



Moving Toward Vehicle Miles of Travel Fees to Replace Fuel Taxes

Assessing the Path Forward

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For nearly a century, federal and state gasoline and diesel taxes have provided the main source of revenue for funding the nation’s road network. But such taxes—typically levied on a cents-per-gallon basis—must be raised periodically to keep pace with inflation and improved fuel economy. With the rise in antitax sentiment over the past several decades, elected officials have grown increasingly reluctant to take on this unpopular task. Thus, fuel tax receipts, measured in real dollars per mile of travel, have fallen precipitously, leaving insufficient revenue to maintain, let alone expand, the road network. This decline will likely accelerate in future decades as conventional vehicles become more efficient and as alternative fuel options (e.g., electric cars) are introduced and gain market share.

Against this backdrop, many believe the nation should replace fuel taxes with a system of user fees based on vehicle miles of travel, or VMT. (VMT fees are also known as mileage-based user fees, or MBUF.) Because VMT is expected to grow faster than fuel consumption in the coming decades, VMT fees should provide a more stable source of revenue. Since 1980, with gradual gains in average vehicle fuel economy, VMT has doubled, while fuel consumption itself has increased by just half. Long-range projections for fuel consumption and VMT from the Energy Information Administration (EIA) suggest that this trend will continue. According to EIA projections, federal fuel tax revenue (assuming current per-gallon rates) should increase by about 10 percent between 2015 and 2030, growing from \$36 billion to \$39 billion (2009 dollars). If, instead, federal fuel taxes were replaced with VMT fees in 2015 at an initially revenue-neutral rate, receipts should increase by 33 percent over the same period, growing from \$36 billion to \$47 billion.

Key findings:

- Adopting more-efficient conventional and alternative fuel vehicles will diminish motor fuel tax revenues in the coming decades.
- Fees based on vehicle miles traveled (VMT) would provide a more stable revenue source and could also support other policy goals.
- Several technical options exist for implementing VMT fees; all face one or more limitations in terms of cost, administrative challenges, or user acceptance.
- Designing and implementing a system of VMT fees poses an array of technical, institutional, and political challenges and uncertainties.
- Conducting a comprehensive set of VMT-fee system trials could resolve many remaining uncertainties.
- The ideal scope and structure of such trials partly depends on the envisioned pathway for transitioning from fuel taxes to VMT fees.

Beyond providing a more stable revenue stream, VMT fees could support many other goals. Rates could be structured to help reduce congestion and harmful emissions, metering devices could provide value-added services (e.g., safety alerts, real-time traffic information and routing assistance, and the ability to save money with pay-as-you-drive insurance), and the system could generate rich travel data for improved transportation planning.

In a two-phase study for the National Cooperative Highway Research Program for

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Corporate Headquarters
 1776 Main Street
 P.O. Box 2138
 Santa Monica, California
 90407-2138
 TEL 310.393.0411
 FAX 310.393.4818

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the Transportation Research Board, a team led by RAND researchers first assessed alternate mechanisms for implementing VMT fees in the near term and then outlined a plan for large-scale system trials to further evaluate the most promising concepts.

Assessing VMT-Fee Implementation Options

Drawing on recent programs, studies, and proposals, the RAND team assessed the eight VMT metering options shown in Table 1. The first three (light gray) rely on odometer checks to determine VMT fees. The middle two (medium gray) use relatively inexpensive automatic vehicle identification (AVI) devices—such as radio-frequency identification (RFID) tags—combined with supporting infrastructure deployed along the roadways and/or at fueling stations. The last three (dark gray) options involve sophisticated on-board units (OBUs) that incorporate a connection to the vehicle’s on-board diagnostic (OBD) port, cellular communications, and/or a GPS receiver. Beyond metering options, the researchers also examined complementary options for collecting fees (with registration, with fuel purchase, with debit cards, or with automated billing), preventing evasion, and protecting privacy.

In assessing these options, the researchers first considered metering capabilities: the ability to track, measure, or estimate mileage, area of travel, route of travel, time of travel, and salient vehicle characteristics. These capabilities affect the ability to pursue alternate pricing policies (e.g., fees that vary by jurisdiction or higher fees for peak-hour congested travel), offer location-sensitive value-added services (e.g., downstream traffic incident alerts), and collect travel data for improved system planning. GPS offers the greatest flexibility, while odometer checks offer the least; other options fall between these two.

Other categories of assessment criteria included cost, functional considerations, institutional complexity, and public acceptability. Assessed in these terms, each option presents one or more limitations. For example, while GPS-based metering offers the greatest flexibility, it would also be costly and create privacy concerns. At the other end of the spectrum, odometer-based options could be less expensive to implement, but metering capabilities are very limited and it would be difficult to detect odometer tampering.

Identifying Promising VMT Options for Large-Scale Trials

Because each option faces one or more limitations, identifying the most promising implementation mechanisms to examine in trials requires policy trade-offs. For example, is it more important to reduce implementation costs or support a broader range of functionality? While such questions can be informed by careful analysis, policymakers must ultimately make the decisions.

Lacking clear consensus among policymakers about the requirements that a VMT system should satisfy, the RAND team relied on recommendations from the National Surface Transportation Infrastructure Financing Commission’s 2009 report. These recommendations argue for examining metering devices that can determine the location of travel (e.g., GPS) to support the broadest possible range of system functionality, along with multiple options for collecting fees, preventing evasion, and protecting privacy.

But such guidance still does not address a much broader set of questions related to the appropriate design for large-scale system trials, such as questions related to the trials’ *scope* (e.g., policy issues to examine, duration of the trials, number of participating motorists, and number of states involved)

Table 1. Range of VMT-Fee Implementation Options Considered

| Metering Option | Description |
|--|---|
| Self-reported odometer readings | Drivers report current mileage each year as part of annual registration process. |
| Required odometer checks | Drivers submit to periodic (likely annual) readings at certified stations as basis for assessing mileage fees. |
| Optional odometer checks | Drivers are assessed an annual fee based on estimated mileage for the vehicle class; those driving significantly less than estimate could submit to annual odometer readings. |
| Fuel consumption-based estimates | Vehicles are equipped with an AVI device that transmits vehicle fuel economy rating to the fuel pump; this is multiplied by gallons purchased to estimate mileage, and resulting fee is added to the price. |
| RFID tolling on a partial road network | Vehicles are equipped with an AVI device that communicates with gantries set up along the most heavily traveled segments of the road network to enable facility-based tolls. |
| OBU with OBD II | Vehicles are equipped with an OBU connected to the OBD port to estimate mileage. |
| OBU with OBD II/cellular | Same as above, but vehicles are also equipped with cellular communication technology to determine area of travel. |
| OBU with GPS | Same as above, but vehicles are also equipped with a GPS device to determine specific route of travel. |

and *organization* (e.g., who should oversee, manage, and be involved in conducting the trials). To gain insight on such questions, the researchers conducted an extensive set of interviews with stakeholders and subject-matter experts and then an expert panel workshop.

Although the interviewees and workshop participants agreed on many issues, they had widely divergent opinions on certain questions, stemming from disparate views about how the transition to VMT fees would likely (or should ideally) unfold. In particular,

- Would it be more desirable—or, alternatively, more likely—for the initial implementation of VMT fees to occur within states or at the federal level?
- Could VMT fees be implemented in just a few years, or would it take a decade or more?
- Should the transition begin with a mandatory phase-in process (e.g., with the purchases of new automobiles by consumers), or should it instead rely on voluntary opt-in strategies for several years prior to the initiation of mandatory adoption?

This divergence led the RAND team to develop three conceptual frameworks, or visions, about how the transition to VMT fees might be pursued and, in turn, how the trials could be scoped and organized in support of that vision. Table 2 summarizes the frameworks along with their strengths, limitations, and risks.

While these frameworks attempt to capture alternate conceptual pathways to the implementation of VMT fees, they need not be viewed as mutually exclusive. It would certainly be possible, for example, to blend elements from the frameworks in the trials or pursue one framework to examine VMT fees for passenger cars and another to examine VMT fees for commercial trucks. Still, considering the frameworks and making an explicit choice among them would help to clarify trial goals.

Using the insights gained during the interviews and workshop, along with supporting analysis where helpful, the researchers distilled a set of options for scoping and structuring the trials to ensure that they would be as productive as possible. The researchers also identified how certain elements of the trials might be modified in subtle but important ways to more directly support any of the specific frameworks. The following describes an approach, consistent with the research findings, for scoping and structuring the trials in an effective manner:

- **Management structure:** Regardless of framework, an oversight panel including key agencies and stakeholders is created to provide critical policy guidance for the trials. A separate agency or organization is chosen to solicit proposals, award funding, and manage the trials. Finally, a committee is created to develop relevant technical and functional interoperability standards to enable multiple vendors to provide metering and billing services across jurisdictions.

Table 2. Three Conceptual Frameworks for Transitioning to VMT Fees

| Framework | Strengths and Limitations/Risks |
|--|---|
| <p>State—Help States Help Themselves: Help interested states, or groups of adjacent states, develop their own systems, with the federal government potentially developing a national system at a later date based on the lessons learned in state programs</p> | <p>Strengths: Could be easier to gain public acceptance for VMT fees in an individual state than at national level, thus increasing odds of actual implementation</p> <p>Limitations/Risks: Would not, in near term, help address federal transportation funding shortfalls; could pose risk that the systems developed in different states would not be interoperable; would reduce opportunities to drive down costs through economies of scale</p> |
| <p>Federal—Carefully Plan a National System: Help the federal government plan and develop a national system of VMT fees to replace or augment current federal fuel taxes, making the system flexible enough for states to levy their own VMT fees if they choose</p> | <p>Strengths: Would directly address need to augment federal transportation revenue; would maximize opportunity to reduce costs through economies of scale; would ensure interoperability</p> <p>Limitations/Risks: Would require some degree of national consensus to implement national VMT fees, a significant challenge to surmount; would likely involve some form of mandatory adoption, compounding the difficulty of gaining public acceptance</p> |
| <p>Market—Foster Market for In-Vehicle Travel Services: Foster the emergence of a market for in-vehicle metering devices that can levy federal, state, and potentially local VMT fees and simultaneously provide additional value-added services; this would culminate in an operable system in which the adoption of VMT fees is initially voluntary</p> | <p>Strengths: Would reduce government cost for collecting VMT fees; would maximize the social value of the investment in metering devices by providing value-added services; could circumvent public acceptance challenges through the voluntary opt-in period</p> <p>Limitations/Risks: Assumes an unproven market for value-added services; would require an initial set of interoperability standards and corresponding certification process to be developed in advance of the trials</p> |

- **Awarding and conducting trials:** Trial funding is awarded competitively. In the *state or federal frameworks*, states assemble teams (including technology providers, research support, etc.) to bid for funding. In the *market framework*, technology vendors, states, auto insurers, local jurisdictions, and research institutions are separately funded to ensure their trial participation.
- **Number, size, duration, and cost of trials:** Regardless of framework, trials are conducted in three to six states or groups of adjacent states and last four to six years, including up to two years for planning, up to three years for trials, and a final year for assessment. Collectively, the trials include at least 50,000–100,000 motorists, resulting in an estimated cost in the range of \$100 million–\$400 million. Under the *market framework*, in which the trials culminate in an operational system with trial participants becoming the initial voluntary adopters, it could be beneficial to include up to a million motorists, increasing the likely cost to \$1 billion or more.
- **Technical implementation options:** Regardless of framework, the trials examine GPS-based metering and possibly other metering approaches. The trials include multiple options for collecting fees, preventing evasion, and protecting privacy. Examining system interoperability standards is particularly important in the *state framework* (to ensure systems developed in different states can interact) and the *market framework* (to ensure multiple vendors can compete to provide metering and billing services).
- **Other key issues to examine:** Regardless of framework, critical issues and capabilities to examine include VMT

fees for both passenger vehicles and trucks, VMT fees that vary by jurisdiction, alternate institutional arrangements for collecting and apportioning fees, integration with existing toll systems, rebating fuel taxes (allowing for a phased transition), voluntary adoption incentives, and user acceptance and understanding of VMT fees. Under the *market framework*, it is also important to examine actual (versus simulated) collection of VMT fees, use of travel data from the system to support value-added functionality, and competition among multiple firms in the trials.

- **Optional issues to examine:** Regardless of framework, additional issues and functional capabilities that would be beneficial to examine and might be used as criteria to rank trial proposals include variable fee structures (e.g., congestion tolls or emissions fees), use of travel data to support improved planning and operations, actual revenue collection, and charging foreign or out-of-state vehicles.

Conclusions

While the envisioned trials would require considerable investment, they would also play a critical role in helping to prepare for the potential implementation of VMT fees by states or the federal government in the next five to ten years. The prospect of designing, implementing, and transitioning to a system of VMT fees poses numerous technical, institutional, and political challenges, and many uncertainties remain. The trials are explicitly intended to reduce or resolve such uncertainties to inform the policy debate and support the design of a capable, cost-efficient, and publicly acceptable system of VMT fees. ■

This research brief describes work done for RAND Infrastructure, Safety, and Environment documented in *Implementable Strategies for Shifting to Direct Usage-Based Charges for Transportation Funding*, by Paul Sorensen, Liisa Ecola, Martin Wachs, Max Donath, Lee Munnich, and Betty Serian (Washington, D.C.: National Cooperative Highway Research Program, September 2009; available as RP-1395 at <http://www.rand.org/pubs/reprints/RP1395.html>), and *System Trials to Demonstrate Mileage-Based Road Use Charges*, by Paul Sorensen, Martin Wachs, and Liisa Ecola (Washington, D.C.: National Cooperative Highway Research Program, December 2010; available as RP-1423 at <http://www.rand.org/pubs/reprints/RP1423.html>). This research brief was written by Paul Steinberg. The RAND Corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors. RAND® is a registered trademark.

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