



# Ten Reasons Why Per-Mile Tolling Is a Better Highway User Fee than Fuel Taxes

By Robert W. Poole, Jr. and Adrian T. Moore, Ph.D.

## Introduction: Why the Debate Over Fuel Taxes?

Fuel taxes have been the primary source of highway funding in America since 1919, when Oregon enacted the first state fuel tax and dedicated the proceeds to creating and maintaining paved highways. The other 47 states had all followed suit by 1930, enacting fuel taxes and highway funds. The federal government first enacted a dedicated fuel tax (on gasoline and diesel fuel) in 1956, creating the federal Highway Trust Fund at the same time, to pay for building the Interstate highway system.

During the 20<sup>th</sup> century (except during World War II), the annual amount of both federal and state fuel tax revenue increased each year, as population grew, more households could afford cars, and the amount of driving per household increased with rising affluence. Congress and state legislatures occasionally increased the fuel tax rate, mainly to counteract the accumulated effects of inflation (since hardly any state fuel taxes were indexed to inflation, nor were the federal taxes).

All this began to change early in the 21<sup>st</sup> century. First, the routine annual increase in total vehicle-miles of travel was reversed during the Great Recession,

as fewer people were employed, and is only now (2014) resuming a slower up-trend. Most transportation researchers also believe that VMT per capita has peaked. Therefore, future growth in total VMT will be driven largely by population growth alone, and will be at a lower rate than has been the case historically. That will slow the growth of fuel tax revenue.

Second, the federal government in recent years has imposed stringent fuel-economy requirements on new cars, with the Corporate Average Fuel Economy (CAFE) standards now requiring an average of 34.5 mpg for new cars by 2016, and 54.5 mpg by 2025, compared with an actual new-car average of 24.7 mpg for the 2013 model year.<sup>1</sup> Since the fuel tax is charged *per gallon*, when cars travel twice as far on a gallon of gas, the amount of fuel consumed—and hence fuel tax revenue—will be cut in half. Auto companies are committed to achieving the 54.5 mpg target, and will do it via some combination of improving the mpg of internal combustion engines and producing hybrid and non-petroleum-fueled vehicles as part of their product mix.

The third problem for highway funding is political opposition to increasing the rate charged per gallon. There has been no increase in federal gasoline and diesel tax rates since 1993, and only about half of the states have increased their own fuel tax rates since that time.<sup>2</sup> Especially at the federal level, voters have lost confidence in the “trust fund” model, under which fuel taxes in the 20<sup>th</sup> century were originally dedicated solely to the capital and operating costs of the highway system. They see traffic congestion, pot-holes, and pork-barrel projects that suggest existing highway tax money is not being spent wisely. Moreover, most states and the federal government now fund a broad array of “surface transportation” programs out of fuel tax revenues, including urban transit, sidewalks, bike paths, highway beautification, recreational trails, even a national network of interstate bicycle routes. A 2010 Reason Foundation study found that in recent years nearly 25% of federal highway user-tax money was devoted to purposes other than the construction, operation and maintenance of highways.<sup>3</sup>

The Transportation Research Board of the National Academy of Sciences issued a special report in 2006 concluding that fuel taxes would not be sustainable as the primary highway funding source in the 21<sup>st</sup> century, for the above reasons.<sup>4</sup> A subsequent congressionally authorized commission on future transportation funding reviewed a wide array of alternatives and concluded that charging highway users *per mile*, rather than *per gallon*, was the best way forward.<sup>5</sup>

When the states began enacting dedicated fuel taxes for highway funding, the proponents recognized that the fuel tax was only a rough proxy for the amount

of highway use. A per-mile toll would have been a far more accurate user charge, but in the 20<sup>th</sup> century this required creating and staffing toll booths, an added cost that fuel taxation dispensed with. But there was no pretense that a per-gallon tax was an “ideal” user fee. It was only a proxy for highway use, and has become far less so as we reduce the petroleum-intensity of the vehicle fleet. As discussed below, today’s all-electronic tolling is very different from 20<sup>th</sup>-century cash tolling.

Considerable recent research on possible mileage-based user fee (MBUF) concepts has been carried out by academics, think tanks, and federal and state departments of transportation (DOTs). Most of the transportation research and policy community has concluded that some form of MBUF should eventually *replace* fuel taxes, and a number of pilot projects in various states have tested motorist reaction to various alternatives.

But the public thus far has not been persuaded. Among highway user groups, AAA has expressed interest in continued research, but has not endorsed a transition plan. The American Trucking Associations (ATA) is strongly opposed, arguing instead for increasing fuel tax rates. Popular media have been skeptical, and their superficial reporting has created the impression that any MBUF system would require active “tracking” of every vehicle, creating visions of Big Brother surveillance. And this misleading portrayal of per-mile charging has created increased rhetorical support for fuel taxes. A recent anti-MBUF editorial in the conservative *Washington Times* asserted that “The gasoline tax is an ideal user fee. Those who use the roads pay according to how much they use it. A fuel tax rewards efficiency, costs nearly nothing to collect, and creates no incentives for fraud.”<sup>6</sup>

This policy brief takes a different view. It presents 10 reasons why a per-mile charge, especially one implemented via 21<sup>st</sup>-century all-electronic tolling technology, is a far better highway user fee than per-gallon fuel taxes.

The focus of this brief is *highways*, rather than all streets and roads. Neighborhood streets have historically been funded by local governments, generally out of property taxes, since having paved-road access increases a property’s value, just as having police and fire protection does. County roads and minor long-distance roads can be funded via a low-tech per-mile state DOT system that periodically records a vehicle’s odometer reading. The real challenge is developing a viable, user-friendly, per-mile charging system to replace fuel taxes for the nation’s major highways—expressways and Interstates. That is the focus of this policy brief.

## Ten Reasons to Prefer Per-Mile Tolls to Per-Gallon Fuel Taxes

This brief will use the term *per-mile tolling* to refer to all-electronic per-mile charging for the use of major (limited-access) highways. What follows are 10 reasons why per-mile tolling is a better user fee than per-gallon fuel taxes.

### Reason 1: Per-mile tolling is a direct, rather than indirect, user fee.

When we pay for most services, we pay directly. Think about your water bill, electric bill, gas bill, cable bill or phone bill. In each case, the charge is based on the amount of the particular service you have used (cubic feet of water, kilowatt-hours of electricity, etc.). And you send your payment directly to the provider of the water, electricity, etc. So in two senses, these are *direct* user fees. You pay for the specific amount of the service you have received from the provider. And you pay the provider directly for providing that service. Just as important, you know how much you pay and what you get for it.

The same cannot be said for fuel taxes for highway use. In this case, what you pay is not directly related to the amount of use you have made—which is miles of travel on the highway. Two different vehicles of similar size and passenger capacity—for example, a Chevy Cruze and a Chevy Volt—use exactly the same amount of road service, but the first pays an amount based on how much gasoline it uses to travel those miles while the second pays zero.

Moreover, today's fuel taxes are not paid directly to the state DOT responsible for building, operating and maintaining the highways. They are paid to the state (or federal) treasury. Even in those cases where the revenue is dedicated to highway use, how much gets spent and where it is spent are up to elected legislators. Compound that with the fact that the average person does not know how much fuel taxes are or how much he pays per month or per year. This indirect and opaque means of paying for highways creates another whole set of problems, in comparison with utilities that are paid directly by their customers.

A utility-like system for a state's major highways (e.g., Interstates and expressways) would yield a monthly highway bill, similar to those already received by customers using tolled expressways and Interstates in 15 northeastern and midwestern states using the region-wide E-ZPass electronic tolling system. Ideally, the revenues generated would flow directly to the

provider(s) of those highways, in proportion to the miles driven on each. Customers would know how much they were paying and that they were paying specifically for that set of highways.

## **Reason 2: Per-mile tolling is a sustainable long-term funding source for long-term infrastructure.**

Funding highways with fuel taxes is trying to pay for long-term infrastructure by taxing something that both policy and economics will be steadily reducing in the years ahead. Just as in trying to fund health care via tobacco taxes, it pairs a declining revenue source to pay for something with stable or increasing use, resulting in a funding death spiral. Shifting to per-mile tolling creates a more sustainable funding system in several ways.

First, a better user fee to replace per-gallon taxes should be *independent* of the energy source used to propel the vehicles, so that no matter what future course vehicle technology takes, funding will be based on the actual use of highways and hence will be a reliable source to pay for reconstruction, expansion, and ongoing maintenance. With per-mile electronic tolling, the revenue is directly related to use of the system and thus with the need for operations and maintenance.

Second, increasing or decreasing the per-mile charge in response to changes in system use or changes in construction costs is much simpler than with an indirect tax on fuel. Because use and payment are more transparent to users, it is a simpler value proposition, more like changes in electricity rates or phone rates than like tax increases. Customers can more readily see if they are getting their money's worth.

Third, since customers paying per-mile user fees are far more aware of what they pay and why they pay it than with fuel taxes, it will be politically more difficult for politicians to raid those funds for other purposes or shift their use to services that don't benefit the highway customers. Increased transparency from direct user fees will help rebuild confidence in the highway funding system.

## **Reason 3: A per-mile toll can be tailored to a highway or bridge's cost.**

Replacing the indirect fuel tax with a direct per-mile electronic toll makes it feasible to tailor the toll rate to the cost of each major highway. Under the fuel

tax system, every driver pays an average rate per mile driven, based on gallons consumed, regardless of whether the driving takes place on inexpensive local streets and two-lane country roads or on multi-billion-dollar expressways and Interstates. In other words, under a fuel tax system, operators of cars and trucks pay a single *average price* to use all roads, regardless of their cost.

This inherent feature of a fuel tax funding system helps to explain why it is so difficult to expand major highways such as expressways and Interstates these days. Those who use them are paying only the average cost, but the per-mile cost of building, rebuilding, expanding, operating and maintaining those major highways is *far above average*. And since legislators each year want to be sure to have projects in their districts, the highway money gets divided into many small amounts, paying for many average-cost projects. That makes it hard to assemble the funding for needed major projects (which by definition are located in a single political district). By contrast, the ability to charge a higher per-mile rate for a replacement bridge or a major interchange reconstruction will make it possible to do those projects when needed, instead of having to wait sometimes several decades to amass enough funding.

#### **Reason 4: A per-mile charging system will mean increased fairness to users.**

If the per-mile user fees are directly related to the costs of specific highways or bridges, people will pay specifically for what they use and will not have to pay for what they do not use. Someone who drives only around town on ordinary streets and roads would avoid having to pay for costly freeways and Interstates. On the other hand, those who extensively use Interstates (such as long-haul trucking companies) would pay rates that cover the cost of building, operating, and maintaining those more-expensive highways—as do users of the toll road portions of the Interstate system today (and with trucks continuing to pay a higher per-mile rate than cars, due to their much greater impact on pavement). At the same time, everyone who consumes goods moved by truck would be helping pay for the highway as the costs of tolls are embedded in the prices of goods.

This kind of facility-specific funding would make it feasible to add barrier-separated truck-only lanes to those highways (mostly Interstates) that are major truck routes. This would be popular with motorists on those highways, increasing their safety and comfort levels. It would also be of great benefit to trucking companies, enabling their professional drivers to avoid sometimes erratic automobile traffic and would reduce the extent of car/truck accidents. It

would also permit trucking companies to operate longer double-trailer and triple-trailer rigs that are more productive than standard big rigs. These “longer combination vehicles” carry more cargo per mile and produce lower emissions per ton-mile transported.

Some have raised concerns that if we switch from fuel taxes to per-mile charging, rural residents will be disadvantaged, on the premise that they have to drive longer distances than residents of urban areas. Careful studies have shown that per-mile tolls are more equitable overall than fuel taxes.<sup>7</sup> Another study found that, on average, rural residents drive fewer total miles per year than most urban-area residents.<sup>8</sup> But in addition, if rural drivers use mostly country roads that are not very expensive to build and maintain, they would pay lower per-mile rates than those paid by people using Interstates and especially by those using urban expressways, the most expensive components of our highway system. Another study, of a per-mile fee pilot program in Oregon, found that it was more equitable for rural drivers than the fuel tax.<sup>9</sup> So rural residents would be *better off*, not worse off, under this kind of a per-mile charging system.

### **Reason 5: Per-mile electronic tolling would be self-limiting.**

Another advantage over today’s fuel tax system is the *self-limiting nature* of a toll-financed system. Over the past six decades, the federal fuel tax has gradually evolved from a dedicated Interstate highway user fee to a general-purpose federal transportation tax. Voters see their fuel taxes going to all manner of things like “bridges to nowhere” that lead them to lose trust in the federal highway program as directly benefiting them.

By contrast, with modern toll roads there is far more transparency for motorists in what they pay and where the money goes. Toll roads that use their toll revenues to pay solely for the toll road have few problems with trust, while there are more such concerns with the small number of agencies where toll money is diverted to fund other projects in the region. Importantly, toll roads and bridges are financed mostly by issuing long-term revenue bonds. Bond buyers impose stringent conditions on the use of toll revenues (including several types of reserve funds) to ensure a high probability that the toll revenues will cover the contractually called-for (and legally enforceable) debt service payments. Hence, those paying tolls to use such facilities can generally count on their toll dollars being used for the construction, operation, maintenance, improvement and reconstruction of those specific facilities.

This is a far more transparent and sustainable model of users-pay/users-benefit than what the federal Highway Trust Fund has become. In designing the replacement system for highway fuel taxes, non-highway interest groups will argue for making the per-mile tolls an all-purpose surface transportation funding source, able to be used for all the myriad purposes federal fuel taxes are now used for. But the only way to ensure that per-mile tolls remain a pure highway user fee (and hence do not over-charge highway users) is to structure them as tolls, dedicated via long-term financing agreements solely to support the highways on which they are charged. Highway user groups should strongly support this approach.

### **Reason 6: Per-mile tolling ensures proper ongoing maintenance.**

Historically, toll roads in America have been the exception rather than the rule. They are premium facilities that motorists or truckers in most cases have the option to use—or not. As such, they must offer better performance than is available from their non-tolled competition—such as less (or no) congestion, smoother pavement, less-steep grades, service patrols, etc. When it comes to proper maintenance, those who put up the money to finance the toll road (by purchasing toll revenue bonds) understand this, and require funds to be set aside to ensure proper ongoing maintenance—in many cases even before the toll operator makes the scheduled payments to bondholders. It's as if every toll road comes equipped with an endowment fund to ensure that it is properly maintained over its lifetime. These provisions in bond covenants have a long history of being legally enforceable.

Nothing approaching this kind of maintenance guarantee exists with our fuel-tax-funded highways. In those cases, what gets spent on maintenance each year is whatever the state legislature appropriates—and legislators are known for preferring to spend money on new projects (which provide opportunities for ribbon-cuttings) rather than fully adequate maintenance (which is boring and largely invisible to voters). The result is that many states defer maintenance, which is ultimately more expensive. Or they accept worse highway conditions, which decreases the quality of service for motorists and increases wear and tear on their vehicles.

In addition, since federal grants focus primarily on capital expenditures, this creates a subtle incentive for states to let highways and bridges wear out completely so that they can be reconstructed largely with federal funds. This kind of perverse incentive is absent when dedicated toll financing is used.



## Reason 7: Per-mile tolling provides the means to expand a highway when needed.

Legislators routinely face constraints on putting money into major highway projects (such as adding lanes to a freeway or replacing an obsolete interchange) since there are typically far more projects around the state seeking funds than the amount of fuel tax funds available each year. That means these big-ticket items often get put off, to enable the funds available to be spent on many smaller projects. The same \$500 million it would take for one major interchange reconstruction project (in a single legislator's district) could fund 20 smaller projects in numerous members' districts. That is clearly the more politically attractive choice, so decisions like that are often made.

But if the highway or bridge is tolled, and a large new investment in it makes financial sense, that project is more likely to get financed and built, serving current and new customers. Projects that more people will use have more projected revenue and will be easier to fund. This will naturally drive investment to the most productive uses of the funds. The toll rate might have to be increased to generate enough additional revenue, but the ability to generate the funding is there. In short, a toll-based system *facilitates needed expansions* in a timely manner.

## Reason 8: Per-mile tolling brings a shift from *funding* to *finance*.

Speaking casually, people often say that the federal fuel tax was used to “finance” construction of the Interstate highways. But that is not accurate. Federal highway grants were a means of *funding* the Interstates. Each year for many years Congress appropriated money from the Highway Trust Fund, so that each state could build another set of miles of Interstates. In other words, those major highways were paid for in cash, in bits and pieces over many years. And that is how nearly all states fund the rest of their highways, as well.

When you buy a house or a car, you can either pay cash or *finance* the purchase over time. The vast majority of people finance a long-term asset such as a house, because they can obtain it much sooner than if they first had to save up the entire purchase price and only then buy it and enjoy its benefits. The same differences apply to major highways and bridges. It makes far better sense to *finance* such big-ticket items, to get them into service as soon as they are needed, and have the users pay for them over time (basically over the facilities' useful lives). This is especially the case when a state or country has a huge backlog of infrastructure needs (such as reconstructing worn-out Interstates). Instead of

waiting decades to save up enough money to do each billion-dollar project, using *toll financing means the project can be done when needed*, with users paying to use it over the 50 or so years of its useful life (for a highway; bridges can be up to 100 years).

Nearly all other major infrastructure is financed in this manner, rather than being built using annual cash flow. That is how railroads pay for major projects like double-tracking or new railroad yards, how electric utilities pay for new generating plants and transmission lines, and how municipal water agencies pay for new filtration and treatment plants. Airports likewise *finance* major projects like new runways and terminals. Toll roads are just about the only U.S. highways that are financed via long-term revenue bonds. Nearly all other highways are funded out of annual appropriations. A shift to per-mile tolling will facilitate a shift from funding to financing. And that will provide a means for working down the very large backlog of needed reconstruction of aging highways and bridges, as well as adding capacity where needed.

Those who may be concerned about high levels of government debt will appreciate that revenue bonds do not obligate taxpayers, as general-obligation bonds do. The kinds of revenue bonds used for toll projects are secured by the revenues from the toll road or bridge. Those who buy such bonds understand that they are secured by the toll revenues, not by a claim on the taxing power of the government. This kind of financing is called “project finance,” to underscore the point that it is the project itself that provides the revenues to pay the debt service on the bonds.

### **Reason 9: Per-mile tolling can reduce traffic congestion.**

One more advantage of tolling over fuel taxes is that in cases of serious urban freeway congestion, all-electronic tolling makes it feasible to *vary the toll amount to reduce congestion*. Pilot projects on per-mile charges for road users have shown that the increased visibility of what people pay—even at exactly the same cost as with current fuel taxes—leads many people to reduce their total miles driven.<sup>10</sup> Even modest peak/off-peak differentials, such as those now used on a number of toll bridges and tunnels in the New York metro area and on the San Francisco-Oakland Bay Bridge, have reduced peak-period congestion—by encouraging motorists to shift less-critical trips to other times of day, encouraging some commuters to carpool instead of driving alone, and encouraging others to use transit for peak-period trips. Far more dramatic results have been achieved on express lanes with variable tolling in urban areas of California, Florida, Texas, Virginia and other major metro areas.

Variable tolling amounts to using market pricing during peak periods to get the most use from the available traffic lanes. When too many vehicles try to crowd onto a freeway at the same time, traffic flow breaks down into stop-and-go conditions and becomes mathematically unstable. The number of cars per lane per hour drops sharply, so that everybody's trip takes much longer. In the growing number of cases where carpool lanes have been replaced with variably priced express toll lanes, market pricing typically increases the traffic flow rate dramatically. Variable tolling of this sort was not possible with 20<sup>th</sup>-century toll booths and cash tolling, but is easy to do with today's all-electronic tolling.

### **Reason 10: Per-mile tolling would be the first big step toward replacing fuel taxes with mileage-based user fees.**

Given how large a change it will be to replace fuel taxes with per-mile charges, this process will almost certainly be incremental, taking place over several decades. And it is states that are already taking the lead in bringing about this conversion, building it up from small beginnings. Several states have conducted pilot projects, and Oregon has put into place a voluntary per-mile fee replacement for fuel taxes.<sup>11</sup> And while some fear that government will mandate that all vehicles in the country be equipped with an expensive box that records every trip and does many other things, the state pilot projects have explored multiple methods that give highway users a number of alternatives to choose from.<sup>12</sup>

In a recent policy study, Reason Foundation suggested a two-part approach to implementing per-mile charging.<sup>13</sup> States would implement a basic per-mile charge for using "ordinary" streets and roads, giving motorists a choice of several low-tech options such as annual odometer reading, a device that plugs into the car's diagnostic port and records only miles traveled (not where and when), and a more sophisticated version of the latter that uses cell-tower locations to distinguish between in-state miles driven and out-of-state miles. And for "premium" highways (Interstates, expressways, and other limited-access highways), per-mile charging would use current electronic tolling transponder technology (E-ZPass in the Northeast and Midwest, SunPass in Florida, FasTrak in California, etc.). Full inter-operability among these and other electronic tolling systems is being worked out by the toll industry, with a target date of 2016 for nationwide inter-operability. Once that occurs, motorists will be able to use one transponder nationwide, and have a single toll account that provides a single monthly bill, regardless of what state or facility one drives on. It would be analogous to being able to use your mobile phone or Master Card nationwide, with a single monthly bill.

This approach raises none of the Big Brother privacy concerns that popular media have associated with mileage-based user fees. Current transponder-based tolling has been widely accepted in all states with toll roads. And the low-tech options for ordinary streets and roads are receiving positive responses from motorists in pilot project testing in Oregon, Minnesota and other states. Variable pricing is being done routinely on over a dozen HOT lane/express toll lane projects across the country. There is no need for a costly, complex GPS box in every vehicle in order to do variable pricing where it is useful. And since nearly all serious traffic congestion in America is on limited-access highways (freeways and Interstates), that is where variable pricing should be employed.

The Interstate system alone handles nearly 25% of all vehicle-miles of travel. Adding other urban expressways that are not Interstates would likely increase the total to 30%. Therefore, replacing fuel taxes on limited-access highways with all-electronic tolling would convert nearly one-third of all vehicle-miles of travel to a mileage charge system. The Reason study proposed that such tolling be introduced in conjunction with the reconstruction and modernization of the aging Interstate highway system, with the tolls only being collected on a corridor *after* the reconstruction and any needed lane additions are completed<sup>14</sup>. That means each reconstruction/modernization project would be financed, raising the funds up front, and paid for out of toll revenues over the useful life of the rebuilt and modernized corridors.

## Conclusion

The fuel tax was never an “ideal user fee,” but was only a crude proxy for highway use. And 20<sup>th</sup>-century fuel taxes are not sustainable as the 21<sup>st</sup>-century’s primary highway funding source. In designing a replacement, we need to learn from the many flaws of the fuel tax system as it has evolved over the decades.

The replacement should be a direct charge for the amount of highway services a motorist uses. It should be sustainable, fair, efficient, and—for major highways and bridges—tailored to the capital and operating cost of those individual facilities. The system used to implement the direct charge should not create privacy concerns by enabling governments to track where and when people travel. And it should give motorists choices in how to pay for their miles traveled.

An array of low-tech choices is available for a basic per-mile system to pay for the capital and operating costs of ordinary roads and streets. For major highways, bridges and tunnels, a system using today's well-accepted all-electronic tolling technology will accomplish the needed functions, while permitting the higher capital and operating costs of these premium highways to be paid for only by those who use them.

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## Endnotes

- <sup>1</sup> Jack Opiola, et al., “Let there be RUC,” *Thinking Highways* (North America edition), Vol. 8, No. 3, 2013, Figure 1.
- <sup>2</sup> State Motor Fuel Tax Rates, 1992–2006 ([www.fhwa.dot.gov/policy/ohim/hs06/pdf/mf205.pdf](http://www.fhwa.dot.gov/policy/ohim/hs06/pdf/mf205.pdf))
- <sup>3</sup> Robert W. Poole, Jr. and Adrian T. Moore, *Restoring Trust in the Highway Trust Fund*, Policy Study No. 386, (Los Angeles: Reason Foundation, August 2010).
- <sup>4</sup> Committee on the Long-Term Viability of Fuel Taxes for Transportation Finance, *The Fuel Tax and Alternatives for Transportation Funding*, Special Report 285, Washington, DC, Transportation Research Board, 2006.
- <sup>5</sup> National Surface Transportation Infrastructure Financing Commission, *Paying Our Way: A New Framework for Transportation Finance*, February 2009.
- <sup>6</sup> “Spies on Your Drive,” editorial, *The Washington Times*, August 29, 2013
- <sup>7</sup> “Equity of Evolving Transportation Finance Mechanisms,” Table E1, p. 167, Transportation Research Board, 2011.
- <sup>8</sup> Brian A. Weatherford, “Distributional Implications of Replacing the Federal Fuel Tax with Per Mile User Charges,” *Transportation Research Record No. 2221*, Transportation Research Board, 2011.
- <sup>9</sup> B. S. McMullen, L. Zhang and K. Nakahara, “Distributional Impacts of Changing from a Gasoline Tax to a Vehicle-Mile Tax for Light Vehicles: A Case Study for Oregon,” *Transport Policy*, Vol. 17, 2010.
- <sup>10</sup> Anthony Rufolo, “Factors Affecting Behavioral Changes in Response to Road Fees,” Oregon Transportation Research and Education Consortium, 2009 (<http://otrec.us/project/116>)
- <sup>11</sup> <http://www.oregon.gov/ODOT/HWY/RUFPP/Pages/Index.aspx>.
- <sup>12</sup> [www.mbufa.org/where.html](http://www.mbufa.org/where.html) provides description of domestic pilot projects on mileage-based user fees.
- <sup>13</sup> Robert W. Poole, Jr., *Interstate 2.0: Modernizing the Interstate Highway System via Toll Finance*, Policy Study No. 423, (Los Angeles: Reason Foundation, September 2013).
- <sup>14</sup> Ibid.