
Surface Transportation System Funding Alternatives Phase I Evaluation

Pre-Deployment of Innovative Revenue Strategies and Public Outreach by Missouri Department of Transportation

FHWA-HOP-19-046

August 2022



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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 ABBREVIATIONS

ConOps	concept of operations
COTS	commercial-off-the-shelf
DOR	Department of Revenue
FHWA	Federal Highway Administration
FY	fiscal year
MoDOT	Missouri Department of Transportation
MPG	miles per gallon
RUC	road usage charge
STSFA	Surface Transportation System Funding Alternatives
USDOT	U.S. Department of Transportation
VIN	vehicle identification number

EXECUTIVE SUMMARY

This report presents the independent evaluation results of Missouri's *Road to Tomorrow: Surface Transportation System Funding Alternatives (STSFA) Pre-Deployment Innovative Revenue Strategies and Public Outreach* initiative. The State received fiscal year (FY) 2016 funding from the U.S. Department of Transportation's (USDOT's) STSFA Program. The FY 2016 funding and associated grantee programs constitute the first phase of the STSFA Program and are referred to throughout this document as "Phase I." The Missouri Department of Transportation (MoDOT) received \$250,000 in FY 2016 STSFA funds to conduct pre-deployment planning to establish a new user-based registration fee to address changes in fuel efficiency, and to address equity and fairness in what users pay for the maintenance of road and bridge infrastructure. MoDOT is one of eight 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 Act¹ 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 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 of the need for alternative funding sources for surface transportation programs and 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 Federal Highway Administration (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.

The U.S. Congress and 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 evaluated the seven

¹ Public Law 114-94, H.R. 22, § 6020, H.R. 22, 114th Congress. 2015.

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, 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.

MISSOURI'S PRE-DEPLOYMENT ACTIVITIES AND OUTREACH EFFORTS

Missouri DOT reported that motor vehicle and driver's license fees comprise approximately 21 percent of the State's funding, but many of the fee structures have not been changed, nor have rates increased, since 1984 (and in the case of some fees, since 1969).³ Current rates do not reflect actual infrastructure needs or support sustainable programs of asset management to preserve the bridge and highway system Statewide. MoDOT's current vehicle registration-fee structure is based on *taxable horsepower*, a measure computed by a formula based on cylinder dimensions, which does not relate to the real impact the vehicle has on the transportation system. Missouri is the only State still using this metric to assess vehicle registration fees.

Missouri has based its vehicle registration fee on the taxable horsepower. In the early 20th century, this was an acceptable measure and a majority of States used taxable horsepower as the basis for vehicle registration fees. Currently, Missouri is the only State still basing its vehicle registration fee on taxable horsepower. Taxable horsepower does not reflect developed horsepower; instead, it is calculated upon the engine's bore size and number of cylinders. At the beginning of the twentieth century, taxable horsepower was reasonably close to real power; however, as the internal combustion engine developed, real power became larger than nominal taxable power by a factor of ten or more. Until the early 1980s, taxable horsepower was generally a good proxy for fuel consumption and was generally easy to administer. However, with development of more fuel-efficient engines, and the introduction of hybrid, electric, and alternative fuel vehicles, taxable horsepower is no longer correlated to fuel efficiency in gasoline and diesel engines, and cannot be derived for electric motors (or rotary engines). As a result of the obsolete measure, the publication for taxable horsepower has been discontinued for many years, and the consultants formerly engaged to impute or estimate equivalent rates based upon previous data no longer offer this service.

In addition to being an archaic measure of vehicle power, the concept of taxable horsepower is poorly understood by residents. This makes the fee nontransparent and results in increased errors in fee assessment. The objective of MoDOT's STSFA Phase I Pre-deployment Project was to test the feasibility of transitioning the vehicle registration-fee schedule from taxable horsepower to combined miles per gallon (MPG) rating of the vehicle. MoDOT considers this a more fair and equitable measure to assess the fees paid to operate a vehicle in Missouri. All pre-deployment activities were completed by August 15, 2018.

As part of the STSFA Phase I Project, MoDOT conducted the following pre-deployment activities:

- Developed a platform for new registration-fee schedules to capture fuel-efficient vehicles: MoDOT proposed a new registration-fee structure based on vehicles' estimated fuel efficiency (measured in Miles Per Gallon [MPG]). As part of the Phase 1 project,

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

³ Missouri Department of Revenue. 2018. Analysis of Transportation Revenue Sources. n.p., page 4.

MoDOT worked with other Missouri State agencies to develop a full-scale implementation strategy to amend the existing registration-fee schedule. The intent of this new schedule was to capture the lost gas tax revenues of modern fuel-efficient vehicles (i.e., vehicles that average greater than 20 MPG). While this is not a fee based on vehicle miles traveled, which is a type of fee that other STSFA pilot sites are exploring, it does attempt to reduce the inherent inequity of the gas tax.

- Conducted education and outreach activities, including with the Missouri General Assembly, regarding alternate funding and new technology for transportation infrastructure: Pre-deployment activities included a full-scale outreach campaign to educate the legislators about the need for alternative funding and innovative technology to advance transportation interests in the State.

It is important to note here that Missouri's approach is not a road usage charge (RUC), and it cannot be compared to one. The primary goal of Missouri's proposed program is to address declining fuel tax revenue by mitigating deficiencies in the existing Missouri Department of Revenue (DOR) metric, which uses taxable horsepower as the basis for the State's registration-fee system. The purpose of MoDOT's STSFA Phase I pilot was to confirm the State's financial model, which projects that an incremental fee structure tied to vehicle fuel-efficiency measures will provide more revenue than the current program

In November 2018, a Missouri ballot measure to increase the gas tax by 10 cents—to 27 cents per gallon—failed. The increase was predicted to generate an additional \$123 million for road and bridge improvements in the State of Missouri.⁴ Had this ballot measure passed, Missouri would have been allowed to implement its proposed registration fee schedule based on miles per gallon.

MoDOT addressed the following challenges in implementing Phase I of the STSFA Project:

- Identifying appropriate system architecture: MoDOT evaluated existing data and system capabilities at the Missouri DOR to determine what new system architecture should be implemented to administer the registration fee, with the major options being a registration-fee system architecture in the form of a software-as-a-service or commercial-off-the-shelf (COTS) implementation.
- Communicating the strategy to the public sector: MoDOT and the Missouri DOR anticipated facing backlash from affected stakeholders, including local license offices and other DOR contractors, when implementing the new fee. MoDOT worked closely with DOR to predict and overcome these challenges and to facilitate a smooth transition in the deployment phase.

MAJOR FINDINGS

The independent evaluation assessed the impacts of the STSFA-funded activities in a systematic manner across all pilot sites. The objective was to document the applicability, motivations, and impediments to implementing user-based fee mechanisms as alternatives to the gas tax on a Nationwide level in the future.

⁴ Missouri Secretary of State. [2018 Ballot Measures](#). Last accessed May 6, 2019.

Key Findings from the Missouri Approach

Notable findings of Missouri's STSFA Phase 1 explorations follow:

- Collecting a mileage-based tax was not considered a viable option in Missouri, because RUC vendor costs are greater than 3 percent of total revenue. The Missouri constitution (Article 4, Section 30 a) limits the actual cost of collecting MFT to 3 percent.⁵
- MoDOT found that engaging stakeholders early and often was essential for an alternative revenue pilot or program to succeed. MoDOT was successful in partnering with and involving other agencies that this proposed transition will impact, specifically the DOR and the Office of Administration Information Technology Services Division. Involving public sector stakeholders early, and retaining their motivated engagement, was critical in Missouri's case, to presenting this strategy as a viable option to elected officials.
- MoDOT found that it was important to convey to stakeholders and legislators that older vehicles owned by predominantly low-income drivers use a lot of gas, and therefore disproportionately contribute to transportation funding. A large proportion of Missouri legislators represent rural areas and found common cause with rural vehicle owners, who pay a high gas tax and currently subsidize fuel-efficient vehicles that contribute little or nothing toward transportation funding. The legislators could see that the gas tax disproportionately impacts owners of vehicles in the 14- to 18-MPG fuel-efficiency range.

A mileage-based tax will not be viable in Missouri if RUC vendor costs are above 3 percent of total revenue. The Missouri constitution (Article 4, Section 30 a) limits the actual cost of collecting MFT to 3 percent.

⁵ Missouri General Assembly. [Missouri Constitution Section: Article IV, Executive Department, Section 30a](#), November 14, 2016. Last accessed May 6, 2019.

CHAPTER 1. INTRODUCTION

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 has come into question. Recognizing this trend, the Fixing America's Surface Transportation Act⁶ of 2015 established the Surface Transportation System Funding Alternatives (STSFA) Program. The purpose of the STSFA Program is 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.

By funding pilots that investigate alternative revenue mechanisms, the U.S. Congress and the Federal Highway Administration (FHWA) seek to understand whether a user-fee structure is a viable substitute to the MFT and has the potential to be implemented nationally in the future. As part of this endeavor, the FHWA evaluated seven of the eight grantee sites that received funding in Federal fiscal year (FY) 2016, also referred to as Phase I of the STSFA grant program.⁷ The evaluation reports will inform the 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.

Staff from the FHWA Office of Operations have the overall responsibility for administering the program and conducting the independent evaluation. The FHWA Division office staff provide direct support by overseeing the program in participating States. The independent evaluation of the program assessed the impacts of the STSFA-funded activities conducted by each grantee in a systematic manner across all sites. The objective of the evaluation was to document the applicability, motivation, and impediments to implementing user-based fee mechanisms as alternatives to the gas tax on a Nationwide level in the future. This report documents the findings of the independent evaluation of Missouri Department of Transportation's (MoDOT's) Phase I activities supported by the STSFA grant funds.

MISSOURI'S PRE-DEPLOYMENT OF INNOVATIVE REVENUE STRATEGIES AND PUBLIC OUTREACH

Missouri is the only State that continues to use a vehicle registration system based on the concept of taxable horsepower. Until the 1980s, taxable horsepower was a good proxy for fuel consumption. Further, taxable horsepower only applies to internal combustion engines, making it difficult to determine the correct registration fee for electric cars and vehicles with rotary engines. In 2017, MoDOT conducted a study to explore and analyze a range of new fee structures; this became the precursor to Missouri's proposed approach under STSFA.

As part of the 2016 STSFA grant cycle, MoDOT requested \$1 million in Federal funds to conduct various activities in preparation for a future deployment of an alternative revenue strategy. The final award approved some of the proposed project elements for a total Federal funding of \$250,000 towards MoDOT's pre-deployment efforts. The STSFA-funded activities included:

⁶ Public Law 114-94, H.R. 22, § 6020, H.R. 22, 114th Congress. 2015.

⁷ The Phase I evaluation for the eighth pilot site, Hawaii, was delayed due to delays in pilot start.

- Developing a platform for new registration-fee schedules to capture fuel-efficient vehicles: MoDOT proposed a new registration-fee structure based on a vehicle's estimated fuel efficiency (measured in miles per gallon [MPG]). As part of this activity, MoDOT worked with other State agencies to develop a full-scale implementation strategy to amend the existing registration-fee schedule. The intent of this new schedule was to capture the lost gas tax revenues of modern fuel-efficient vehicles (i.e., vehicles that average more than 20 MPG). While this is not a fee based on vehicle miles traveled, which is a type of fee other STSFA pilot sites are exploring, it does attempt to reduce the inherent inequity of the gas tax.
- Conducting education and outreach to the Missouri General Assembly regarding alternate funding and new technology for transportation infrastructure: MoDOT recognized a need for a customized, tailored approach to reaching out to the State General Assembly. Pre-deployment activities involved a full-scale outreach campaign to educate the legislators about the need for alternative funding and innovative technology to advance transportation interests in the State.

ORGANIZATION OF THIS REPORT

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

Chapter 2 details the activities planned and accomplished by MoDOT under Phase 1 of the STSFA grant program for the FY 2016 grant cycle.

Chapter 3 presents the evaluation framework as proposed under the 2016 Notice of Funding Opportunity, the key U.S. Department of Transportation (USDOT) questions that the evaluation seeks to address, and the evaluation team's approach.

Chapter 4 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 5 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 6 presents the references that are used in this report.

CHAPTER 2. MISSOURI PRE-DEPLOYMENT ACTIVITIES

This chapter presents MoDOT's pre-deployment activities, as proposed in its grant application, and summarizes activities conducted as part of Phase I of the STSFA grant program, or the fiscal year (FY) 2016 grant cycle.

BACKGROUND

Missouri has based its vehicle registration fee on the taxable horsepower. In the early 20th century, this was an acceptable measure and a majority of States used taxable horsepower as the basis for vehicle registration fees. Currently, Missouri is the only State still basing its vehicle registration fee on taxable horsepower. Taxable horsepower does not reflect developed horse power; instead it is calculated upon the engine's bore size and number of cylinders. At the beginning of the twentieth century, taxable horsepower was reasonably close to real power; however, as the internal combustion engine developed, real power became larger than nominal taxable power by a factor of ten or more. Until the early 1980s, taxable horsepower was generally a good proxy for fuel consumption and was generally easy to administer. However, with development of more fuel-efficient engines, and the introduction of hybrid, electric, and alternative fuel vehicles, taxable horsepower is no longer correlated to fuel efficiency in gasoline and diesel engines, and cannot be derived for electric motors (or rotary engines). As a result of the obsolete measure, the publication for taxable horsepower has been discontinued for many years, and the consultants formerly engaged to impute or estimate equivalent rates based upon previous data no longer offer this service.

In addition to being an archaic measure of vehicle power, the concept of taxable horsepower is poorly understood by residents. This makes the fee nontransparent and results in increased errors in fee assessment. In its grant application, MoDOT proposed to (1) develop the new fee schedule to capture lost gas tax revenues resulting from greater use of fuel-efficient vehicles, and (2) implement a scheduled fee for vehicles averaging greater than 20 miles per gallon (MPG). This fee would have a sliding scale so that all highway users pay a similar fee regardless of the fuel efficiency of their vehicle. This report focuses on these two proposed activities that were funded by the STSFA grant program.

PROGRAM OBJECTIVES

The primary goals for Missouri's efforts with alternative revenue were to:

- Make up for lost buying power of State gas taxes.
- Design a registration fee that is fair, reliable, and protects privacy.
- Attain both General Assembly and public support.

MoDOT's Phase I program objectives under policy, technical, and organizational categories were as follows:

- Policy objectives:
 - Support a legislative Task Force on transportation funding.
 - Craft legislative language to authorize and support exploration of alternatives.

- Form a joint Task Force on registration fee modernization with the Department of Revenue (DOR).
- Technical objectives:
 - Build a flexible modeling tool to analyze alternative policy approaches for transportation funding.
 - Conduct gap analysis on the existing DOR registration-fee system.
 - Create a concept of operations (ConOps) for a new fee system that considers vehicle fuel economy.
- Organizational objectives:
 - Transfer technical knowledge for use in ongoing analysis and legislative support.
 - Seek Federal funding to support continued agency investigation of alternative user-based funding.
 - Identify necessary cross-agency linkages between MoDOT and DOR to sustain the project.

SUMMARY OF MISSOURI'S PHASE I ACTIVITIES

In 2017, MoDOT studied updating the State's antiquated vehicle registration-fee system. The State explored and analyzed a range of possible new fee structures based on factors other than horsepower, principally relying upon MPG, a common measure of fuel economy. An updated fee structure would simultaneously address the following two problems:

- As Missouri's vehicle fleet grows more fuel efficient, the State expects its fuel tax revenues to decline. A registration fee counteracting that decline in MFT revenues could sustain transportation revenues while ensuring fairness.
- The Missouri DOR, which administers and collects vehicle registration fees, struggles to maintain its fee tables and fee collection system in an era when vehicle information decreasingly features taxable horsepower ratings.

Developing a Platform for New Registration-Fee Schedules to Capture Fuel-Efficient Vehicles

MoDOT proposed a new registration-fee structure based on vehicles' estimated fuel efficiency (measured in MPG). As part of this activity, MoDOT worked with other State agencies to develop a full-scale implementation strategy to amend the existing registration-fee schedule. The intent of this new schedule was to capture the lost gas tax revenues of modern fuel-efficient vehicles (i.e., vehicles that average greater than 20 MPG).

Key deliverables related to developing the new registration-fee schedule include:

- A dynamic financial modeling tool and user guide to illustrate and test how an MPG fee can replace the current registration-fee schedule. The model uses existing vehicle identification numbers (VINs) of registered vehicles to determine the make, model, year, and MPG of the current passenger residential fleet (while maintaining owner privacy).

- A ConOps for an MPG-based fee schedule and vehicle registration system for passenger vehicles in the State of Missouri. The ConOps can potentially serve as a basis for designing and procuring a vehicle registration system that incorporates an MPG-based fee schedule in place of the current taxable horsepower-based fee schedule.
- The technical memorandum on VIN decoding and analysis that documents the methodology used to associate each passenger vehicle in Missouri with its U.S. Environmental Protection Agency-estimated fuel economy, fuel type, and other vehicle descriptors. The derived data were used as input to the baseline of the Missouri STSFA Financial Model, as well as to an analysis of the differential impacts of transitioning from a taxable horsepower-based vehicle registration-fee schedule to one based on fuel efficiency. The analysis examined impacts by vehicle fuel type and geography.

Education and Outreach to Missouri General Assembly Regarding Alternate Funding and New Technology for Transportation Infrastructure

MoDOT recognized a need for a custom-tailored approach to reach out to the State General Assembly. The pre-deployment activity involved a full-scale outreach campaign to educate legislators about the need for alternative funding and new, innovative technology to advance transportation interests in the State. MoDOT assisted with developing language for several legislative bills and a ballot measure to help fund the future roll out of the alternative revenue program. These legislative measures have yet to be successful; however, MoDOT continues its outreach to legislative and other stakeholders. As part of the outreach activities, MoDOT organized a State Innovation Forum—a month-long, open meeting, with 5-minute slots for anyone to present innovative solutions to transportation funding challenges.

CHAPTER 3. INDEPENDENT EVALUATION METHODOLOGY

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

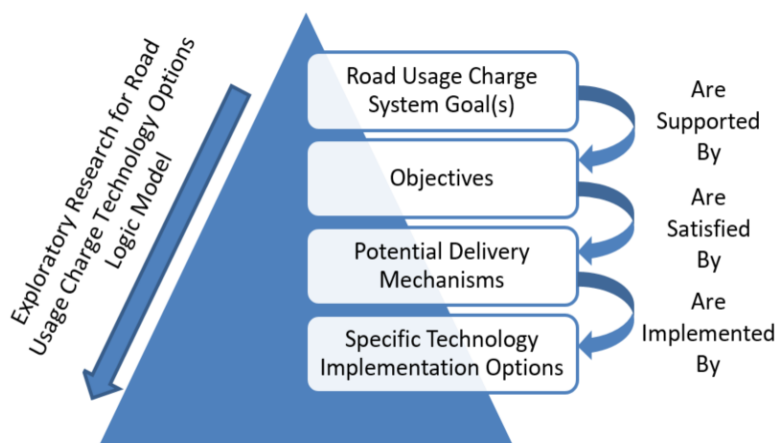
EVALUATION APPROACH

As its name suggests, the fundamental concept of an RUC is that users pay a direct charge for the use of a roadway. However, it is important to understand that both “use” and “user” can be defined in several different ways, and the mechanism by which a charge is levied can also vary significantly. This is clear among the Phase I grantees evaluated, all of which are using different combinations of technologies and various paradigms and mechanisms to levy charges. Often, the fundamental objective for the RUC system is a significant factor in identifying the technology options, data collection, and how fees are levied. Figure 1 shows the logic model.⁸

One essential component of this evaluation is understanding the fundamental objectives of the RUC systems as deployed by the grantee sites. The objectives provided 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 for a summary of how the study team conducted this evaluation.)

EVALUATION FRAMEWORK – U.S. DEPARTMENT OF TRANSPORTATION QUESTIONS

To explore the key questions that USDOT intends to examine as part of this evaluation within the context of each grantee site’s proposed activities, the evaluation team defined relevant metrics for each question. While the evaluation team considered some questions highly applicable to Phase I activities, others were marginally applicable. Table 1 provides the assessment framework, and table 2 provides the system attributes relevant to the evaluation.



Source: HDR Inc.

Figure 1. Diagram. Exploratory research for road usage charge technology options logic model.

⁸ HDR Inc. 2011. *Exploratory Research on Technology Options for Collection of Road Use Fees*. Unpublished Technical Memorandum developed under contract to the Federal Highway Administration.

Table 1. Assessment framework.

No.	U.S. Department of Transportation Evaluation Question	Relevant Site Question/Metrics	Applicability to Missouri's Program
Q1	What is the viability of a road usage charge (RUC) on a Nationwide scale?	Not applicable.	Not applicable.
Q2	Would the fee assessment and collection mechanisms be scalable?	In determining the appropriate approach regarding administering the miles-per-gallon fee, how have considerations related to scalability been included?	Marginally applicable.
Q3	What is the efficiency of the fee assessment and collection relative to the gasoline tax (i.e., would the fees collected be sufficient, at a national scale, to offset the absence of the gasoline tax)?	What are the incremental administrative costs for the proposed fee structure over and above that currently incurred for the collection of gas tax?	Marginally applicable.
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?	As Missouri's approach does not involve collecting and basing revenue calculation on vehicle miles' data, several of the system attributes in table 2 do not apply to the system.	Not applicable.
Q5	What is the user and stakeholder perception of RUC in general and of pilot activities?	What are some of the lessons learned with outreach to stakeholders, especially legislators?	Marginally applicable.
Q6	What changes in institutional and financial setting, frameworks, models, and elements are required?	What changes in organizational processes are imminent with a vehicle mileage-based system of calculating registration fee?	Marginally applicable.

MoDOT's application did not propose a typical RUC system; rather, it suggested a mechanism to address the inequity of the current gas tax through a vehicle registration-fee structure that considers fuel efficiency. As such, several typical independent evaluation assessment questions are not directly applicable to MoDOT's proposal.

Table 2. System attributes.

Functional Parameter	Description
User-Orientated Parameters	
Privacy	The nature of the information being collected, as opposed to the integrity of the information.
Equity	How user costs and other outcomes will impact people in different income brackets and of different races/ethnicities, gender, English proficiency level, and travel mode.
Potential for Value-Added Services	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	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	Ability of the system 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.

Table 2. System attributes. (continuation)

Functional Parameter	Description
System-Orientated Parameters	
Interoperability	Ability for the system to interact and exchange information across multiple jurisdictions.
Compatibility with Low Tech	Ability of the system 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.
Cybersecurity	Extent to which the system is vulnerable to a cyberattack 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.

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. The MoDOT Phase I activities did not include implementation of a pilot.

Transportation Research Board Annual Meeting Workshops

Throughout the Phase I evaluation, the STSFA evaluation team facilitated two workshops during the 2018 and 2019 Annual Transportation Research Board Conference in Washington, D.C. At the time of the 2018 workshop, MoDOT was just starting on its Phase I activities. The first segment of the 2018 workshop addressed one or several “big questions” that each project was designed to answer. The questions were then structured as a hypothesis that would be either supported or not as a result of the Phase I activities. Table 3 lists the specific questions posed during the 2018 Transportation Research Board workshop, and table 4 summarizes MoDOT’s responses.

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 primarily based on prior RUC endeavors or on very early activities.

Table 3. Workshop questions.

No.	Question
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?

Table 4. Missouri’s Phase I summary as articulated at the 2018 Transportation Research Board workshop.

Field Deployment (Yes/No) Using 2016 Funds	The “one big question” at the Start of Phase I	Lessons Learned	Challenges
No	Can State vehicle registration fees use passenger vehicle miles per gallon to assess a fair and equitable user charge for electric, hybrid, and gas-powered vehicles?	Building consensus, especially amongst legislators, for the need for alternative funding sources is critical.	Supporting transition of State agencies to a registration fee system; managing public awareness.

At the time of the 2019 workshop, MoDOT had completed its Phase I activities. The MoDOT representative at the workshop shared the following observations about the program:

- The MoDOT approach front loads fees by charging a fixed annual amount for access to the transportation system. Access to the roadway system is a benefit regardless of the number of miles driven on it. As such, MoDOT’s approach is based on access, not miles or distance.
- Eastern Missouri has 1,900 electric vehicles and it is a challenge for the State to keep up with fuel-efficiency technology. MoDOT recognizes that RUC, as the pilot sites currently envision, would need to be updated periodically to keep up with the increasing fuel efficiency, and would be captive to the same political system that currently governs MFT increases. The MoDOT registration-fee approach would not be subject to these limitations.
- Missouri is trying to stay under the legislated 3-percent collection cost limit for any alternative to the MFT. Usage drives the marginal costs of the system, and a fee based on usage would drive up the cost of administering the system.

Conference Call Update

In September 2018, the evaluation team, in conjunction with the FHWA's STSFA program team, conducted a conference call update with MoDOT to learn about project progress, initial findings from completed activities, and timeline to complete remaining activities.

Chapter 4 presents the significant findings from Missouri's Phase I explorations.

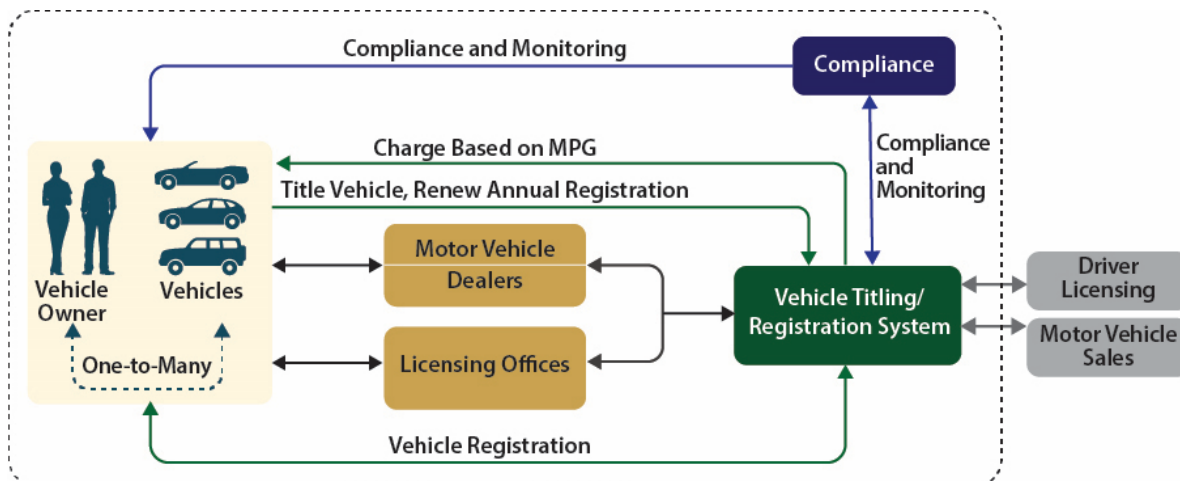
CHAPTER 4. MAJOR FINDINGS

This chapter presents an overview of MoDOT’s proposed system to replace shortfalls in fuel taxes, 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 3, which is based on the STSFA grant evaluation criteria, as provided in the notice of funding opportunity.⁹

MoDOT’s Phase I scope only included pilot planning and set-up activities. As such, several evaluation criteria were not directly addressed within the scope of grant-funded activities. MoDOT may be addressing additional aspects of an RUC system with non-Federal funds and/or may address some aspects in the future as it advances towards executing a pilot. Given the limitations of scope of this effort, this chapter includes detailed discussion only on the attributes of the proposed system that MoDOT explored, examined, or tested during Phase I of the STSFA funded project.

OVERVIEW OF MISSOURI’S PROPOSED SYSTEM

Missouri’s approach to replacing shortfalls in the gas tax due to the emergence of higher efficiency, hybrid, and purely electric vehicles relies on developing a graduated schedule of fees using the relative fuel consumption as a metric for vehicle registration fees. The fee structure would charge less-efficient vehicles a lower registration fee, and higher efficiency vehicles a higher fee. The approach assumes the existing gas tax remains, and lower efficiency vehicles are still paying their share of roadway cost through the existing gas tax. Because higher efficiency vehicles use less fuel, they likewise pay less tax for the same mileage driven when compared to a low-efficiency vehicle. This approach is not intended as a fee for road usage, but instead a method to recapture the lost gas tax revenue that is beginning to drop and will continue to decrease as vehicles continue to increase their fuel efficiency. Figure 2 presents an overview of Missouri’s proposed system.



Source: Missouri Department of Transportation.

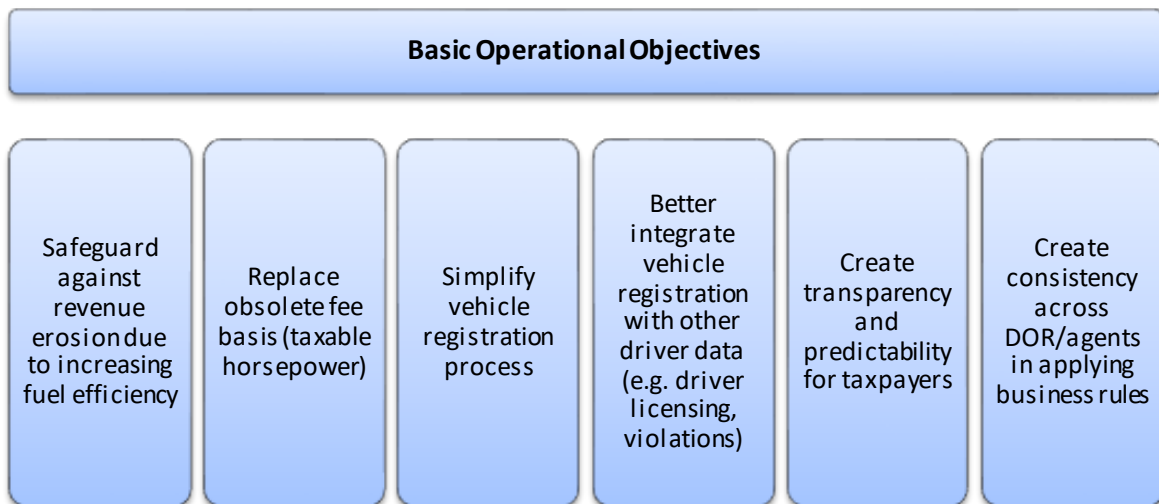
Figure 2. Diagram. Missouri’s user fee system overview.

⁹ [USDOT Notice of Funding Opportunity Number DTFH6116RA00013](#), issued on March 22, 2016.

The ConOps for Missouri’s proposed approach explored the following operational concepts, in order of increasing modification from the existing vehicle registration system:

- Operational Concept 1: Modify the existing vehicle registration system to accept a fee schedule based on vehicles’ mileage efficiency ratings (e.g., miles per gallon [MPG]) in lieu of the current taxable horsepower system.
- Operational Concept 2: Develop a new vehicle registration fee-determination system with MPG as one basis, among potentially others, to determine vehicle fees. This new system would automate the process for determining vehicle registration fees, which would then be assessed via the existing vehicle registration system.
- Operational Concept 3: Fully replace the existing vehicle registration system at the DOR with a custom application utilizing an MPG-based fee schedule to be determined by the General Assembly.
- Operational Concept 4: Replace the existing vehicle registration system at the DOR with a commercial-off-the-shelf (COTS) system utilizing an MPG-based fee schedule. The COTS solution could be hosted either by the State or by a cloud-based service provider.
- Operational Concept 5: Subscribe to a cloud-based Software as a Service solution that uses an MPG-based fee schedule.

The basic operational objectives of a modified registration fee system are illustrated in figure 3.



Source: Missouri Department of Transportation.

Figure 3. Diagram. Basic operational objectives of Missouri’s proposed vehicle registration system.

SYSTEM-ORIENTED PARAMETERS

Flexibility to Adapt and Expand

Missouri's registration-fee approach could be changed or updated to address almost any form of emerging transportation technology if that technology requires some form of registration to operate. The current registration fee is based on a vehicle's horsepower, with a higher base license registration accompanying higher horsepower vehicles (maxing out at 72 horsepower). The new approach would replace the horsepower scale with one that places a higher registration fee on vehicles with higher fuel efficiency.

The ability to change or adapt the system will be dependent on the State's ability to change or update policy, and the ability of the State's agencies to properly assess and charge the vehicle licensure fee.

Compatibility with Low-Technology Options

Missouri's approach is essentially a low-technology option that does not take miles driven into consideration, but instead, uses the vehicle's fuel consumption per mile as a benchmark for assessing a graduated license fee.

Enforcement and Compliance

System enforcement is built into the existing structure of vehicle licensure. If a vehicle is licensed, then its owner has paid the fee. Law enforcement would most likely be involved in enforcement at a level comparable to that currently needed to enforce existing vehicle licensing laws.

System Costs

As stated previously, Missouri's constitution (Article 4, Section 30a) limits the cost of collecting the MFT to 3 percent.¹⁰ As such, there is widespread agreement among stakeholders—including MoDOT, motor vehicle dealers, vehicle license office contractors, and vehicle owners—that the system administration and compliance costs should not deviate significantly from the current system's costs. The ConOps drafted as part of Phase I activities indicates that there may even be some savings from moving to a system based on a vehicle's MPG ratings.

Some operational concepts explored in the ConOps could result in a system that requires additional ongoing maintenance costs due to custom development and update needs associated with a system that ties the vehicle's VIN to its

“Any new MPG-based vehicle registration system should either not impact DOR's sales reporting system (although there are very good reasons why it should be updated in tandem with the passenger vehicle registration system), or be simple for dealers to integrate with to keep compliance costs as low as possible.”

Source: Missouri Department of Transportation and D'Artagnan Consulting. 2018. *Concept of Operations for an MPG-Based Fee Schedule and Vehicle Registration System.*

¹⁰ Missouri General Assembly. [Missouri Constitution Section: Article IV, Executive Department, Section 30a](#), November 14, 2016. Last accessed May 6, 2019.

MPG rating. These additional costs, however, should be balanced with the user experience benefits. A standardized system of looking up vehicle efficiency ratings will provide better user experience and less discrepancy in fee assessment than a system in which vehicle owners are left to self-report their vehicle's MPG rating.

USER-ORIENTED PARAMETERS

Equity and Public/Stakeholder Perception

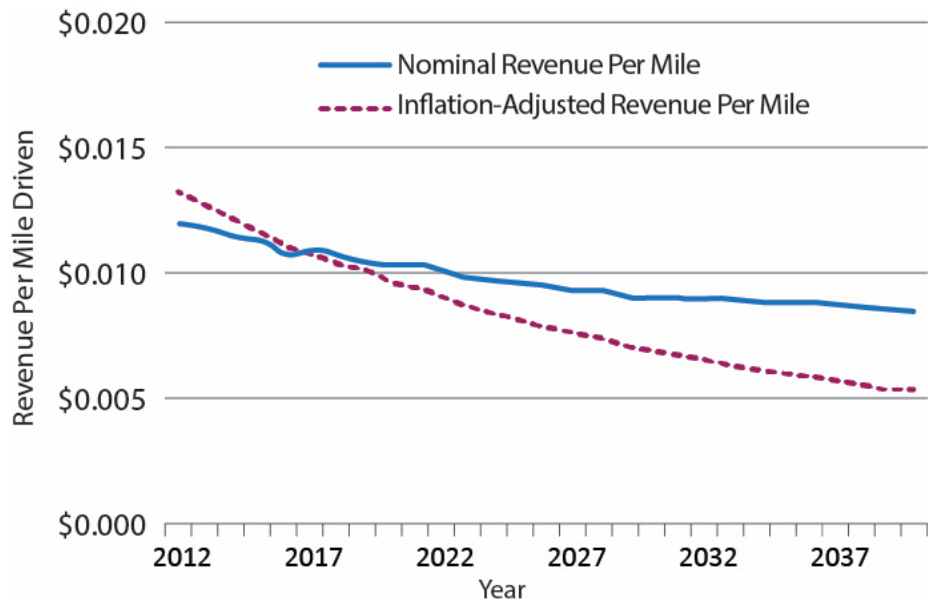
Assessing equity was not an element of the proposed STSFA Phase I approach; however, outreach and communication to legislators was one of the stated goals. As part of this, MoDOT conducted a State Innovation Forum, which was a month-long, open meeting with 5-minute time slots for anyone to present. A significant number of original equipment manufacturers participated in this forum.

At this stage of planning, MoDOT did not actively seek public involvement; however, the *Missouri MPG-based Registration Fee Demonstration Alternatives* study explored the following considerations:

- Collaboration between the FHWA, MoDOT, and Missouri General Assembly representatives through the State's Every Day Counts initiatives on this subject.
- Engagement with local MoDOT staff, including regionally based personnel; select State and local elected officials; and stakeholder groups, including automobile clubs, trucking organizations, government watchdog groups, automobile dealers, and other State agencies.
- Mechanisms for soliciting the involvement of the general public, media, and academia.
- Types of communication (i.e., horizontal [focused on "who" receives the message], vertical [focused on the "manner" of communication], and temporal [focused on "when" or "how often" the message is conveyed]).

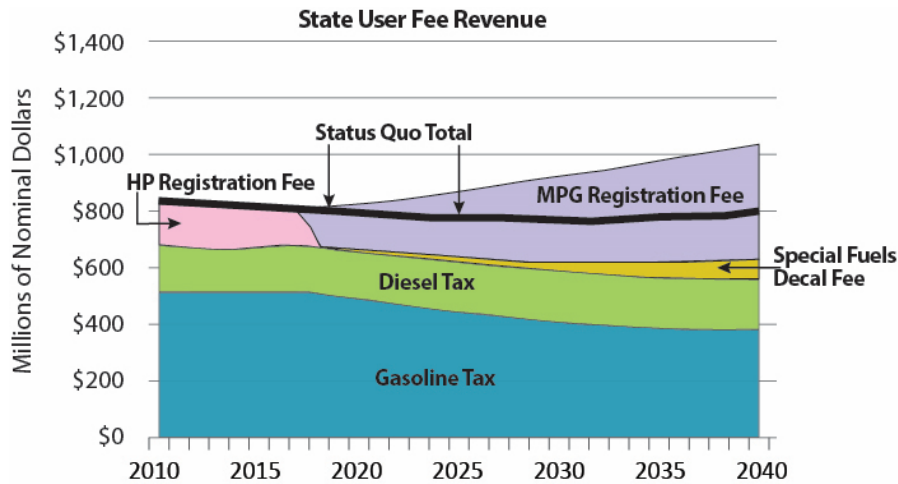
Figure 4 presents an example of a graphic used to communicate to legislators the message that transportation revenues are projected to decline in real terms, despite increasing vehicle miles traveled. Consequently, costs for maintaining and upgrading the transportation system will be unmet as purchasing power declines.

Figure 5 presents how a vehicle MPG-based registration fee can change that projection to one of nearly flat transportation revenues (in nominal terms) by implementing a policy of a \$25 registration fee and a \$4 charge per additional MPG on vehicles averaging more than 25 MPG. Subfigure 5A presents State user fee revenue in millions of nominal dollars. Subfigure 5B presents State user fee revenue in millions of dollars.



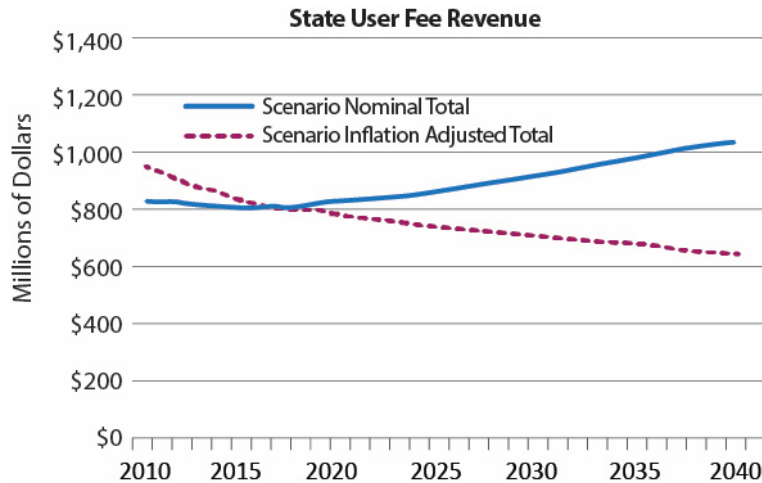
Source: Missouri Department of Transportation.

Figure 4. Chart. State user fee revenue base case.



Source: Missouri Department of Transportation.

A. State user fee revenue in millions of nominal dollars.



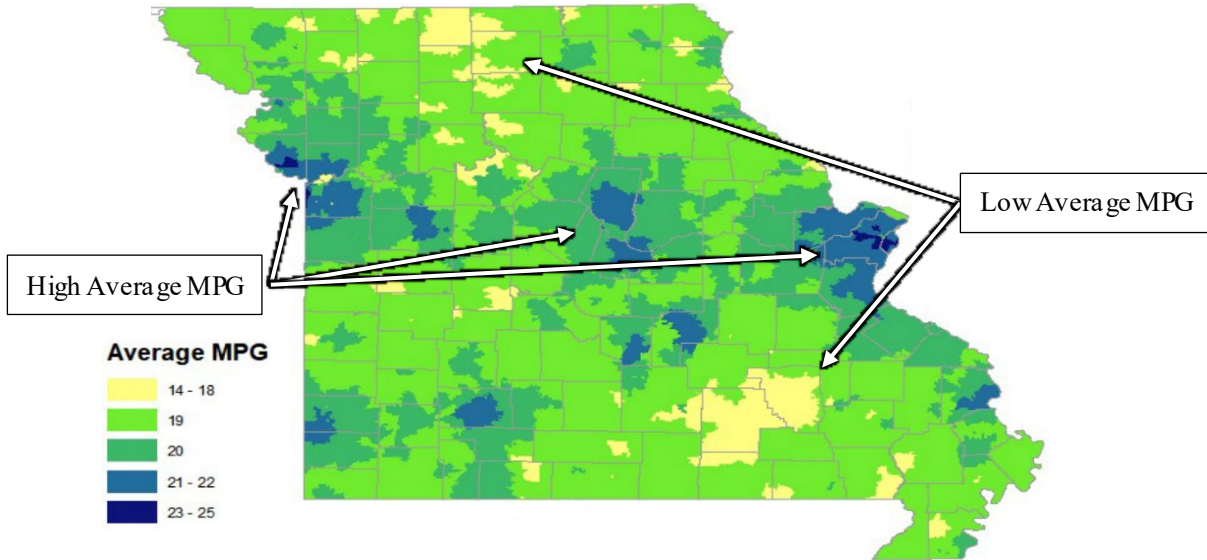
Source: Missouri Department of Transportation.

B. State user fee revenue in millions of dollars.

Figure 5. Charts. State user fee revenue for scenario with vehicle registration fee of \$25 plus \$4 per efficiency rating greater than 25 miles per gallon.

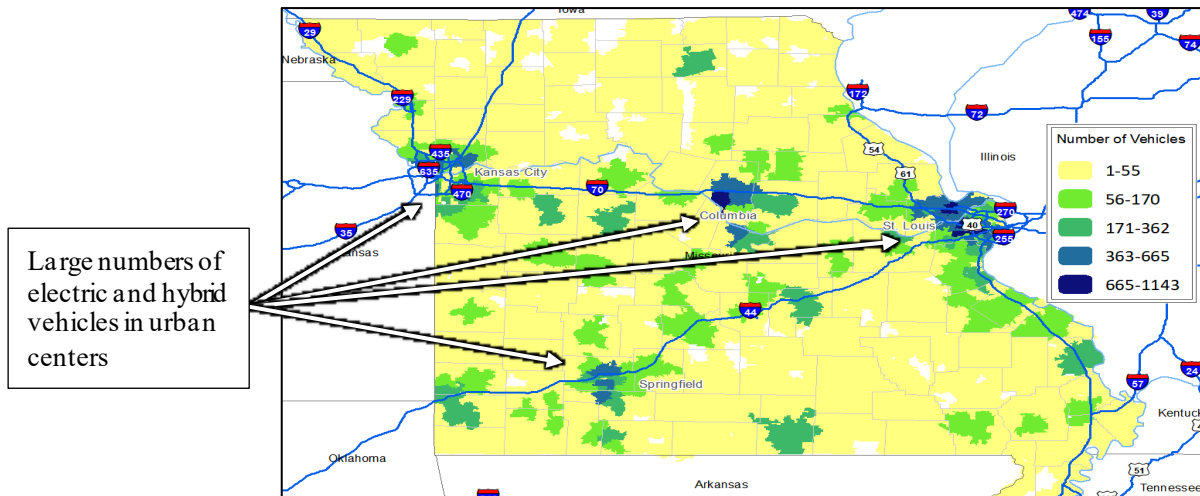
Figure 6 and figure 7 present findings of the Urban and Rural Transportation Funding Analysis that can be used to further analyze equity issues—groups that will be impacted by the proposed registration-fee schedules, and the extent of impact.¹¹ This analysis can also be used to develop effective communications strategies with key stakeholders.

¹¹ As part of Phase II, MoDOT seeks to study the impact an MPG-based registration fee would have on various geographic regions in the State. The initial perception is the fee would be unfair to citizens based on their geographic locations (urban versus rural). The results shown in figures 6 and 7 are some of the preliminary findings of this study.



Source: Missouri Department of Transportation.

Figure 6. Map. Geographic distribution of registered Missouri light-duty fleet by average miles per gallon.



Source: Missouri Department of Transportation.

Figure 7. Map. Geographic distribution of electric and hybrid vehicles by zone improvement plan code.

The key outreach activities conducted as part of Phase I included:

- Supporting a legislative Task Force on transportation funding (2017).
- Crafting legislative language to authorize and support exploration of alternatives.

The primary results of studies undertaken as part of Phase I included:

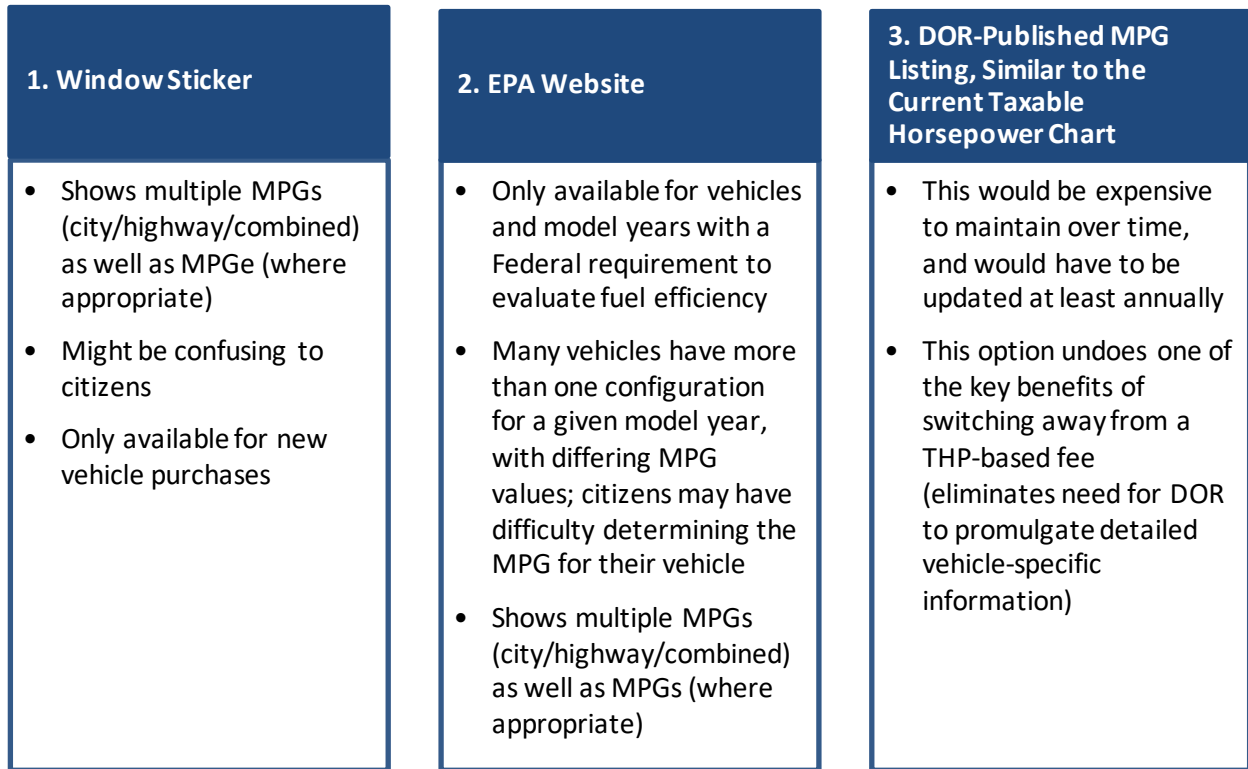
- Options for transitioning the registration-fee system.
- Cost distribution by vehicle type and geographic region of transitioning.
- Comparison of projected revenues under each option over a 20-year period.

- Impact each option would have under the Hancock amendment.¹²

Ease of Use

Of the operational concepts explored in the ConOps, Concept 1 is likely to be more onerous for vehicle owners than the other concepts. Concept 1 is closest to the base case (current system), with updated data tables, data entry screens, and vehicle registration forms to include an ‘MPG’ field and removal of the taxable horsepower field. Figure 8 shows the options that vehicle owners will have under Concept 1 to determine their vehicle’s MPG rating.

In all other concepts, vehicle owners will have an interface to look up the VIN numbers. From a user-experience perspective, as well as to avoid confusion and discrepancy in assessment of a fee based on MPG, these concepts are more attractive. However, such VIN decoding services may be expensive for the State to subscribe to, particularly if they are web-based and their use is open to the public.



Source: Missouri Department of Transportation.

DOR = Department of Revenue; EPA = Environmental Protection Agency; MPG = miles per gallon; MPGe = miles per gallon equivalent; THP = thrust horsepower

Figure 8. Diagram. Vehicle owners’ sources of information about miles per gallon ratings for their vehicles, as proposed in the Draft Concept of Operations.

¹² The Constitution of Missouri was amended in 1980 to add Article X, Sections 16 through 24, commonly referred to as the Hancock Amendment. This tax limitation amendment imposes restrictions on the amount of personal income used to fund State government and the amount by which fees and taxes can be increased.

CHAPTER 5. SUMMARY AND IMPLICATIONS FOR NATIONAL IMPLEMENTATION

MoDOT approached its pre-deployment activities based on the concept that access to the roadway system is a benefit regardless of the number of miles a given user drives on it. Hence, Missouri's approach is access-based, not miles- or distance-based. The Missouri approach involves front-loading a user-based fee structure to a fixed annual fee. The key findings of the evaluation follow:

- Missouri determined that a vehicle miles- or usage-based tax will not be viable in the State: The tax will not be available if RUC vendor costs are greater than 3 percent of the total revenue. The Missouri constitution (Article 4, Section 30a) limits the actual cost of collection of MFT to 3 percent.¹³
- Missouri found that engaging public sector stakeholders early and often is recommended: Missouri succeeded in partnering with and involving other agencies that will be impacted by this proposed transition, specifically the Missouri DOR and the Office of Administration Information Technology Services Division. These partnerships are critical to the success of the project. Involving public sector stakeholders early, and retaining their motivated engagement, was critical, in Missouri's case, to presenting this strategy as a viable option to elected officials:
 - MoDOT found that it was important to convey to stakeholders and legislators that older vehicles owned by predominantly low-income drivers use a lot of gas, and therefore disproportionately contribute to transportation funding. A large proportion of Missouri legislators represent rural areas and found common cause with rural vehicle owners, who pay a high gas tax and currently subsidize fuel-efficient vehicles that contribute little or nothing toward transportation funding. The legislators could see that the gas tax disproportionately impacts owners of vehicles in the 14- to 18-MPG fuel-efficiency range.
- Missouri addressed, partially or wholly, the following challenges in its Phase I implementation:
 - Determining appropriate system architecture: MoDOT evaluated existing data and system capabilities at DOR to determine what new system architecture should be implemented to administer the registration fee, with the major options being a registration-fee system architecture in the form of a software-as-a-service or COTS implementation. MoDOT also conducted a peer review of other departments of transportation to find similarities and what worked in other States as part of its Phase II funded deployment activities.

¹³ Missouri General Assembly. [Missouri Constitution Section: Article IV, Executive Department, Section 30a](#), November 14, 2016. Last accessed May 6, 2019.

- Public sector communication: MoDOT and the Missouri DOR recognized that they may face backlash from affected stakeholders, including local license offices and other DOR contractors, when implementing the new fee. MoDOT worked closely with DOR to predict and overcome these challenges and to facilitate a smooth transition in the deployment phase.

Missouri's approach is not an RUC. However, it offers a viable alternative to address the issue of declining gas tax receipts in the face of increasing vehicle fuel efficiency and electrification. Missouri's approach provides an alternative to States that are not yet ready to accept a complete move to an RUC-based transportation revenue mechanism. Further, it provides an alternative that may have lower administrative costs than a complex distance-based RUC that is designed to collect mileage information from individual drivers. This approach may thus be viable in other States where legislation or other concerns preclude a discussion of RUC due to higher administrative costs than the MFT or other reasons. However, despite the efforts undertaken with STSFA funds, wide political acceptance of this potentially low-cost approach has been hard to achieve in Missouri, which reflects the need for continued outreach and education.

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U.S. Department of Transportation
Federal Highway Administration
Office of Operations
1200 New Jersey Avenue, SE
Washington, DC 20590

Office of Operations Website
ops.fhwa.dot.gov

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