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# Mileage-Based Road User Charges

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## Summary

A mileage-based road user charge would involve assessing owners of individual vehicles on a per-mile basis for the distance the vehicle is driven. Currently, federal highway and public transportation programs are funded mainly by motor fuel tax receipts that flow into the Highway Trust Fund (HTF). The tax rates, set on a per-gallon basis, have not been raised since 1993, and receipts have been insufficient to support the transportation programs authorized by Congress since FY2008. The long-term viability of motor fuels taxes is also questionable because of increasing vehicle fuel efficiency and the wider use of electric vehicles. Economists have favored the use of mileage-based user charges as an alternative to motor fuels taxes to support highway funding. Congress, in Section 6020 of the Fixing America's Surface Transportation Act (FAST Act; P.L. 114-94), provided \$95 million to fund large-scale pilot studies by states or groups of states to demonstrate "user-based revenue systems" to maintain the solvency of the HTF.

Under this user charge concept, motorists would pay based on distance driven and, perhaps, other costs of road use, such as wear and tear on roads, traffic congestion, and air pollution. Mileage-based road user charges could range from a flat cent per mile charge based on a simple odometer reading to a variable charge based on a global positioning system (GPS). Other proposals envision mileage-based road user charges that would mimic the way Americans now pay their fuel taxes by collecting the charge at the pump. Most road user charge systems would require electric vehicle users to pay for their use of the roads. Charging by the mile could in itself provide an incentive to drive less. Such a reaction would reduce revenue, however.

Implementation of a mileage-based road user charge would have to overcome a number of potential disadvantages relative to the motor fuels tax, including public concern about personal privacy; the higher costs to establish, collect, and enforce (estimates range from 5% to 13% of collections); the administrative challenge of the billing process given the size of the private vehicle fleet (estimated at roughly 256 million vehicles or points of collection); and the setting and adjusting of the road user charge rates, which would likely face as much opposition as increasing the motor fuels taxes.

Experiments with road user charges have been conducted in the United States. Although useful, most of these have been small-scale experiments done at the state or local level. Other countries have implemented full-scale road user charge systems that offer more information on the potential costs and benefits. These include road user charges on trucks in Germany, Switzerland, and Austria, as well as charges on both trucks and automobiles in New Zealand.

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## Introduction

Federal highway and public transportation programs are funded mainly by taxes on motor fuel that flow into the Highway Trust Fund (HTF). The tax rates, set on a per-gallon basis, have not been raised since 1993, and motor fuel tax receipts have been insufficient to support the transportation programs authorized by Congress since FY2008. Increases in vehicle fuel efficiency and wider use of electric vehicles raise questions about the long-term viability of motor fuel taxes as a means of funding surface transportation.

Economists have long favored mileage-based user charges as an alternative source of highway funding. Under the user charge concept, motorists would pay fees based on distance driven and, perhaps, on other costs of road use, such as wear and tear on roads, traffic congestion, and air pollution. The funds collected would be spent for surface transportation purposes.<sup>1</sup>

The concept is not new: Federal motor fuel taxes are a form of indirect road user charge insofar as road use is loosely related to fuel consumption. Some states have charged trucks by the mile for many years, and toll roads charge drivers based on miles traveled and the number of axles on a vehicle, which is used as a proxy for weight. Recent technological developments, as well as the evident shortcomings of motor fuel taxes, have led to renewed interest in the user charge concept, including establishment of a pilot program in legislation enacted in 2015.

## How Road User Charges Might Work

A road user charge system would involve assessing owners of individual vehicles on a per-mile basis for the distance the vehicle is driven. Depending upon the details of such a program, a basic per-mile charge could be adjusted based on any number of factors, such as the time of day a trip is taken, the place of travel, the weight of the vehicle, and the emissions of the vehicle's engine. Most studies of road use charging envision a single national system that would distribute revenue to the HTF and directly to the states, which currently impose their own taxes on motor fuels for transportation purposes. Existing motor fuel taxes might be discontinued, phased out, or diverted to other uses as a user charge system takes effect.

Proposed systems generally involve three functional components:

1. **Metering:** determining the number of miles traveled on roads subject to the user charge and any other information needed to determine fees owed.
2. **Billing:** communication of mileage and fees owed, issuance of bills, and collection of the revenue. Most charging proposals envision that fees would be charged to the vehicle owner's credit or bank card, as occurs on many toll roads today.
3. **Enforcement:** assuring that motorists have been charged correctly and have paid their fees. Enforcement actions could include checks for tampering with on-board units (OBUs) that might be used to collect data, checks of OBUs against odometer readings, and legal measures to collect unpaid charges. If some motorists were allowed to continue to pay motor fuel taxes rather than distance-

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<sup>1</sup> Transportation Research Board, National Cooperative Highway Research Program, *Implementable Strategies for Shifting to Direct Usage-Based Charges for Transportation Funding*, NCHRP Project 20-24(69), Web-Only Document 143, October 2009, [http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp\\_w143.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w143.pdf). See also Paul Sorensen, Liisa Ecola, and Martin Wachs, *Mileage-Based User Fees for Transportation Funding: A Primer for State and Local Decisionmakers*, Rand Corporation, 2012, pp. 1-34, [http://www.rand.org/content/dam/rand/pubs/tools/TL100/TL104/RAND\\_TL104.pdf](http://www.rand.org/content/dam/rand/pubs/tools/TL100/TL104/RAND_TL104.pdf).

based user charges, authorities would need to verify that such taxes were being paid. If a road user charge were to have multiple objectives, enforcement could become more complex. For example, if the system were to have lower charges for trucks with low-emissions engines than for trucks with high-emissions engines, it would be necessary to verify that each truck is using an OBU that identifies its emissions level correctly.

There are numerous ways in which a nationwide road user charge could be structured and collected. One key issue in implementation would be whether individual vehicle owners could opt out—and, if so, how they would contribute to the cost of building and maintaining surface transportation infrastructure.

## GPS-Based Mileage Fee System

Under this system, an OBU installed on each vehicle would receive global positioning system (GPS) location signals from a satellite. The location data could be used to inform the driver of the fee in real time or could be transmitted via mobile phone to a central processing office for calculation. In either case, the central office data center would use the information to prepare the user's invoice. The on-board unit (OBU) offers the ability to vary the charges on a particular vehicle based on multiple objectives. However, it also raises the greatest concern about privacy, as the operators of the system would be able to track each vehicle's movements. This may have legal implications as well.<sup>2</sup> Although the technology would be quite different from existing electronic tolling systems, such as E-ZPass, the experience would be quite similar for drivers, who would not need to take any special action to figure out their liability and pay their bills.

## Pay at the Pump

A different approach to distance-based user charges would mimic the way Americans now pay their fuel taxes. Two states have tested user charges of this sort. A test in Nevada simply estimated each vehicle's mileage based on the vehicle's fuel efficiency and the amount of gasoline purchased. When the vehicle pulled up to the gas pump, a transponder installed in the vehicle transmitted this information to a transponder in the pump. The pump transponder retransmitted the mileage information to a central office, which calculated the road user fee and sent the information back to the pump for inclusion in the price of fuel. The participant received a receipt, printed at the pump, specifying the cost of fuel and the user charge. Oregon ran similar tests with

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<sup>2</sup> For example, a program that *mandated* the use of a GPS tracking on all vehicles could implicate, among other constitutional concerns, the Fourth Amendment privacy rights of the drivers. In 1983, the Supreme Court held in *United States v. Knotts*, 470 U.S. 276, that the government's use of a location tracking device did not violate the Fourth Amendment, as individuals are not entitled to a reasonable expectation of privacy when traveling on public streets. However, in the more recent 2012 case *United States v. Jones*, 132 S. Ct. 945, the majority, relying on a trespass theory of the Fourth Amendment, held that the physical attachment of a GPS device and subsequent monitoring rose to the level of a Fourth Amendment search. Additionally, two widely cited concurrences in *Jones*, joined by five members of the Court, would have found that the 28-day monitoring constituted a search, even without the physical trespass. Note that several circuit courts have addressed a similar legal question, likely informing the debate here: whether accessing cell site location data—a less precise form of geolocation information than GPS—constitutes a Fourth Amendment search. The majority of courts have held that accessing such data did *not* trigger Fourth Amendment protections as the information was already revealed to a third party—the cell provider—in the course of providing the service. *See, e.g., United States v. Graham*,—F.3d—, 2016 WL 3068018, \*11 (4<sup>th</sup> Cir. May 31, 2016); *In re Application for Historical Cell Site Data*, 724 F.3d 600, 615 (5<sup>th</sup> Cir. 2013). Ultimately, a Fourth Amendment analysis of this type of program would likely depend on a host of factors, including whether the device was installed prior to purchase, whether the program provided an alternative to location monitoring, whether the device tracked the vehicle on private property, what types of data the device recorded and precision of such data, whether the data is shared with a third party servicer, and to what uses the data would be put.

and without installation of a GPS-based recording device in the vehicles. Participants expressed privacy concerns about the GPS devices. The systems without GPS devices, however, cannot charge variable rates depending upon time of day or road congestion, as they reveal only how many miles the vehicle was driven, not where or when it was driven.

Pay-at-the-pump systems might allow a mileage-based user charge to coexist with a motor fuels tax, with vehicle owners having the option of paying one or the other. However, it could be administratively complex. The current federal fuels taxes are collected from fuel dealers prior to the wholesale level, not from retail gas stations, so charging in this way would require the federal government to establish thousands of new collection points.

## **Odometer Readings**

A simple mileage-based user charge could be assessed based on each vehicle's odometer reading, perhaps taken during an annual inspection.

The advantage of the basic odometer system is its simplicity. Also, it would likely raise fewer privacy issues than a GPS-based system. But an odometer-based system would have numerous limitations. Fraud could be a major problem, as drivers might have incentives to install defeat devices and software. A straightforward odometer reading would not support higher user charges at peak times or on congested roads, and it would not be able to avoid double-charging vehicles that use toll roads.

Oregon has implemented an odometer-based system, known as OReGO, on a voluntary basis. The system uses a plug-in device to collect revenue at a rate of 1.5 cents per mile. Taxpayers have a choice of a device with no GPS that tallies charges for all miles driven or a device with GPS that tallies only miles within the state. Each vehicle's mileage is transmitted to an account manager, who then bills participants. To prevent double taxation, participants receive a state motor fuel tax credit equal to the amount of road user charge they pay.

## **Prepaid Manual Mileage Fee System**

Under this system, the driver would purchase a license or card that permits a certain number of miles of driving based on an odometer reading at the time of purchase. No information on the vehicle's location is collected. This is the New Zealand system discussed later in this report.

## **Offering Users a Choice of Charging Methods**

Providing a variety of charging methods to motorists might make road user charges more acceptable. So, for example, some drivers could install OBUs while others could opt for an annual odometer reading. The federal motor fuels tax could continue to be an option for those who reject the use of any road charging system and for foreign drivers, although this could require significant changes in the way the federal motor fuels tax is collected. Providing choices could mitigate opposition by road users who have privacy concerns. However, it would likely raise administrative costs and lower the net revenue per dollar collected.

## Cost of Collection and Administration

One of the advantages of the federal motor fuels tax 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.<sup>3</sup> This has been the case since 1986, when the U.S. Treasury shifted its collection of the gas tax to the refinery “rack” to reduce tax administration problems and curb fuel tax evasion.<sup>4</sup> The federal government has no need to assess taxes at 111,000 gasoline stations or charge millions of vehicle owners individually. Tax administration costs are generally estimated to be less than one cent per dollar of revenue. The road user charge would reverse this by taking a small and simple tax administration problem and making it large: A mileage-based road user charge that encompasses all private vehicles could require as many as 256 million points of collection.<sup>5</sup>

## Electronic Billing and Collection

In principle, the cost of operating an electronic road user charge scheme based on distance driven should be minimal, thereby leaving most of the revenue available for transportation use. However, experience in the United States and other countries suggests that the administrative and enforcement costs of collecting user fees would be in the range of 5% to 13% of collections.

U.S. toll road agencies that make extensive use of electronic toll collection experience costs of roughly 7% to 12% of revenues.<sup>6</sup> For example, the New Hampshire Turnpike system reported that its E-ZPass processing fees were 7.3% of total E-ZPass revenues in FY2015. Fees charged by banks for processing transactions and enforcement costs are not included in that percentage.<sup>7</sup> While a federal system based on equipping all vehicles with standardized OBUs with GPS technology could bring the costs down eventually, the cost of operating the system seems likely to be above 5% of revenue under the best of circumstances.

## Credit and Bank Card Fees

Credit card and bank fees will be difficult for any road user charging system to avoid. The experience of electronic toll collection can shed some light on these costs. An evaluation of operational costs by the Washington State Department of Transportation in 2007 found that credit card fees paid on collections by toll facilities were equal to 3.45% of adjusted gross revenue.<sup>8</sup> More recently, the New Hampshire Turnpike System reported that for the 2015 fiscal year, bank

<sup>3</sup> Most fuel taxes are paid by a registered “position holder,” who holds taxable inventory of motor fuels at a refinery or tank farm. The position holder pays the tax when the fuel is removed from the terminal. This is often referred to as collecting at the “rack.” Registered entities include refiners, pipeline operators, terminal operators, and others.

<sup>4</sup> The change was made in the Tax Reform Act of 1986 (P.L. 99-514) to constrain what was seen at the time as rampant fuels tax evasion, mostly at the wholesale level. It also limited gas tax evasion to two primary sources of tax fraud: (1) on-road use of non-taxed fuel meant for off-road vehicles, and (2) use of aviation fuel in trucks. The provision was made effective for all fuel removed from the refinery rack after December 31, 1987.

<sup>5</sup> Federal Highway Administration, *2014 Highway Statistics*, <http://www.fhwa.dot.gov/policyinformation/statistics/2014/pdf/mv1.pdf>.

<sup>6</sup> See CRS Report R43575, *Tolling U.S. Highways*, by Robert S. Kirk.

<sup>7</sup> State of New Hampshire, *Department of Transportation Turnpike System Annual Financial Report: Fiscal Year Ended June 30, 2015*, January 13, 2016, p. 19, <https://www.nh.gov/dot/org/operations/turnpikes/documents/DOTPKESAnnualReport20160113FinalSigned.pdf>.

<sup>8</sup> Washington State Department of Transportation, *Comparative Analysis of Toll Facility Operational Costs*, February 22, 2007, pp. 1, 5, <http://www.tollfreeinterstates.com/sites/default/files/wsdotoll%20-%20electronic%20toll%20operation%20costs.pdf>.

and credit card fees were 2.7% of its electronic E-ZPass revenues.<sup>9</sup> This indicates that the cost of any electronic user charge scheme relying on users paying via credit and bank cards would likely be more than double the cost of collecting the federal motor fuels tax, even before administrative or enforcement costs are considered.

### Charging Unbanked and Underbanked Users

About 7.7% of U.S. households are “unbanked,” lacking any bank account at an insured institution. Another 20% are “underbanked,” having a bank account of some kind but also using alternative financial services such as postal money orders, payday loans, pawn shop loans, or auto title loans.<sup>10</sup> Over 30% of consumers do not have a credit card, and 20% do not have a debit card.<sup>11</sup> Unbanked and underbanked road users would not be easily brought into a charging system based on electronic payments. This is also the portion of the population that may find it most difficult to purchase and install an OBU or purchase a new vehicle equipped with one. Allowing these motorists to pay road user charges through a cash alternative would increase administrative costs.

### Billing and Enforcement

In any form of mileage-based road user charge, the amounts owed would have to be determined, the vehicle owner would have to be billed, and tax evasion would have to be prevented. This could be done by the U.S. Internal Revenue Service, which administers the federal fuel taxes. A nationwide federal road user charge might benefit from economies of scale and keep costs down. Alternatively, billing and enforcement could be contracted out to a commercial account manager, which could provide these administrative services in return for a reasonable profit. Electronic tolling systems typically engage commercial account managers.

Operators of U.S. toll facilities generally assume a “leakage rate”—the share of transactions for which payment is not received—of 5% to 10%.<sup>12</sup> Enforcement costs are difficult to evaluate because the cost of on-road enforcement by state police is not always reflected in turnpike authorities’ financial reports. However, figures from toll authorities that do break out enforcement costs suggest that the cost of policing toll roads—including stopping toll evaders—is generally about 5% of toll revenues. The cost of enforcing road user charges could be quite different, especially if the charges for a particular trip are based on congestion, number of passengers in the vehicle, or other factors in addition to mileage traveled.

The administrative and enforcement costs matter. If a road user charge were designed to raise the same amount of revenue as the current motor fuels tax but were far more costly to administer, it would generate less money for transportation purposes. If, on the other hand, a road user charge were designed to raise the same amount of net revenue for transportation as the current motor fuels tax, it would need to raise significantly greater gross revenue in order to cover administration and enforcement costs.

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<sup>9</sup> State of New Hampshire, *Department of Transportation Turnpike System Annual Financial Report*, p. 19.

<sup>10</sup> Federal Deposit Insurance Corporation, *2013 FDIC National Survey of Unbanked and Underbanked Households: Executive Summary*, October 2014, p. 3, <https://www.fdic.gov/householdsurvey/2013execsumm.pdf>.

<sup>11</sup> Scott Schuh and Joanna Stavins, *2013 Survey of Consumer Payment Choice: Summary Results*, Federal Reserve Bank of Boston, Research Data Reports, July 27, 2015, p. 20, <https://www.bostonfed.org/economic/rdr/2015/rdr1504.pdf>.

<sup>12</sup> Transportation Research Board, *Costs of Alternative Revenue-Generation Systems*, NCHRP Report 689, 2011, pp. 17-18.



## Which Vehicles Would Be Charged?

A mileage-based road user charge could be designed to encompass all non-government vehicles or only certain categories of vehicles. In general, the more vehicles covered, the lower the per-mile charge would need to be to produce a given amount of revenue.

There is no limit to the number of vehicle categories that could be established. For example, given its past support for low-emission vehicles, Congress might wish to exempt electric vehicles from the mileage-based charge. Similarly, vehicles owned by nonprofit organizations could be exempt from the charge, or vehicles owned by disabled individuals could face a lower charge per mile. Such provisions would either reduce revenues or require other vehicle owners to pay higher rates to produce the same amount of gross revenue. Creating numerous categories with distinct charges would increase the complexity of administration and enforcement, likely raising the cost of operating the system.

One option, widely adopted in Europe, is to limit mileage-based road user charges to trucks. Fitting trucks with OBUs based on GPS technology would raise fewer privacy concerns than a system encompassing all vehicles, and implementation costs would be lower. Trucks could be categorized by weight, number of axles, engine emissions, or other measures, assessing higher charges on classes of vehicles that cause greater wear to highway infrastructure or emit higher levels of pollutants.

## Federal-State Relations

A road user charge at the federal level could raise significant questions about federal-state relations. If Congress were to create a road user charge and order state officials to implement it directly in statute, the charge could be subject to legal challenges under legal precedents limiting federal authority over state officials.<sup>13</sup> Providing states with financial incentives to implement distance-based road user charges, rather than mandating that they do so, may obviate such concerns.<sup>14</sup>

<sup>13</sup> The Supreme Court has held that Congress is without authority to “commandeer” state officials. See *Printz v. United States*, 521 U.S. 898 (1997); *New York v. United States*, 505 U.S. 144 (1992). In *Printz v. United States*, the Court considered an interim provision of the Brady Handgun Violence Prevention Act that required state and local law enforcement officers to conduct federally mandated background checks on prospective handgun purchasers. After a historical study of federal regulation of state officials, the Court concluded that commandeering state executive branch officials to enforce a federal program was outside of Congress’s power, and consequently a violation of the Tenth Amendment. Similar challenges could arise if Congress structures a mileage-based road user charge in such a way that mandates states to implement the federal program, unrelated to the provision of federal funds. For more information see CRS Report RL30315, *Federalism, State Sovereignty, and the Constitution: Basis and Limits of Congressional Power*, by Kenneth R. Thomas.

<sup>14</sup> Congress could use its spending power to encourage states to take certain actions. Such exercises of the spending power may be subject to limitations under the Tenth Amendment. See *South Dakota v. Dole*, 483 U.S. 203 (1987), finding that a federal law withholding 5% of federal highway funds from states that did not adopt a specific drinking age did not violate the Tenth Amendment because the condition was sufficiently related to the funding source and the level of funding withheld was not coercive. But see *Nat’l Federation of Independent Bus. v. Sebelius*, 567 U.S. \_\_\_\_ (2012), 132 S. Ct. 2566, holding that the enforcement mechanism applied to a state’s failure to comply with the extension of Medicaid in the Patient Protection and Affordable Care Act violated the Tenth Amendment, in part, because it was coercive.

## Treatment of Existing Toll Facilities

A nationwide mileage-based road user charge would be analogous to a national toll. This raises the prospect that vehicles using toll roads might be charged twice, although this effectively happens now in that toll road users also pay tax on the motor fuel they consume while using the toll road. Technically, it would be possible for a road user charge to replace an existing toll, but this could cause complications with respect to the servicing of bonds funded by toll-road revenue.

## Road User Charge and Non-road Programs

Since 1982, the HTF has financed most federal public transportation programs as well as highway programs. If a distance-based road user charge were to be used strictly for highway purposes, it might reasonably be characterized as a user fee even if the amount paid by each individual driver does not correspond precisely to the social cost of that user's driving. In this case, however, Congress would need to find another source of funds if it wishes to continue supporting public transportation. A road user charge that funded both highways and public transportation might arguably be seen more as a tax than a user fee. This distinction raises a number of legal issues.<sup>15</sup> Any legislation establishing a road user charge would have to clearly identify what the charge would be spent on. If the existing HTF were to be retained, legislation would have to specify what share of the revenue would be credited to the separate highway and mass transit accounts within the fund.

## FAST Act Section 6020 Pilot Program

On December 4, 2015, President Barack Obama signed the Fixing America's Surface Transportation Act (FAST Act; P.L. 114-94), which authorized federal surface transportation programs for five years. Section 6020 of the FAST Act authorized \$95 million over the life of the bill to provide grants to states to "demonstrate user-based alternative revenue mechanisms that utilize a user fee structure to maintaining the long term solvency of the Highway Trust Fund." Any state or group of states may apply for funding. The state matching share is 50%. The Government Accountability Office (GAO) called for establishment of such a pilot program in 2012.<sup>16</sup>

The objectives of the program include testing the design, acceptance, and implementation of two or more future user-based alternative mechanisms; improving their functionality; conducting outreach to increase public awareness; and minimizing the administrative costs of potential mechanisms. The grant awardees are to address the potential hurdles to the adoption of user-based alternative mechanisms, the protection of personal privacy, the use of independent and private

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<sup>15</sup> There may be legal considerations depending on whether the road user charge is structured as a fee or tax. See, for example, U.S. CONST. Art. 1, §8, cl. 1 ("all Duties, Imposts and Excises shall be uniform throughout the United States"). Legally, the two are distinguished by the relationship between the amount charged by the government and the services rendered to the payor. For example, the Supreme Court has explained that a tax may be administered "arbitrarily and [without regard to] benefits bestowed by the Government on a taxpayer and go solely on ability to pay, based on property or income," while a user fee is a specific charge imposed for a benefit that accrues only to the payors. *Nat'l Cable Television Ass'n v. United States*, 119 U.S. 336, 340-41 (1974).

<sup>16</sup> GAO, Highway Trust Fund: Pilot Program Could Help Determine the Viability of Mileage Fees for Certain Vehicles, GAO-13-77, December 2012, <http://www.gao.gov/products/GAO-13-77>.

third-party vendors to collect fees, market-based congestion mitigation, equity concerns, ease of compliance, and the reliability and security of technology.<sup>17</sup>

One important issue such a pilot program would need to study is the ability of a distance-based charging system to deal with vehicles crossing jurisdictional lines. Currently, states impose motor fuel taxes at varying levels, and in some cases regions within states impose additional taxes on fuel. An eventual national user charge scheme would need to be able to determine the distance a vehicle has driven in each jurisdiction and assess the appropriate per-mile charge levied by that jurisdiction, if any, in addition to the federal charge. To test this capability, the pilot will likely need to equip and track the actual movements of several thousand vehicles over several years as well as billing and collecting revenue from the users.

The cost of a pilot study has been estimated to be \$2,000 to \$4,000 per participant.<sup>18</sup> At that cost, the \$95 million of federal funds, matched with a like amount of state funds, could provide enough funds for a pilot program with 45,000 to 90,000 participants. However, Section 6020(e) requires that the Secretary of Transportation consider geographic diversity in awarding grants for the pilot program. If this provision is understood to require that funds be disbursed across many states, relatively small numbers of users will be able to participate in any single state, potentially limiting the value of the findings.

## State-Level Experiments

Several states have conducted trials of mileage-based road user charge systems. It is important to note that nearly all of these tests have been small in scale, so none of them sheds much light on the potential administrative costs of running a large-scale system. Also, few of the trials to date have addressed interstate issues, such as those that might arise if different states were to impose different systems.

Perceptions of privacy risks have had an impact on studies of road user charges at the state level. Virtually all the outreach in connection with state-run studies identified privacy concerns both during participant recruitment and in follow-up surveys. The concerns included the use of a GPS device to track vehicle movements and possible disclosure of drivers' personal information to law enforcement agencies or private companies.<sup>19</sup> Because of these concerns, Oregon and Nevada decided not to use GPS-based systems in any future pilot studies. (Privacy also developed as a major concern in the Netherlands, where Dutch officials suspended plans to implement a road user charge due to negative media coverage of the program's potential to compromise personal privacy.)

### Oregon

Oregon conducted a study of mileage fees with almost 300 voluntary participants in 2006-2010. Each vehicle was equipped with a GPS metering unit. The amount owed was reported via wireless communications when participants bought fuel at two specially equipped gas stations. One group of drivers was charged 1.2 cents per mile for all travel within Oregon. The second group was charged less at non-rush hours (0.43 cents per mile) and more during peak hours in

<sup>17</sup> U.S. Department of Transportation, *Notice of Funding Opportunity: Surface Transportation System Funding Alternatives*, March 22, 2016, pp. 1-23, [http://www.fhwa.dot.gov/fastact/nofo\\_stsfa\\_20160322.pdf](http://www.fhwa.dot.gov/fastact/nofo_stsfa_20160322.pdf).

<sup>18</sup> AASHTO Center for Excellence in Project Finance, *Forum on Funding and Financing Solutions for Surface Transportation in the Coming Decade*, January 2011, pp. 51-52.

<sup>19</sup> For potential legal concerns, see note 13.

congested areas (10 cents per mile). The study showed that the drivers did respond to mileage-based pricing by reducing travel, especially during rush hours. Precautions were taken during the course of the study to protect participant privacy.

In a follow-up study that started in 2012, Oregon responded to public concerns regarding privacy by allowing allowed drivers to select among different metering technologies, including a method that eliminated any ability of an outside party to determine the location of travel. A flat annual fee was also considered. The pilot program ended in March 2013.<sup>20</sup>

In July 2013, the Oregon legislature enacted Senate Bill 810 (Or. Rev. Stat. §319.883-319.947 [2015]) directing the Oregon Department of Transportation to deploy a road charging system by 2015. The result of the bill is OReGO, which allows for up to 5,000 volunteers to sign up to pay a state road usage fee of 1.5 cents per mile rather than a state gas tax. To prevent double taxation, participants receive a fuel tax credit for the amount charged under the Oregon road user charge. OReGO went online July 1, 2015, and has been providing revenue since then.<sup>21</sup> The technology, billing, and collection services are all provided by a commercial account manager.<sup>22</sup>

## California

The California legislature enacted SB 1077 (Cal. Veh. Code §3093 [2015]) directing the California Department of Transportation to establish a road charge pilot by July 2016 and to provide a final report to the legislature in June 2017. The pilot is to analyze alternative means of collecting road usage data, including manual alternatives that do not rely on electronic vehicle location data; collect a minimum amount of personal information necessary to implement the road charge program, including location tracking information; and ensure that the processes for managing data are in place to protect the integrity of the data and safeguard the privacy of drivers' data. Recommendations to the legislature are to be presented in December 2017.<sup>23</sup>

## University of Iowa

The University of Iowa Public Policy Center conducted a mileage-based road user charging study in 12 states with funds provided by the Safe, Accountable, Flexible, Efficient, Transportation Equity Act: a Legacy for Users (SAFETEA-LU; P.L. 109-59) in 2005. The center tested a GPS mileage-fee system in the vehicles of 2,600 volunteer participants from October 2008 to June 2010. The system computed hypothetical mileage fees for federal, state, and local jurisdictions and periodically uploaded the information over a cellular communications link to a central billing office. The billing center sent monthly bills to the participants. Researchers found that mileage-based road user charges were feasible using current technology but that installing charging equipment in existing vehicles could pose a significant challenge.<sup>24</sup>

<sup>20</sup> Oregon Department of Transportation, *Road Usage Charge Pilot Program 2013*, Final Report, February 2014, pp. 1-52, <https://www.oregon.gov/ODOT/HWY/RUFPP/docs/RUCPP%20Final%20Report%20-%20May%202014.pdf>.

<sup>21</sup> Oregon Department of Transportation, *Road Usage Charge Program*, <http://www.oregon.gov/ODOT/HWY/RUFPP/pages/index.aspx>.

<sup>22</sup> *Toll Road News*, "Sanef, Verizon and Azuga Tapped for Oregon's Pioneering Road Usage Charge Program," January 27, 2015, <http://tollroadsnews.com/news/sanef-verizon-and-azuga-tapped-for-oregons-pioneering-road-usage-charge-program>.

<sup>23</sup> California Department of Transportation, *California Road Charge Pilot Program*, January 2016, [http://www.dot.ca.gov/road\\_charge/](http://www.dot.ca.gov/road_charge/).

<sup>24</sup> Transportation Research Board, *Costs of Alternative Revenue-Generation Systems*, NCHRP Report 689, 2011, p. 24. See also David J. Forkenbrock and Paul F. Hanley, "Mileage-Based Road User Charges," *Public Roads*, March/April

## Puget Sound Regional Council

Between July 2005 and February 2006, the regional council installed meters using GPS technology in roughly 500 vehicles in 275 households. Participants agreed to be charged tolls for using the otherwise untolled freeways in the Seattle metropolitan area. The OBU displayed the toll rates for the current road based on the time of day. Longitude and latitude coordinates and toll data were periodically transmitted to the central office, which withdrew the appropriate amount of money from the user's account. Drivers in the study did change their travel behavior in response to congestion charges. The equipment in the study functioned properly.<sup>25</sup>

## Minnesota

Minnesota tested a distance-based fee system that used smartphones with GPS receivers and mileage-metering applications. The phones were installed in 500 cars belonging to voluntary participants for three six-month test periods. Participants paid variable charges for peak and off peak times. They paid one cent per mile off peak in Minneapolis-St. Paul and three cents during peak, and there were no charges for driving out of state.<sup>26</sup>

## Nevada

Nevada has been running pilot tests using a pay-at-the-pump scheme. The system being developed does not use GPS but rather a wireless transponder that is connected to the vehicle's OBU and transmits mileage data to a wireless receiver at equipped fuel pumps. This information is then sent to a central office, which calculates the charge based on undifferentiated miles traveled. The central office sends back the mileage fee, which is indicated on the fuel receipt printed out at the pump.<sup>27</sup>

## Foreign Use of Mileage-Based Road User Charges

A number of foreign countries have imposed distance-based road user charges. These generally take different approaches from the charging schemes that have been proposed for the United States.

Two fundamental differences are worth special note. First, of the road user charge schemes that are currently in operation, only New Zealand's taxes automobiles. The other schemes tax only large commercial vehicles. Although proposals have been made in some European countries to bring automobiles under mileage-based road user charges, no such measures have been implemented to date.

Second, whereas discussion in the United States has emphasized the potential of road user charges to generate revenue, their adoption elsewhere has been based principally on environmental concerns, particularly the desire to reduce emissions of particulates and greenhouse gases and to minimize citizens' exposure to noise and vibration from heavy vehicles. Within the European Union (EU), it could be difficult for a single country to effectively enforce more traditional economic measures to meet environmental objectives, such as high taxes on diesel fuel and on high-emissions engines, because owners are free to register their trucks in any

2006, <http://www.fhwa.dot.gov/publications/publicroads/06mar/02.cfm>.

<sup>25</sup> Ibid., p. 23-24.

<sup>26</sup> Rand Corporation, *Mileage-Based User Fees*, p. 12.

<sup>27</sup> Ibid., p. 13.

EU member state. Part of the attraction of road user charges is that they apply to all trucks passing through a country regardless of residence or fueling location. In addition, road user charges have the advantage of forcing foreign operators to cover a significant share of highway maintenance costs.

## Switzerland

Since January 1, 2001, Switzerland has imposed “performance-related fees” on heavy goods vehicles. The fees were approved by Swiss voters in a 1998 referendum and apply to all vehicles weighing more than 3.5 metric tons (about 7,700 pounds) carrying goods on public roads. Part of the purpose of the system was to reduce road damage and environmental harm caused by the large number of foreign trucks transiting Switzerland on trips between Italy and Northern Europe. Switzerland has made significant investments in improving rail freight infrastructure, and the fees are meant to encourage shippers to send their goods by rail.

The fees are based on three factors: the total weight of the loaded vehicle, the emissions of the engine, and the number of kilometers driven. As examples, a 10-ton delivery truck with an older engine would pay 0.31 Swiss francs per kilometer driven (approximately \$0.52 per mile), and a 35-ton over-the-road truck with the most modern engine would pay 0.80 Swiss francs per kilometer (\$1.33 per mile). A limited number of vehicles—including public safety vehicles, buses, and farm equipment—are exempt from the fees.<sup>28</sup>

A heavy vehicle registered in Switzerland must be equipped with an OBU, which must be installed by an approved installer. If the truck is pulling a trailer, the driver uses a chip card to input trailer data into the device before departure. The OBU is mounted behind the windshield, so enforcement personnel can observe lights indicating whether the device is operating and trailer information has been entered. The OBU is linked to the tachograph, which all heavy goods vehicles in Western Europe have been required to use since the 1980s to record distance and driving time. The OBU is automatically switched off by a microwave beacon at the border crossing if the vehicle leaves Switzerland, and it is automatically turned on in the same way when the vehicle reenters. The system does not employ real-time data collection. Instead, the vehicle owner must download the data from the OBU on a periodic basis and forward them to the Swiss Customs Administration, which is responsible for collecting payment. The system therefore does not generate information about a specific vehicle’s itinerary except when it leaves or enters the country.

Vehicles registered in other countries are not required to have OBUs to use Swiss roads. As an alternative, the driver may stop at a border crossing, register the vehicle, and receive an identification card. Each time the truck enters Switzerland, the driver inserts the card in a terminal at the border crossing and enters the vehicle’s weight and odometer reading. The same information is provided upon exit from Switzerland, when the driver must charge the cost of kilometers traveled to an approved card or a Swiss Customs account or pay in cash.

The Swiss road user charge system appears to be less costly than others, notably the German system (see below), as it does not track vehicles’ movements in real time. According to the Swiss authorities, installation of the system cost the government 290 million Swiss francs (approximately \$290 million). Annual operating costs are said to be 5% to 6% of receipts. Each truck owner must bear the cost of purchasing an OBU (estimated to be 1,000 Swiss francs) and having it installed (300-700 francs).

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<sup>28</sup> The current fee structure and an overview document are available in English on the Swiss Federal Customs Administration website at [http://www.ezv.admin.ch/zollinfo\\_firmen/04020/04204/04208/04744/index.html?lang=en](http://www.ezv.admin.ch/zollinfo_firmen/04020/04204/04208/04744/index.html?lang=en).

## Germany

The German charging system covers all trucks weighing more than 7.5 metric tons (16,535 pounds) using 12,174 kilometers (7,565 miles) of expressways and 2,300 kilometers (1,429 miles) of four-lane roads linked to expressways.<sup>29</sup> In 2018 the charging system is to be expanded to all federal motorways.

The toll-collection system is complex, in part because EU law prohibits Germany from requiring foreign truckers to install OBUs that allow a truck's location to be identified by GPS. The OBUs contains mobile telephone equipment that automatically communicates the vehicle's position (as determined by GPS) to Toll Collect, the private contractor that operates the system. Drivers of trucks without OBUs must pay the toll by credit card or direct debit either on the Internet or at kiosks installed at gas stations and highway rest stops. Because the toll varies with the number of axles and engine emissions, the German system requires an extensive surveillance effort, including overhead cameras, roadside measurement stations, and random checks of trucking companies to ensure that each vehicle has paid the correct toll.<sup>30</sup>

The toll rates vary from €0.125 per kilometer (\$0.21 per mile) for a truck with a low-emissions engine and three or fewer axles to €0.214 per kilometer (\$0.344 per mile) for a truck with four or more axles and an engine with the highest allowable emissions level.<sup>31</sup> There is no adjustment for an increased number of axles beyond four. The road user charge in Germany is assessed on the basis of kilometers rather than ton-kilometers, as in Switzerland. This fee structure gives operators an incentive to load their vehicles to the maximum permissible weight. Maximum loading may be desirable from an environmental perspective, as it encourages efficient truck use, but it may be less desirable from the perspective of road maintenance, as highway damage caused by a truck increases with the weight on each axle.<sup>32</sup>

In 2015, Germany raised €4.3 billion (\$4.9 billion) from truck road user charges.<sup>33</sup> Foreign-registered trucks accounted for 40.1% of the kilometers subject to the charge. Poland was by far the largest source of foreign trucks paying the road user charge, accounting for more than 13.6% of all travel covered by the charge.<sup>34</sup> Direct taxes on German-registered trucks were reduced by as much as €929 per year when the charge was introduced. Approximately €150 million per year raised from the charge is distributed to German states in compensation for revenue forgone when previous truck taxes were reduced.<sup>35</sup>

Toll Collect does not disclose operating costs. However, the U.S. GAO determined that the German government paid the system operator roughly \$664 million per year—or about 13% of average annual revenue—to manage the system from 2007 through 2011. In addition, about \$740 million is spent annually to assist German trucking firms in complying with the system. The

<sup>29</sup> *Automarkt*, “Lkw-Maut Deutschland Infos und Preise der Neuen Lkw-Maut,” [http://www.kfz-auskunft.de/info/lkw\\_maut.html](http://www.kfz-auskunft.de/info/lkw_maut.html).

<sup>30</sup> Descriptions of the tolling system and the enforcement procedures are available at the website of Toll Collect at <http://www.toll-collect.de/en>. Toll Collect does not publish a financial statement.

<sup>31</sup> The toll rates are set in law. See <http://www.gesetze-im-internet.de/bfstrmg/>.

<sup>32</sup> Federal Highway Administration, *Comprehensive Truck Size and Weight Study*, FHWA-PL-00-029, August 2000.

<sup>33</sup> Bundesministerium der Finanzen, *Monatsbericht*, February 2015, p. 20.

<sup>34</sup> Bundesamt für Güterverkehr, *Mautstatistik Jahrestabellen 2015*, p. 4, [https://www.bag.bund.de/SharedDocs/Downloads/DE/Statistik/Lkw-Maut/Jahrestab\\_15\\_14.pdf?\\_\\_blob=publicationFile](https://www.bag.bund.de/SharedDocs/Downloads/DE/Statistik/Lkw-Maut/Jahrestab_15_14.pdf?__blob=publicationFile).

<sup>35</sup> Bundesministerium für Verkehr und digitale Infrastruktur, “Absenking der KFZ-Steuer,” <http://www.bmvi.de/SharedDocs/DE/Artikel/UI/lkw-maut-absenking-der-kfz-steuer.html>.

German government does not consider this to be part of the cost of operating the system, but it does reduce by roughly 15% the revenues available to be used for other purposes.<sup>36</sup>

The 2011 law now governing the German truck road user charge system includes significant provisions intended to protect privacy. The system operator is prohibited from disclosing data on any vehicle's toll payments, route, time of travel, registration number, number of axles, and engine characteristics, and such data may not be transferred to any other party. Except when a vehicle is under investigation for toll evasion, the system operator must destroy data communicated by the OBUs immediately upon payment. Data and photographs from surveillance devices must be destroyed as soon as the operator confirms that the road user charge has been paid or that the vehicle is not subject to charge.<sup>37</sup>

## Austria

Austria's mileage-based road user charge system, inaugurated in 2004, requires all trucks and buses weighing more than 3.5 metric tons to pay by the kilometer for use of expressways and certain other high-speed roads. Unlike the Swiss and German systems, the Austrian system provides for three different size classifications for vehicles with two axles, three axles, and four or more axles. Rates for vehicles with four or more axles are more than twice those for two-axle vehicles with engines of similar vintage. A three-axle truck with a recent engine pays €0.2198 per kilometer (\$0.40 per mile), and a four-axle truck with an older engine may pay as much as €0.4473 per kilometer (\$0.82 per mile).<sup>38</sup>

The Austrian system does not rely on GPS but uses a microwave transponder mounted behind the truck windshield to communicate with toll-collection devices on road-spanning gantries. It is technically compatible with the Swiss system, so trucks with Swiss OBUs are able to travel on Austrian roads. Trucks equipped with German OBUs may also use them in Austria. However, Austrian transponders will not work in Switzerland or Germany.

The transport ministers of Austria's federal states have proposed extending mileage-based road user charges to all federal and state highways—in part to address complaints that heavy trucks are using these roads to avoid paying the user charges and in part to produce additional revenue for state governments. Such a change would require Austria to shift from its microwave-based system to a GPS-based system such as Germany's, at considerable cost.<sup>39</sup>

## Other EU Countries

Several other EU member states also impose mileage-based road user charges on trucks. Each has a different schedule. Poland has separate rate scales for trucks weighing between 3.5 and 12 metric tons, trucks weighing over 12 metric tons, and buses, with different per-kilometer rates

<sup>36</sup> GAO, *Highway Trust Fund: Pilot Program Could Help Determine the Viability of Mileage Fees for Certain Vehicles*, December 2012, pp. 22-27.

<sup>37</sup> "Gesetz zur Neuregelung mautrechtlicher Vorschriften für Bundesfernstrassen vom 12. Juli 2011," §§4(3) and 9.

<sup>38</sup> "Toll Rates," <https://www.go-maut.at/portal/faces/pages/common/portal.xhtml>.

<sup>39</sup> See "Die Verkehrslandesräte wollen flächendeckende Maut für Lkw," *Nachrichten*, April 5, 2014, <http://www.nachrichten.at/oberoesterreich/Die-Verkehrslandesraete-wollen-flaechendeckende-Maut-fuer-Lkw;art4,1351375>.



within each vehicle class depending upon engine emissions. Rates per kilometer on national highways are 20% less than those on expressways.<sup>40</sup>

The Czech Republic uses a microwave system similar to Austria's. Road user charges are based on the number of axles rather than vehicle rate, but engines are divided into three emissions classes rather than four, as in Poland. User charges on express roads are more than twice those on other highways, and charges on Friday afternoon are significantly higher than on other days of the week.<sup>41</sup>

Slovakia uses a GPS-based system similar to Germany's. For the moment, it is the most extensive anywhere, covering 17,770 kilometers of expressways, highways, and local roads.<sup>42</sup>

Hungary implemented a GPS-based charging system in 2013, but the European Commission concluded that its charges were disproportionate to the cost of the infrastructure. The government has reportedly agreed to review the charges every six months and adjust them as required.<sup>43</sup>

## Future EU Developments

The European Commission, the governing body of the EU, adopted a directive in 2004 requiring that all future electronic tolling systems within the EU be interoperable. This directive applies to road user charging systems as well as systems with more traditional toll structures. It does not require any changes in toll systems that were in place at the time the directive took effect.<sup>44</sup> An EU directive adopted in 2011 requires that road user charges for motorways reflect the environmental burdens caused by trucks.<sup>45</sup>

## New Zealand Road User Charge

New Zealand first imposed road user charges on all diesel vehicles and on all vehicles over 3.5 metric tons in 1977. The charges were based on distance driven and a nominal vehicle weight, as opposed to the actual weight of a vehicle on each trip. The charges were applied to diesel passenger cars as well as heavy goods vehicles. The policy decision to include diesel cars was taken because New Zealand does not assess a road tax on diesel fuel, as more than one-third of all diesel fuel sold in the country is used for off-road purposes. Drivers of vehicles powered by gasoline, compressed natural gas, and liquid petroleum gas pay a road tax collected at the wholesale level and are not subject to road user charge. Revenue from both the road user charge and the road tax, as well as from an annual registration fee on all vehicles, is expended on surface transportation.<sup>46</sup>

The actual charges assessed on individual vehicles are based on a cost-allocation model that aims at forcing individual users to pay the long-run marginal social cost of their use of New Zealand's

<sup>40</sup> See <http://www.viatoll.pl/en/heavy-vehicles/toll-rates>.

<sup>41</sup> See <http://www.mytocz.eu/en/toll-system/toll-rates/index.html>.

<sup>42</sup> See <http://www.emyto.sk/web/guest/technology>.

<sup>43</sup> [http://www.portfolio.hu/en/economy/hungary\\_allays\\_eu\\_concerns\\_about\\_new\\_road\\_toll\\_system\\_portal.27818.html](http://www.portfolio.hu/en/economy/hungary_allays_eu_concerns_about_new_road_toll_system_portal.27818.html).

<sup>44</sup> For details, see EU Directorate-General for Mobility and Transport, European Electronic Toll Service, "Guide for the Application of the Directive on the Interoperability of Electronic Road Toll Systems," 2011, [http://ec.europa.eu/transport/media/publications/doc/2011-eets-european-electronic-toll-service\\_en.pdf](http://ec.europa.eu/transport/media/publications/doc/2011-eets-european-electronic-toll-service_en.pdf).

<sup>45</sup> See European Environmental Agency, "Road User Charges for Heavy Goods Vehicles (HGV)," January 2013, p. 7.

<sup>46</sup> Road User Charges Review Group, "An Independent Review of the New Zealand Road User Charging System," March 31, 2009, <http://www.nzta.govt.nz/resources/road-user-charges/docs/ruc-final-report.pdf>, pp. 19-20.

road network. The most significant of these costs is road wear. The charge for a heavy truck with five axles, for example, is lower than for a heavy truck with three or four axles, because distributing the vehicle weight across more axles reduces the amount of road wear caused.<sup>47</sup> In practice, however, it has been difficult for New Zealand authorities to adjust charges for road wear without compromising simplicity and ease of enforcement. For example, wide tires are known to reduce the pavement wear caused by a heavy vehicle, but adjusting individual vehicles' charges based on the width of their tires would make the charging system more complex and compliance more difficult to monitor.<sup>48</sup>

Road users subject to the road user charge must purchase distance licenses in units of 1,000 kilometers. The license, a placard that must be displayed on the passenger side of the windshield, specifies the vehicle odometer readings at the start and end of its validity. Each vehicle subject to the charge is required to have a hub odometer installed on the left-hand side of one axle, and police and New Zealand Transport Agency inspectors can readily check the hub odometer to determine whether the license is valid.

The cost for a standard passenger car is 62 New Zealand dollars per 1,000 kilometers (US\$0.07 per mile). This is approximately the same cost per mile paid in the form of petrol excise duty by a gasoline vehicle with fuel efficiency of 25 miles per gallon. A four-axle tractor-trailer combination must pay 361 New Zealand dollars per 1,000 kilometers (US\$0.41 per mile). The New Zealand Transport Agency estimates that the road user charge represents about 10% of truckers' total costs. The agency also assesses a transaction fee of 4.80 New Zealand dollars (US\$3.35) each time a license is purchased online, with higher charges for licenses purchased from machines at service stations and over-the-counter at retailers. Continuous licensing is required, so a driver must be in possession of a new license at the time the previous 1,000-kilometer allotment has been used.

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<sup>47</sup> New Zealand Transport Agency, "Road User Charges," December 2015 pp. 30-44, <https://www.nzta.govt.nz/assets/resources/road-user-charges/docs/road-user-charges-handbook.pdf>.

<sup>48</sup> Ibid., pp. 37-40.

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