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Value-Added Tolling: A Better Deal for America's Highway Users

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Introduction: Why Take a Fresh Look at Tolling?

Toll roads in America date back to colonial times. Entrepreneurs in the late 1700s and early 1800s requested and received charters from state governments, enabling them to raise money from investors to improve dirt tracks between towns into regularly maintained roads—in exchange for charging users a toll. Transportation historians have estimated that between 2,500 and 3,200 toll companies built and operated such roads in the 19th century, encompassing between 30,000 and 52,000 miles at various times.[1] The first wave of toll roads occurred in the northeastern states in the late 1700s and early 1800s. And the same pattern was repeated in the western states, especially California, after the Civil War, as those states were settled.

Unfortunately for early toll road investors, first canals and later railroads offered better mobility for freight and passengers once those more-expensive infrastructures came into use, and nearly all the early toll roads ended in bankruptcy. And when motor vehicles were invented around the turn of the 20th

century, the much higher cost of paved roads appeared beyond the ability of investors to finance. The invention of per-gallon fuel taxes, first in Oregon and soon thereafter in the other states, provided an alternate way to pay for paved highways, and such user taxes (generally dedicated to highways) became the mainstay of highway funding.

But in the early years of the 21st century, the fuel tax appears to be the highway funding source of the past, not the future. Federal energy and environmental policy has led to increasingly stringent fuel-economy standards for new vehicles. In the 2013 model year, the corporate average fuel economy of new vehicles averaged 24.7 miles/gallon (mpg). That is nearly double what cars got several decades ago, which means today's new cars go twice as far on a gallon of gas as they did then. But since the gas tax is paid per gallon, unless the tax rate had been doubled (which it has not been), cars are paying about half as much per mile driven as they did in, say, 1970. And this situation will soon get much worse. Current federal standards require the average new car to achieve 34.5 mpg by 2016 and a whopping 54.5 mpg by 2025. That means by 2025 cars will go twice as far as they do today per gallon used, and that the revenue generated per mile driven will be only half as much.

That is a major problem, because the cost of building new highways, reconstructing highways and bridges as they wear out, and properly maintaining them year after year increases at least as much as consumer price inflation—yet fuel taxes (except in a handful of states) are not indexed for inflation. But even simple inflation-indexing would be no match for the mandated increase in mpg between now and 2025. If we continue to use fuel taxes as the primary highway funding source, the rates would have to be increased by considerably more than the consumer price index to prevent continued shrinking of highway budgets.

And even if the fuel tax were to be patched up in these ways, between now and 2025 a growing fraction of all highway users will be employing energy sources other than gasoline and diesel fuel. All-electric vehicles (such as made by Tesla) are in their infancy, but could become a significant part of the fleet by 2025. Hybrids, cars powered by hydrogen fuel cells, and trucks powered by natural gas are all potentially feasible ways in which portions of the vehicle fleet will opt out of using gasoline and diesel in coming years. Yet the costs of building, maintaining and rebuilding highways are independent of the way motor vehicles are powered. Basic fairness demands that all vehicles pay their share of the costs of the highway infrastructure they use.

For these reasons two national commissions, a great many transportation researchers and many state departments of transportation (DOTs) have concluded that America must begin a transition from per-gallon user taxes to per-mile user fees.[2] And one of the most basic forms of per-mile user fee is tolling.

Toll roads were almost unheard of in the early days of paved highways funded by fuel taxes. But when the idea of superhighways came along in the 1930s and 1940s, their cost appeared to be far more than then-current fuel tax rates could generate. And since such limited-access, divided superhighways offered non-stop long-distance travel at high speeds, it seemed only fair that those who opted to use these superior forms of highway pay for them directly. When the first of these super-highways—the Pennsylvania Turnpike—opened for business in 1940, it proved wildly popular and was seen as the wave of the future. Other state highway departments in the Northeast and Midwest planned similar turnpikes, which got under way after World War II was over. Thus, by the time Congress authorized creation of the Interstate highway system in 1956, most of the Northeast and portions of the Midwest already had their portions in place or under construction as toll roads. Because of lower population and traffic in the South and West, however, Congress authorized new federal taxes on gasoline and diesel to pay for building the rest of the system, instead of tolls.

In recent decades, toll-financed projects have proliferated, especially in urban areas in fast-growing portions of California, Florida, Texas and Virginia. Additional highway capacity was needed, but the costs were higher than could be met by the limited amounts of funding available from fuel taxes. So a new generation has come of age using toll roads and/or toll lanes in Austin, Chicago, Houston, Dallas, Miami, Orange County (CA), Orlando, San Diego, Tampa, etc.

Could per-mile tolling become the primary highway funding source to *replace* fuel taxes? Highway users currently are not convinced that this would be in their interest. This policy brief explores the concerns of highway users and seeks to develop approaches that would be genuinely in the interest of those users.

How 21st-Century Tolling Differs from 20th-Century Tolling

For most of the 20th century, paying a toll meant queuing up at a toll booth or toll plaza and dropping coins into a basket, after which the toll gate would rise, allowing the vehicle to proceed. This system of paying tolls had many disadvantages for drivers. *First*, there was often a need to wait in long lines to get to the point where payment could be made. *Second*, the driver needed to have cash available, either paying with exact change or waiting in an even longer line for a booth where a toll collector would make change. *Third*, there were often accidents at toll plazas, as drivers jockeyed for position to be in the shortest lines and as some got rear-ended if they didn't move forward fast enough. And *fourth*, the whole system of toll booths and plazas, toll-collector staff, cash handling and enforcement was very costly. Estimates varied, but it was generally accepted that from 20 to 30% of all toll revenue was needed for collection and enforcement, far more than the estimated 1–2% to collect fuel taxes.[3]

But in the closing years of the 20th century, the technology of electronic toll collection addressed all four of those problems. Two key technologies constitute today's all-electronic tolling (AET).

The first is the transponder, a small device the size of a deck of playing cards that is mounted on the inside of the windshield. When interrogated by an overhead antenna, it transmits the vehicle's toll account number to the electronic toll collection system. In most cases, regular users set up a toll account, linked to a credit or debit card. Each individual toll is deducted from the account's balance, and by agreement with the customer, when the balance reaches a pre-specified low amount (e.g., $10), the credit or debit card is charged enough to replenish the account to an agreed-upon balance (e.g., $50).

The second technology is video imaging of the license plate number. This is needed for enforcement purposes, for those cases where the car in question may have a zero balance, as well as situations where someone without an account tries to go through without paying. But a growing number of toll road operators are offering "pay-by-plate" as an alternative to having a transponder-based account, using the video image of the license plate to create a bill that is sent to the vehicle owner. That typically appeals to people who are not regular users of the toll road, despite a higher charge due to the higher costs involved in billing.

Thus, nearly all 21st-century toll systems have both transponder antennas and video imaging of license plates.

Electronic toll collection has gone through three stages, as follows:

- ETC (electronic toll collection) lanes at toll plazas: In this initial step, toll roads (or toll bridges or tunnels) set aside one or more lanes for those equipped with transponders, enabling them to bypass the lines at cash toll booths to get through the toll plaza faster. This began happening in the mid-1990s.
- ORT (open road tolling): In this second step, toll roads removed toll booths altogether for those with transponders, allowing transponder users to bypass the toll plaza at normal highway speed. This began in the early 2000s.
- AET (all-electronic tolling): In this third step, toll roads are eliminating toll plazas altogether, replacing them with overhead gantries at tolling locations, on which are mounted transponder antennas and video equipment. These AET systems nearly all include a pay-by-plate option for those without transponders. With AET, all vehicles pay their tolls at highway speeds.

Once a toll road gets to the stage of full AET implementation, all three disadvantages of toll booths and toll plazas are eliminated, since the booths and plazas are eliminated. And that means fewer accidents, time savings and emission reductions.

AET also means significantly lower costs of toll collection. In a major 2012 study led by electronic tolling expert Daryl Fleming, the cost of toll collection via AET was estimated to be approaching just 5% of the revenue collected.[4] This was the first study of the cost of toll collection that looked forward (prospectively) rather than backward (retrospectively). All previous studies looked back (say over the past 15 years) to a sampling of toll roads, some of which were still all-cash, some at the ETC stage, and others at the ORT stage—but none at the fully cashless all-AET stage.

By contrast, the Fleming study focused on three all-AET systems: Colorado DOT I-25 HOT lanes, Fort Bend County (TX) Toll Road Authority, and Tampa-Hillsborough County (FL) Expressway Authority. All three are relatively small, and two are relatively new. Their toll rates are toward the low end of charges on today's urban toll roads. Two of the three are also open only during limited hours of the day, rather than 24/7. Yet despite not having the inherent

"economies of scale" of large toll operators, all three have been able to attain significant cost efficiencies.

All three of these AET operators developed streamlined business models based on the new all-electronic operations, and were able to do this without political opposition. All three of them:

- Began their toll collection programs based on an AET operations plan;
- Contracted with other agencies for account management and transactions processing to achieve greater economies of scale;
- Avoided establishing large, full-time administrative staff and the large infrastructure needed to house such staff.

By rethinking their operations plans based on taking full advantage of AET, these three toll operators have achieved cost savings that would otherwise be unreachable.

While it may be many years until larger, long-established toll agencies not only transition fully to AET but also greatly streamline their business models, the example provided by these three small toll operators is fully applicable to new toll operators that would become the toll providers for reconstructed Interstates and other limited-access highways. That is the case whether these operators are new public-sector agencies or investor-owned toll concession companies.

In the same study, Fleming and co-authors did a critical analysis of the widely believed proposition that it costs only 1% of revenue to collect fuel taxes. Their plausible re-estimate, including the cost of exemptions and evasion, is closer to 5%. Thus, it appears that the cost of collecting highway revenue via AET is approaching the cost of collection via fuel taxes.

Highway User Opposition to Tolling

While acknowledging the many benefits of AET, highway user groups still express opposition to wider use of tolling, despite the growing inadequacy of fuel taxes for 21st-century highway funding. This section explains four commonly expressed concerns from highway user groups about U.S. toll roads.

Concern #1: "Adding Tolls to Existing Highways"

This point has been expressed, especially by trucking organizations, in response to a number of proposals by state DOTs to institute tolling on Interstate highways that are currently non-tolled.

Current federal law generally prohibits tolling on federal-aid highways, with only a few exceptions. In 1998, Congress reauthorized the federal surface transportation program, via legislation called TEA-21. One provision of this law created a pilot program under which three states could each use toll finance to *reconstruct* a presumably worn-out Interstate highway. The Arkansas Highway Commission proposed that the state take advantage of this pilot program, and in doing so talked about applying tolls to all the Interstate highways in the state. In response the Arkansas Motor Carriers Association created a national coalition to oppose the plan. Joining the coalition were the Arkansas chapter of AAA, the American Trucking Associations (ATA), the National Association of Truck Stop Operators (NATSO) and the American Highway Users Alliance (AHUA). The coalition created enough political opposition that the Commission declined to submit a tolling proposal to the Federal Highway Administration (FHWA).

In 2007 Pennsylvania applied for a slot in the pilot program, in order to toll and reconstruct I-80, but the proposed tolling plan was designed to generate significant surplus toll revenue that would be used as a general statewide transportation funding source. Because that violated the reconstruct-only restrictions in the law, FHWA turned the plan down. Pennsylvania submitted a revised proposal in 2008, but was rejected again, on similar grounds.

In 2009, the Wyoming DOT, citing insufficient funding to properly maintain I-80 (in part due to trucks accounting for half of the highway's traffic), proposed using toll revenues to supplement existing Interstate funding (from federal and state fuel taxes). In this case, too, opposition—primarily from trucking groups—derailed the proposal before it could be submitted to FHWA. In this case the proposed use of tolling would probably not have met the requirements of the pilot program, since the program requires the toll revenues to be used to *reconstruct* and then maintain the Interstate.

Three states whose proposals met the criteria for the pilot program were eventually granted the three slots: Missouri (to reconstruct I-70), North Carolina (to reconstruct I-95), and Virginia (also I-95). In the several years that each has held its slot, none has been able to develop a politically feasible plan for implementing reconstruction tolling. There has been strong opposition from the

trucking industry regarding I-95 in North Carolina and Virginia, but the trucking industry did participate in a major I-70 reconstruction feasibility study that included adding truck-only lanes to I-70 across four states, including Missouri.[5] Residents near the I-95 corridor in both North Carolina and Virginia have objected to them being "singled out" to have to pay tolls, when users of other Interstates in their state would continue using non-tolled Interstates. And Virginia ended up proposing only to toll traffic just north of its border with North Carolina, aimed at collecting most of the toll revenue from non-Virginians, but which would also generate far less revenue than the amount needed to rebuild and modernize the full length of I-95 in Virginia.

In all of these cases, opponents have characterized the proposals as "putting toll booths on existing Interstates." That language suggests that highway users would be asked to pay a toll but would receive little or nothing better in exchange. And certainly in the case of Pennsylvania, one of the intended purposes of tolling I-80 was to fund highways and transit statewide, rather than simply reconstructing and maintaining I-80. So highway users in that case had good reason to object.

Concern #2: "Diverting Toll Revenues to Other Uses"

A second major concern of highway users is that some *existing* toll roads divert portions of their revenue to other purposes. Most of the 105 toll roads in operation in the United States as of 2012[6] keep faith with their customers, and use their toll revenues for the capital and operating costs of their toll roads. But there are notable exceptions.

Two of the largest diverters are in the New York metro area. The Port Authority of New York and New Jersey operates the George Washington Bridge, several other bridges, and two major tunnels between the two states. Charging among the highest toll rates in the country, the agency uses toll revenue to heavily subsidize its PATH subway between the two states. And MTA Bridges and Tunnels (formerly the independent Triborough Bridge and Tunnel Authority) uses revenues from its toll bridges and tunnels to heavily subsidize MTA subway and bus services. The Port Authority as of early 2014 is subject to a lawsuit from the area's AAA affiliate over using some of the revenues from the agency's recent toll increases for its $15 billion reconstruction of the World Trade Center.[7]

Other fairly well-known examples of toll diversion include the following:

- The New York State Thruway Authority is required to divert toll revenues to subsidize the Erie Canal and other waterways in the state.
- The Atlantic City Expressway diverts toll revenue to various development projects in Atlantic City.
- The West Virginia Turnpike is required to use toll revenues to subsidize economic development and tourism.
- The Pennsylvania Turnpike, under Act 44 (2007) is required to transfer $450 million per year to the state DOT to use for highway and transit funding statewide.
- In Virginia, the Dulles Toll Road in 2006 was transferred from the state DOT to the Metropolitan Washington Airports Authority for the purpose of using tripled toll rates to heavily subsidize the extension of the Washington Metro heavy rail line to Dulles Airport. A lawsuit is also challenging this measure.
- In 2013 the Ohio Turnpike was required to issue $1.5 billion in new debt, backed by increased future toll rates, to help fund other highway projects in the state.
- In San Francisco, both the Golden Gate Bridge and the Bay Area Toll Authority (which operates the other toll bridges in the region) use part of their toll revenues for transit subsidies.

These nine examples are the exception rather than the rule. But many of them are in high-profile cities and states, creating the impression that using toll revenues for other purposes is common practice. In fact, any use of toll revenues beyond what is needed for the capital and operating costs of the toll facility amounts to a tax that singles out toll-payers, rather than applying equally to all motorists or all taxpayers. So it is no wonder that highway user groups oppose such practices.

Concern #3: "Double Taxation"

Even on the large majority of toll roads and bridges where tolling is a pure user fee (paying only for the costs of the toll facilities), highway users still face an inequity, compared with users of highways paid for with fuel taxes. Every gallon of fuel they consume on the toll road carries federal and state fuel taxes. So toll road users pay a toll which covers the cost of building, operating, maintaining and reconstructing the toll road, but in addition they are also paying fuel taxes

for those same miles. This situation is referred to by highway user groups as "double taxation." And under current laws and practice, this is the case for every toll road, toll lane, toll bridge, or toll tunnel that is financed and built in America.

Toll facility users have a legitimate cause for complaint about paying both tolls and fuel taxes for the same highway. Assuming that the toll fully covers all costs of the tolled facility (which in most cases is true), then the fuel taxes they pay in addition are not a "user tax" but are a tax on mobility that unfairly raises the cost to the user of driving on the tolled facility.

In the days of 20th-century cash tolling, it would have been bureaucratically cumbersome to give toll road users a rebate for the taxes paid on the number of gallons of fuel they consumed on the toll road. People paying cash on a 20th-century toll road were not identifiable to the toll road operator, which did not know to whom rebates might be owed. And those toll road users would have had to keep records of each trip they made and send documentation to the operator, requesting rebates. The toll road would have had to develop a method of auditing those requests, to ensure that people were not submitting made-up claims. Moreover, since the fuel taxes were paid, ultimately, to the state and federal DOTs, those agencies would have had to agree to provide the rebates, decreasing the amount of fuel tax money they had available for highway programs. In short, with 20th century tolling, there was no cost-effective way to provide rebates of fuel taxes.[8] But as discussed later on in this brief, 21st-century AET provides a means of giving such rebates, thereby making it possible to eliminate double taxation.

Concern #4: Diverting Traffic to Parallel Routes

Another concern is that some of those who would use a particular highway if it were not tolled would refuse to use it if it were tolled. Since tolling is generally applied only to major highways (such as Interstates), the traffic that is diverted to parallel routes can have adverse effects on the pavement of those routes (which may have been built to a lower standard than that of the major highway), as well as subjecting communities along the parallel route to increased traffic, noise, emissions, etc., and also the possibility of increased accidents. Diversion of heavy trucks is generally of greatest concern.

The toll road industry acknowledges that this effect is real. For example, when a new highway is built using toll finance, one part of the traffic and revenue

analysis is to first estimate the likely traffic the new highway would attract if it were not tolled, and then to apply a "diversion factor" to that projected traffic—i.e., the percentage of cars and the percentage of trucks that would choose non-tolled alternate routes to avoid paying the tolls.

Diversion can also occur if an existing toll road increases its rates steeply. A classic example was the Ohio Turnpike. A series of toll rate increases in the late 1990s (to finance widening the Turnpike from four lanes to six) led to significant diversion of heavy trucks to parallel routes such as US 20. In response to concerns over pavement wear and accidents on the parallel routes, as well as loss of toll revenue, truck toll rates were reduced an average of 25% in 2005, which soon led to a 10% increase in truck traffic.

Value-Added Tolling

Value-Added Tolling is a set of new policy proposals aimed at responding positively to the concerns of highway users discussed above. The overall principle is that tolling only be introduced when and where it creates a *better deal* for highway users than the status quo. Specifically, these five principles are:

- Begin tolling only after major improvements (modernization/reconstruction) are completed;
- Limit the use of toll revenues to the specific highway or highway system where they are collected;
- Charge only enough to cover the cost to build (or rebuild) the highway, maintain it, and improve and eventually rebuild its facilities;
- Use tolls to *replace* existing user taxes, not in addition to them, and
- Provide a better level of service than what prevails on the highways where tolling is introduced.

In the discussion of these principles below, we are assuming that tolling is implemented on a per-mile basis using AET. Hence, per-mile tolls would apply to every trip on the facility, from point of entry to point of exit (which is not always the case on legacy toll roads that toll only at periodic barrier plazas). All users would pay a per-mile rate appropriate for their vehicle category (e.g. car, heavy truck, etc.) for all miles driven on the tolled highway. There would be no such phenomena as "border tolling" aimed at exempting large numbers of

people from paying tolls. And vehicles would suffer no toll penalty for getting off at an exit to buy food or fuel, then getting back on the tolled Interstate, since the per-mile rate would be charged only for the miles actually driven on the tolled highway.

Policy #1: Toll only when construction/reconstruction is finished.

In several recent cases, tolling has been imposed on existing facilities at the start of projects that use toll finance to pay for new facilities. In Washington State, tolling began in 2013 on the existing SR 520 floating bridge before construction began on its replacement with a more-modern bridge. And in the Hampton Roads area of Virginia, a $2.1 billion project to add a third (tolled) tunnel between Norfolk and Portsmouth is being financed with tolls on all three tunnels, beginning early in 2014 simultaneously with early construction work on the new tunnel.

The rationale for starting tolling that early is that the sooner tolling begins, the more revenue that can be raised, which is important if (as in the case of the SR 520 bridge replacement) the project cannot be fully paid for via toll revenue. In the bridge case, the state DOT did enough outreach work that there was majority support in the region for the early tolling. But in the Hampton Roads case, early tolling created a serious public and political backlash, leading to decisions by the state government to put more state highway money into the project in order to reduce the toll rates charged during the construction years.

Historically, *new* toll roads, bridges and tunnels have been financed based on the *projected* revenues from tolls that are charged after the new facility has been completed and is open to traffic. People understand and accept that in many cases, a costly new highway, bridge or tunnel may only be built if tolls are charged and used to finance the project. And it seems obvious that you can't charge tolls on a facility until it is completed and opened to traffic. But when it comes to a major project to, for example, replace the lanes and bridges of a worn-out Interstate highway, many people don't understand where the funds for the reconstruction would come from if tolling does not begin until after all that work is completed.

The answer is inherent in the term "financing." Nearly all non-tolled 20th-century highway projects were *funded*, not financed. This means they were paid for by annual allocations of federal and state fuel tax dollars—in other words,

they were paid for in cash. But toll projects are *financed* by long-term revenue bonds. That means lenders are persuaded to provide the money to build the project *up front*, before construction begins, based on legally enforceable agreements to receive annual payments from the toll revenues over the life of the bonds. Buyers of these bonds understand that they will receive no payments until the project is completed and starts charging tolls to those who use it, and that reality is built into the financing model. The same basic model is used when the private sector is the developer/operator of the tolled facility, except that in these cases the private firm usually also invests equity (analogous to a cash down payment on a house purchase), which reduces the amount of debt that needs to be issued.

Consequently, there is no problem in principle with a policy that says tolls will not be charged for a reconstruction project until it is completed and open to traffic. Making this policy standard, as part of Value-Added Tolling, would be following normal toll-financing principles that have been used for new toll roads and bridges for over a century. But now it would apply not only to brand new facilities but also to major reconstruction and replacement projects in cases of worn-out bridges, tunnels and highways (such as the Interstates). To be sure, not charging tolls until the rebuilt facility is finished means that subsequent toll rates will be somewhat higher, since interest due on the bonds is recorded during the years of construction and added to the total amount to be repaid from toll revenues. But that is what routinely happens with new toll facilities, and a rebuilt and modernized Interstate is essentially a *new highway on an old right of way*.

Policy #2: Limit the use of toll revenues to the tolled facilities.

Most highway users understand and accept the principle of users-pay/users-benefit. Where they have problems is with a payment method that while touted as a user fee is actually partly a fee and partly a tax. That is very clearly what most fuel taxes have evolved into over the last 30–40 years, with nearly 25% of all federal motor fuel tax revenue now spent on non-highway purposes.[9] And that is also the case with prominent toll agencies, such as the Pennsylvania Turnpike and the Port Authority of New York and New Jersey, that divert a substantial portion of their toll revenues to other uses.

But the reality is that toll roads today account for only about 5,000 centerline-miles of U.S. highway. That is just 3% of the 161,000 miles of the major highways defined by Congress as the National Highway System (of which the Interstates account for 47,000 miles). And the small group of toll agencies that

depart from the pure user fee principle represents only one-quarter of the 5,000 tolled highway miles.

We are talking here about shifting all the rest of the country's major limited-access highways from per-gallon taxes to per-mile tolls over the next several decades. Since the vast majority of these highways are not tolled now, the *new tolls* could be developed as *pure user fees* under the Value-Added Tolling principle. The handful of legacy toll roads that divert large fractions of their toll revenue to other purposes would constitute a drop in the bucket in that overall context—less than 1% of the 161,000 NHS miles—and our proposed Value-Added Tolling model would not require the legacy toll agencies to change. But this provision would apply to all *reconstruction* of highways and bridges that are not currently tolled.

How could highway users be assured that this pure user-fee principle would be followed for the long term? First, as with the existing three-state pilot program, *Congress* should require that the new toll revenues be used only for the capital and operating costs of the replacement highways. Second, the *state legislation* that enabled the shift from fuel taxes to tolls should authorize the use of the toll revenues solely to support the highway (or set of highways) on which the tolls are charged. Third, the *bond covenants* that are part of every toll financing are designed to ensure that the toll revenues will be sufficient to cover the annual debt service payments and all operating and maintenance costs. Once those covenants are in place and the bonds have been sold, no subsequent act of legislation can unilaterally change their terms. Fourth, if the toll-financed project (e.g., the reconstruction and widening of a worn-out Interstate) is carried out via a long-term public-private partnership agreement, the detailed contract (called a *concession agreement*) between the state DOT and the private company can also require that toll rates be adjusted over the life of the agreement to limit the revenue to what is needed for the capital and operating costs of the tolled facility, a sinking fund for its eventual replacement, and a reasonable rate of return for the company (in view of the risks it takes on that would otherwise be shouldered by the taxpayers).

Legitimate questions will arise about what constitutes a "system" of tolled highways within a state. Corridor-by-corridor analysis of a state's various long-distance Interstate highways may reveal that reconstructing some would be easy to finance while others would be more difficult. Highway user groups may well be willing to consider the state's set of long-distance highways as a system, so that over time, that entire set of premium facilities could be rebuilt and modernized with standard toll rates. The alternative would be to charge higher

rates for the lower-traffic corridors, which might depress usage. Similarly, an urban area's freeways may make sense to consider as a system, especially given how traffic and congestion on one corridor can have significant impacts on other corridors. These types of questions will need to be worked out case by case, drawing on the local knowledge of traffic engineers at the state DOT and the metropolitan planning organization (MPO) of each urban area.

Policy #3: Use tolls to replace—not supplement—existing highway taxes.

Using per-mile tolls to pay for major, limited-access highways will occur as states are in various stages of phasing out fuel taxes. In many cases, the transition may happen first for these premium facilities before states have come up with mechanisms for replacing fuel taxes on local streets and roads. In those situations, to avoid double taxation for those using the reconstructed tolled highways, it would be desirable to provide a rebate mechanism for those driving on the tolled facilities, so they will not also have to pay fuel taxes for facilities that are now tolled.

All-electronic tolling (AET) provides a plausible way to do this. Everyone who uses a tolled Interstate will either have a toll account (nearly all regular users) or will use the pay-by-plate option (mostly occasional users). In either case, the AET software has the information about who is paying each toll—either the account number or the license plate number. That information identifies the vehicle owner and the make and model of the vehicle. The tolling software can be programmed with a data table giving the EPA highway fuel economy rating for each vehicle (miles per gallon). Based on that information and the number of tolled miles driven, the number of gallons consumed is computed, and from that the amount of state fuel tax the customer would have paid on the fuel used for that trip.

The monthly total of such fuel tax payments would be reported to the state DOT. The DOT, in turn, would *reimburse the highway user* for that sum. One fairly simple way would be for the state DOT to give a data file to the state department of motor vehicles (DMV), listing the amount due to each driver or truck operator who used tolled facilities during the year. The DMV would credit that sum against what each vehicle owed for the coming year's annual registration fee. The DMV would still get all the money it had budgeted for, but a fraction of it would be coming from the state DOT as refunds of small amounts of fuel taxes.

This is not the only possible way to implement such rebates, but simply illustrates that this is not a difficult process to automate in an AET environment.

Policy #4: Provide a higher level of service for tolled highway users.

Congestion is a major problem on U.S. highways, especially urban Interstates and other freeways but also, increasingly, on long-distance Interstates and other limited-access highways. Some congestion, of course, is due to incidents, such as accidents, work zones, severe weather, etc. But half or more of all congestion is due to traffic levels exceeding the lane capacity of the highway in question.

Traffic engineers define traffic flow in terms of Level of Service (LOS). There are five levels, from A (unimpeded flow at high speeds) to F (severe, stop-and-go congestion). As economic growth takes place in a region, more motorists and trucks use a highway, resulting in a decrease in LOS over time. At some point, LOS gets bad enough that the state DOT decides it is time to add lanes to the highway.

Historically, most DOTs used LOS C as the threshold for deciding that a rural highway needed lane additions. But today, many DOTs use LOS D (or even E) as their threshold, primarily because of funding limitations. LOS D defines driver comfort as "poor," whereas LOS C is described as generally free flow but with some driver tension. Since toll finance provides the means to pay for large capital projects such as lane additions, the Value-Added Tolling approach would use LOS C as the threshold for rural lane additions on major highways.

Similarly, because of the very high cost of adding lanes to freeways in urban areas, most state DOTs now use LOS E (or even F) as the threshold for urban lane additions, if indeed they are willing to contemplate adding lanes at all. Since congestion on urban freeways costs car, bus and truck operators $121 billion per year,[10] a threshold of LOS D would be a major improvement over current practice in most metro areas. And since urban tolls would need to be higher (especially during peak periods), a combination of lane additions and variable tolls would make it possible to achieve LOS D conditions in most cases.

Limited-access highways are intended to be premium facilities, offering non-stop travel unimpeded by traffic signals or cross traffic. By making use of higher Level of Service standards, combined with variable-rate tolling in urban areas, state DOTs could provide shorter travel times and much-reduced congestion, restoring these premium facilities to their originally intended role in the

transportation system. Numerical examples of potential toll rates and the revenues they could generate for Interstate highway reconstruction and widening were developed in a 2013 Reason Foundation policy study.[11]

Policy #5: Charge only enough to cover the capital and operating costs of the tolled corridor.

For at least three reasons, diversion of cars and trucks from reconstructed and modernized Interstates to alternate routes under our Value-Added Tolling scenario would be less than was common in the 20th century. First, if toll rates are limited to amounts necessary for the capital and operating costs of the tolled highways *only*, they would be lower than some of the rates being charged today on legacy toll roads that charge higher tolls in order to support real estate projects, subways, canals and other non-highway purposes. (In other words, *less diversion of toll revenue will mean less diversion of traffic*.)

Second, the tolled reconstruction of Interstates and other limited-access highways is assumed to be taking place over several decades during which the states are phasing out per-gallon fuel taxes and replacing them with simple mileage-based user fees (MBUFs) for all *other* streets and roads. Estimates of the level of MBUF needed to replace a typical state fuel tax fall in the range of 1.0 to 1.5 cents per mile for cars. This basic MBUF could be collected as part of the annual vehicle registration fee (based on annual odometer readings) or via simple technology such as a device plugged into each car's diagnostic port that records only total miles driven. For our purposes here, the significance is that at some point in this several-decade transition period, the parallel alternate routes will carry a known charge per mile, rather than being perceived as being "free."

Third, if Value-Added Tolling is implemented as recommended, aiming to achieve a higher level of service than is typical of limited-access highways and freeways today, the value proposition for using the premium tolled highways will be greater than it is today, thereby attracting a larger fraction of potential users.

These three factors do not mean there will be no diversion to alternate routes, but that diversion will be less than we are used to. And states will still have tools to limit negative impacts of such diversion that does occur. States can set *and enforce* gross weight limits on secondary highways and bridges. They can set appropriate speed limits for these non-premium roadways. And they can also invest in improvements such as median barriers and rumble strips to reduce the extent and severity of accidents on these secondary roads.

Reaction of State DOTs to these Policies

The four Value-Added Tolling policies discussed above may at first encounter resistance from many state DOTs. For a decade or more they have been increasingly focused on how to raise additional revenue to offset the projected declines in federal and state fuel tax revenues. So their current interest in mileage-based user fees can be summed up in one word: "more." Their understandable reaction to policies that limit toll revenues—not beginning toll collection on a rebuilt corridor until it is open to traffic, using the toll revenues only for the tolled corridors, and potentially granting rebates to toll-payers to avoid double taxation—will likely face a negative reaction on first hearing.

But the case for DOTs and legislators to consider Value-Added Tolling is that turning replacement highway tolling into a cash cow for all kinds of transportation projects may create such a strong negative reaction from highway user groups that the transition to per-mile tolling *cannot be done at all*. Legislators and state DOTs may have to ponder whether getting half or two-thirds of a loaf is better than getting no loaf at all.

In point of fact, a policy of paying for the reconstruction, modernization, operation and maintenance of limited access highways via per-mile tolls sufficient to do *only those tasks* will still be a net win for state DOTs, even with the rebates and other provisions of Value-Added Tolling. To understand why requires crunching a few numbers. Figures from the Federal Highway Administration, combined with data on vehicle ownership and use from Oak Ridge National Laboratories' transportation energy database, reveal that the average *household* pays $552 per year in *federal plus state* fuel taxes, and drives 24,815 miles a year. That works out to 2.22 cents per mile. The average state fuel tax is higher than the 18.4 cents/gallon federal rate, so let's assume a typical state gets 1.25 cents per mile from its current state fuel taxes. The 2013 Reason Foundation Interstate tolling study estimated that most states could finance the reconstruction and widening of their Interstate system with a per-mile toll (for passenger cars) of 3.5 cents/mile, adjusted annually for inflation. That means this average state would be 2.25 cents/mile ahead (3.5¢/mile minus 1.25¢/mile rebate) on Interstates if it made the switch right now, even after granting a rebate for current state fuel taxes.

The reason for this result is as follows. Under today's fuel tax system, every motorist pays the same *average* rate per mile via fuel taxes, whether driving on local neighborhood streets, six-lane urban arterials, or massive eight-lane freeways. Yet the costs of building, operating and maintaining those different

categories of roadway vary enormously. A shift from everyone paying average costs via fuel taxes to one in which people pay per-mile user fees based on the type of roadway they use will mean that, for the first time, the premium highways will be getting enough revenues on a regular basis to properly build, operate, maintain and replace them. This will be a huge step forward for America's most important highways. And state DOTs are the best candidates to understand the benefits of this kind of change, and do their part to educate their legislators and the driving public.

Conclusions and Recommendations

Value-Added Tolling is a set of principles aimed at making expanded use of tolling to pay for highway infrastructure a positive development for highway users. These principles begin with the transition that is already far along to eliminate 20th-century cash tolling, replacing it with 21st-century all-electronic tolling. That change will eliminate the disadvantages and hassles of 20th-century toll booths and toll plazas. But Value-Added Tolling goes beyond that, to configure new highway tolling as a *pure user fee*, in which only the users pay and only the users benefit, just as with bills for the services of other network utilities such as water, gas and electricity. It would *replace*, not supplement, fuel taxes on the highways on which it is implemented. And implementation would be phased in as specific corridors were reconstructed and modernized, with tolling only taking place once the rebuilt capacity was operational.

Highway user groups should seriously consider the benefits of a Value-Added Tolling approach as a means to ensure the long-term viability of America's limited-access highways, our most vital arteries for travel and goods movement. They should insist on Value-Added Tolling principles being adopted as a condition for supporting tolling flexibility for states. State DOTs should embrace these principles as offering a user-friendly approach to replacing per-gallon fuel taxes with per-mile user charges for the major highways that carry *one-third* of all vehicle-miles of travel.

Congress has an upcoming opportunity to enable states to begin this transition. They can do this in the next reauthorization bill by revising and mainstreaming the existing three-state pilot program that permits using toll finance to rebuild and modernize aging Interstate highways. It should be expanded in two ways: (1) from three states to all 50 states, and (2) from one Interstate per state to all the Interstates in each state. Those changes would maximize the probability that

one or two "pathfinder" states will develop a viable political consensus on toll finance as the best way forward in rebuilding and modernizing America's most valuable highway infrastructure. They would become the role models for other states to emulate.

But Congress should also strengthen the conditions attached to this new tool, by including all four Value-Added Tolling principles instead of the pilot program's much narrower restrictions on the uses of toll revenue. Providing this precondition is likely to encourage highway user groups to support this important change.

About the Author

Robert W. Poole, Jr., is Director of Transportation Policy and the Searle Freedom Trust Transportation Fellow at Reason Foundation. He received his B.S. and M.S. in mechanical engineering from MIT and did graduate work in operations research at New York University. He has advised the US DOT Office of the Secretary, the Federal Highway Administration, the Federal Transit Administration, and the state DOTs of a half dozen states, including California and Florida. He has also testified before House and Senate committees on transportation policy issues, as well as before a number of state legislatures. He is a member of the Transportation Research Board's standing committees on Congestion Pricing and on Managed Lanes. In 1995–96 he was a member of California's Commission on Transportation Investment. In 2008 he was a member of the Texas Study Committee on Private Participation in Toll Roads, and in 2010 he served as a member of Washington State DOT's Expert Review Panel on a proposed $1.5 billion managed lanes project on I-405. And in 2010 he was a member of the transportation policy transition team for Florida Gov.-elect Rick Scott. He received the American Road & Transportation Builders Association's 2007 Private Sector Entrepreneur of the Year award, and he received the TRB Managed Lanes Committee's 2012 Leadership Award.

Endnotes

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[4] Daryl S. Fleming, P.E., Ph.D., et al., *Dispelling the Myths: Toll and Fuel Tax Collection Costs in the 21st Century*, Policy Study 409 (Los Angeles: Reason Foundation, November 2012).

[5] Wilbur Smith Associates, "I-70 Dedicated Truck Lanes Feasibility Study," June 2010.

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[8] Despite the above-noted difficulties, at least two toll roads—the Massachusetts Turnpike and the New York State Thruway—have operated limited rebate programs for trucking companies. For example, Massachusetts Turnpike users can submit documentation of their use of the turnpike and claim a refund for the estimated number of miles they drove on that facility. The cost of operating this rebate program has not been disclosed.

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