likely to continue for a long time. It is challenging to design a solution for universal replacement of the motor fuel tax that begins to approach its simplicity and efficiency. The cost of collecting the motor fuel tax in Minnesota is less than 0.5 percent of the fees collected. By the most optimistic forecasts, the cost of operations and retro-fitting vehicles with technology, as well as setting up the appropriate enforcement structures for a mileage-based fee, is likely to be in the range of 5-10 percent of total fees collected. By comparison, the motor fuel tax, while imperfect, is likely to remain in place for a long time.*[18]

[16] Congressional Research Services. 2016. *Mileage-Based Road Usage Charges*, Washington, DC. Available at: <https://fas.org/sgp/crs/misc/R44540.pdf>, last accessed April 25, 2019.
[17] Minnesota House Research Department. "Highway Finance" (website). Available at: <https://www.house.leg.state.mn.us/hrd/pubs/hwyfin.pdf>, last accessed April 25, 2019.
[18] Minnesota Department of Transportation. 2018. *Minnesota Distance-based User Fee Demonstration Plan, Concept of Operations, 90% Draft Final*, St. Paul, Minnesota. p.11.

Key Finding: While costs related to technology, operations, compliance, and enforcement are likely to be lower in the Minnesota approach versus some of the other pilot approaches, several categories of potential changes to administrative costs attributable to the unique nature of distance-based fee collection processes will need to be accounted for in further research and exploration.

MnDOT is currently targeting a level of cost-efficient administration between that of the State's fuel tax and the sales tax collection. If the administrative costs can be demonstrated to be lower than other RUC efforts, the Minnesota approach is likely to become more widely considered by other States, particularly those already conducting pilots.

As the project moves ahead, MnDOT would need to explore categories of administrative costs or fees such as:

- **Structural changes in the organization to support revenue collection, including integrating functions with the Department of Revenue.** Given that MnDOT has not previously been in the business of collecting revenue, this will be a new function introduced within the organization. The Phase I efforts, as reported, have involved some coordination with the Department of Revenue; however, there may be additional needs in terms of organizational changes, including staffing needs, workforce development, and others, to administer the program.

- **Electronic billing and collection charges, including credit card and bank fees.** This may be already embedded in the fare collection methods used by shared mobility providers; however, depending upon the specifics of the agreement with the providers, MnDOT may have to account for a share of these expenditures.

- **Revenue leakage that will need to be addressed through enforcement.** Because the technology interface in the proposed demonstration is with the shared mobility providers rather than individual drivers, there is likely to be limited opportunity for violations and need for enforcement; however, these questions will become more relevant as the pilot progresses and with the proof of concept testing.

- **Technology acquisition.** For Minnesota's proposal, this is likely to be a less critical component of capital investment because the approach utilizes telematics already available on vehicles that shared mobility providers use.

SUMMARY OF USER-ORIENTED PARAMETERS

User Privacy – Perceived and Real

Both *perceived privacy* and *real privacy* are important factors in a RUC program given the public's potential for pushback to the program based on perceptions of the program's privacy properties and the potential for actual privacy breaches. Minnesota's Phase I activities did not include a detailed examination of privacy concerns. These are planned to be detailed in the agreement with the shared mobility providers and verified through the proof-of-concept testing and future demonstrations.

Privacy in a distance-based fee system pertains to:

- **The type and quantity of raw data being collected.** In Minnesota's proposed concept, minimal or no additional data may need to be collected across interfaces than what is being currently collected.

- **How the raw data are treated (i.e., sanitized) and where in the system they are stored.** Specific methods of sanitizing and scrubbing privacy-sensitive data would need to be detailed in future RUC pilot documentation. In addition, data aggregation rules would need to be clarified or standardized as well. Left unmitigated, high amounts of data aggregation may lead to privacy losses, especially if future RUC deployments collect higher resolution RUC source data. Higher resolution position time data collection may necessitate careful examination of data aggregation in conjunction with allowed data retention periods, especially as RUC programs begin to institute sub-regional, demand-based RUC charging designed to influence driver behavior.

- **The intractability of performing geo-temporal driver tracking.** As RUC systems mature and more elaborate road-usage charging scenarios are developed, more fine-grained location and distance information collection may become necessary. Aggregating too much of this data may introduce retroactive privacy breaches (i.e., tracking one's location history). In addition to data collected, the confidentiality protections afforded the data become paramount.

The following inputs were collected and documented as part of stakeholder outreach (Task 5 of the Phase I program) related to stakeholders' concerns about privacy:

> *The need for privacy during the collection and tracking of a distance-based user fee was a consistent concern of elected officials and advocacy organizations. Stakeholders recognized that tracking of individuals and their travel habits is looked upon poorly by the general public and could be a significant barrier to implementing a distance-based user fee. Several interviews discussed how using shared mobility to track distance traveled may be looked upon more favorably because tracking ride history information such as route and distance traveled are all considered features of shared mobility applications. While data tracking may be acceptable to the public when they opt into it and the information is kept by private companies, several elected officials brought up how attitudes would be different if the government tracked that information.*[19]

The ConOps noted that public awareness and mistrust of the handling of PII is growing. The proposed demonstration model will not require government access to individual user accounts or any PII tied to individual users. Nevertheless, the MnDOT team plans to comply with industry data standards related to data protection and to perform necessary due diligence such as sanitizing PII before information is transferred from a shared mobility provider to the State.

MnDOT conducted a proof-of-concept focused test of how DBUF can be collected from shared mobility and automated vehicles. In collaboration with a shared mobility provider and a research

[19] Minnesota Department of Transportation. 2018. *Distance-based User Fee, Task 5 Report*, St. Paul, Minnesota.

partner, MnDOT collected data from participating vehicles for the purpose of assessing whether DBUF is feasible. The data from a variety of vehicles were sanitized and aggregated and transmitted securely to a data repository. The data were then used to create simulated invoices, assessing a DBUF of miles traveled and crediting fuels tax on gallons purchased. Finally, the Department of Revenue reviewed the simulated invoices and related data to determine potential integration with existing tax collection systems and processes and to confirm auditability.

According to MnDOT:

> *The proof of concept demonstrated that it is possible to accurately capture and report travel data from a [shared mobility] provider to state agencies without impeding motorist privacy. The DBUF collection and reporting has a small footprint and does not negatively impact [shared mobility] provider operations. Existing systems and interfaces can be used to collect and report DBUF-related data. There are still open policy considerations, including how to handle federal DBUF, federal fuels tax credits, and out-of-state mileage. Ultimately, the largest takeaway from the proof of concept is that this DBUF model is viable, cost effective, and scalable for a larger implementation.*[20]

While the approach to user privacy at this early state stage is sound, MnDOT could benefit from exploring standardized privacy policies for future demonstration.

Equity – Disparate Impacts Across Populations

Minnesota's Phase I activities did not include a detailed examination of perceived and real equity considerations. However, the following inputs were collected and documented as part of stakeholder outreach (Task 5 of the Phase I program):

> *The issue of equity in implementing a distance-based user fee can mean different things to different people. Representatives from Transit for Livable Communities, now known as Move Minnesota, and the Association of Minnesota Counties were both concerned about the disparate impact a distance-based user fee would have on low-income individuals. Concerns about the inequity for rural versus urban users were discussed during interviews with two politicians but both thought that this issue was addressed with this project. Two politicians brought up the issue of fairness to drivers with electric vehicles and vehicles that get different gas mileage….*
>
> *Advocacy organizations and elected officials agreed that the issue of where any money raised is spent is important. Two politicians wished to ensure the funding is dedicated to transportation related projects and not spent elsewhere. Several interviewees brought up the need for current recipients of gas tax revenue to continue to receive funds even if a distance-based user fee is implemented.*[21]

[20] Minnesota Department of Transportation. 2019. *Minnesota Distance-based User Fee Demonstration Plan, Proof of Concept Report, Version 1.3*, St. Paul, Minnesota.
[21] Minnesota Department of Transportation. 2018. *Distance-based User Fee, Task 5 Report*, St. Paul, Minnesota.

The MnDOT program could benefit from exploring and analyzing the following equity considerations along with preparation for deployment:

- **All electric/fuel-efficient vehicles pay their fair share towards transportation expenditures.** The premise for the Minnesota approach is that a majority of travel in the future will be accounted for through shared mobility providers.[22] However, by several accounts, sales of personal vehicles is expected to continue to grow globally even if at a reduced rate than in the past.[23] There has also been a recent stagnation in shared mobility services evidenced by the exit of Car2Go from the Minnesota market in December 2016. The Shared Use Mobility Center notes that the success of shared mobility in the Minnesota/Twin Cities urban region requires stronger policy and programmatic support to fulfill its promise and serve a broader range of neighborhoods. [24]

  Overall, there is sufficient uncertainty regarding the timing and extent of adoption of shared vehicle use over personally owned vehicles. Until the time of a significant transformation, a transportation tax system that is based on collections through shared mobility providers will not account for the mileage of personally owned fuel-efficient and electric vehicles. If these vehicles continue to be a significant share of the vehicle mix—as personally owned vehicles—into the foreseeable future, the proposed concept would not allow a fair assessment of a distance-based tax on all electric and fuel-efficient vehicles.

- **Impact on low-income/rural drivers.** While shared mobility is currently mostly an urban phenomenon, this may change in the future. If the shared mobility provider market expands into rural and exurban areas, the Minnesota approach will need to contend with both urban and rural equity considerations that the other pilot sites have been trying to address.

- **Revenue distribution.** As part of the stakeholder outreach conducted by MnDOT in Phase I, the question of the use of transportation revenues resulting from a DBUF approach was raised by some responders. There may be conflicting opinions on this topic among stakeholders, with some arguing for all mileage-based tax revenues to go towards transportation expenditures while others argue the need to maintain the funding streams that the current beneficiaries of the fuel tax revenue receive. A portion of the current fuel tax revenue—about $22.8 million in fiscal year (FY) 2017—is attributed to fuel use in non-highway activities, such as operating all-terrain vehicles and motorboats, and transferred into various accounts related to those activities. This issue may be less relevant if both the fuel tax and a distance-based tax is simultaneously levied for different vehicle types.

[22] Minnesota Department of Transportation. 2018. *Minnesota Distance-based User Fee Demonstration Project, Draft Concept of Operations*, St. Paul, Minnesota.
[23] McKinsey & Company. 2016. *Automotive Revolution – Perspective Towards 2030 How the convergence of disruptive technology driven trends could transform the auto industry*.
[24] Shared Use Mobility Center. 2017. *Twin Cities Shared Mobility Action Plan*. Available at: <https://sharedusemobilitycenter.org/wp-content/uploads/2017/10/SUMC_TWINCITIES_Web_Final.pdf>, last accessed April 25, 2019.

Exploring the above equity considerations would involve examining potential adverse impacts, developing mitigation approaches, and designing education and outreach initiatives to address stakeholder concerns regarding such issues.

As the demonstration takes shape, Minnesota could also benefit from assessing the public's perception of equity and fairness of the RUC approach. As noted in *National Cooperative Highway Research Program Synthesis 487, Public Perception of Mileage-Based User Fees* (2016), equity and privacy are key concerns of the public. This synthesis, which reviewed results from 38 surveys and 12 focus groups, concluded that the public has numerous questions about the fairness and equity aspects of a RUC, including:

- Fairness to all drivers:
  - Is an RUC a fair way to raise transportation revenues?
  - Is an RUC more or less fair than a fuel tax?
- Is an RUC fair because it charges in direct proportion to highway use?
- Fairness to certain classes of drivers:
  - Is an RUC fair to people who drive vehicles that use little or no gasoline?
  - Is an RUC fair to rural drivers? (Two questions from two surveys).
  - Is an RUC fair to people who drive long distances for work?
  - Is it fair to charge a higher RUC rate for heavy vehicles, because they cause more wear and tear on roads?

The evaluation team held the opinion that Minnesota may wish to use this set of questions as a starting point to design an evaluation of how residents in the State perceive the equity and fairness of a RUC. For example, these questions and related concerns could form part of a future focus group study and other forms of public feedback and input.

Key Finding: The key equity issue to explore in the future phases would be evaluating the implications of the scenario in which electric vehicles continue to be widely personally owned instead of being part of the shared mobility fleet, thus eliminating the possibility of collecting any revenue from them (fuel tax or mileage fee).

Ease of Use and Public Acceptance

The degree to which a system is straightforward, easy to use, and accepted by public has been identified as a critical user need in MnDOT's ConOps. Under the Minnesota concept, public acceptance of the proposed model has two aspects:

- Acceptance by shared mobility customers.
- Acceptance by shared mobility providers.

Acceptance by Shared Mobility Customers: For acceptance by shared mobility customers, ease-of-use measures would include:

- Time and complexity of the sign-up procedure.
- Transparency, including sharing information such as mileage rate and mileage incurred on the receipt (similar to sales tax).
- Convenience of payment.

Acceptance by Shared Mobility Providers: For acceptance by shared mobility providers, ease-of-use measures would include a system with non-intrusive to regular operations that is easy to integrate with existing systems.

Minnesota, in coordination with MnDOT, conducted a survey to determine perceptions of car sharing members. Of the approximately 400 survey respondents, most were either slightly knowledgeable or not knowledgeable about the funding structure of Minnesota's transportation system, and a majority had not heard about DBUF. Figure 4 shows the survey respondents' perception on the extent that a DBUF will affect them.

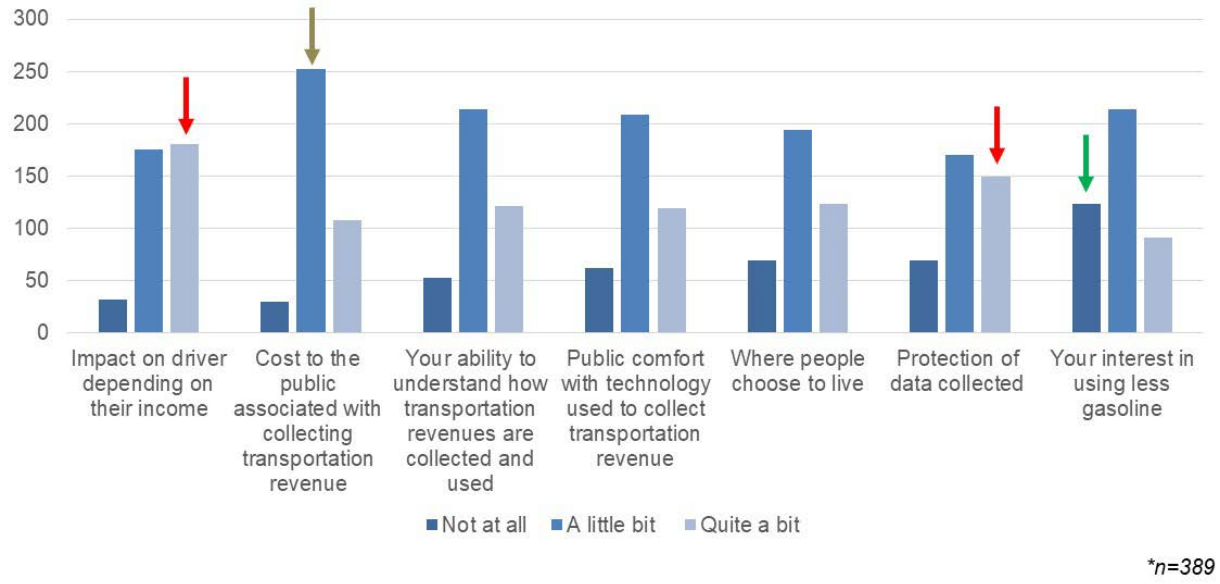


Figure 4. Chart. Survey respondents' perception on the extent that a distance-based user fee will affect them.

Additionally, the survey found that 40 percent of the respondents have concerns related to DBUFs. The key concern is how their data will be protected. The respondents also shared concerns about impact on low-income communities and shared mobility services.

The survey also found that, while a large number of respondents asked for more information before being able to express support for DBUF on all vehicles, the level of support for the concept increased when the question was posed about DBUF implemented through shared mobility services.

Additionally, when asked about the impact of DBUFs on the use of gasoline, a good number of respondents mentioned that DBUF would not incentivize less use of gasoline.

Likewise, MnDOT identified the following questions to explore further in future tasks:

- Why is public support greater for DBUF implemented though shared mobility services? Could this be related to greater trust in shared mobility companies?

- What are the factors underlying the perceived lack of impact of DBUF on the use of gasoline? Is it because respondents are largely already using electric or fuel-efficient vehicles?

CHAPTER 6. SUMMARY AND IMPLICATIONS FOR NATIONAL IMPLEMENTATION

The independent evaluation assessed the impacts of Surface Transportation System Funding Alternatives (STSFA)-funded activities in a systematic manner across all sites. The key findings of the evaluation are summarized below.

Minnesota is approaching a user fee structure focused on efficiency. The Minnesota approach suggests that the fuel tax, despite its advantages and deficiencies, is likely to continue for a long time, primarily because of its simplicity and efficiency. The cost of collecting the fuel tax in Minnesota is less than 0.5 percent of the fees collected. Structuring a distance-based user fee (DBUF) approach around the mobility-as-a-service (MaaS) business model may afford a comparable level of efficiency to existing tax collection systems because onboard technology embedded in the MaaS vehicles is already used to collect trip and mileage data for the MaaS business. Minnesota aims to have costs of collecting the DBUF fall between that of the fuel tax and sales tax.

- **Administrative costs:** While costs related to technology, operations, compliance, and enforcement are likely to be lower in the Minnesota approach, several categories of potential changes to administrative costs attributable to the unique nature of distance-based fee collection processes will need to be accounted for in further research and exploration.

The user fee structure is premised on the convergence of potentially disruptive technologies either already in the market or on the horizon. Minnesota's proposed DBUF system is not a single technology or system, but rather a series of agreements to collect mileage fees from commercial mobility operators. While the future of mobility remains uncertain, this approach allows for a high level of flexibility to adapt and expand. The DBUF system proposed is a simple fee collection from a limited number of commercial operators that provide a mobility service and is neutral to the specific technologies deployed to measure mileage driven by a vehicle.

Minnesota's approach has the potential for enhancing privacy and minimizing security issues typically associated with road usage charge (RUC) data collection by leveraging currently collected data using currently available technology. In the survey conducted by Minnesota on car-sharing members, a good portion of the respondents (40 percent) had concerns related to DBUF, particularly with regard to how their data will be protected. However, collecting mileage fees directly from the car-share company for the mileage driven for each vehicle does not necessitate the collection of data or information as to what particular driver has made a trip. The data being collected can be based solely on the qualifying, fee-generating mileage for each specific vehicle, regardless of driver.

Minnesota's STSFA Phase I activities demonstrate progress towards the larger goal of collaborating with MaaS providers. Specifically, the proof of concept demonstrates that DBUF-relevant data can be downloaded and transferred to a secure data repository. The approach is responsive to a potential future scenario where vehicle ownership is low and significant share of travel is accounted for by MaaS service providers. However, the likelihood

of realization of the specific scenario that is the premise of Minnesota's approach is subject to several market forces including technology evolution and travel behavior patterns.

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