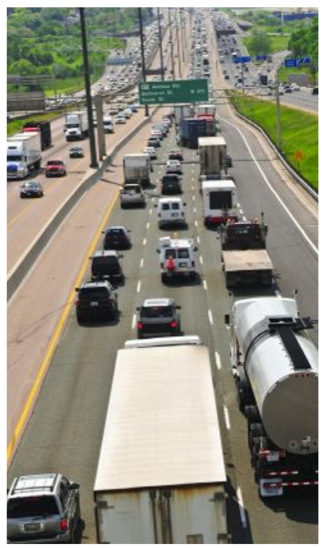
The Impact of Fuel Use Trends on the Highway Trust Fund's Present and Future



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Prepared for Associated Equipment Distributors

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This report was prepared for

Associated Equipment Distributors (AED)

All findings and recommendations presented in this report are those of the authors and do not necessarily represent the views of AED, the Thomas Jefferson Program in Public Policy, or the College of William & Mary.

We would like to thank Associated Equipment Distributors for their support, encouragement and resources throughout this project. Many thanks are owed to Professor Rui Pereira and Professor Admasu Shiferaw for their comments and suggestions as faculty advisors to the project. We also are very appreciative of the work conducted by our research assistant, Matthew Hough. We are grateful to Danton Noriega, a previous intern with the Department of Transportation, for providing us the use of his model of Highway Trust Fund revenue. Finally, we are indebted to the Thomas Jefferson Program in Public Policy for putting this opportunity together. Program Director Sarah Stafford as well as Program Office Managers Sophie Correll and Barbara Boyer have been invaluable resources.

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Foreword

Associated Equipment Distributors (AED) is proud of the role it played in helping to enact Moving Ahead for Progress in the 21st Century (MAP-21), the two-year surface transportation authorization law signed by President Obama in July 2012. The legislation will provide some much-need short-term certainty for state transportation officials and the construction industry. The new law also included significant reforms that have made the highway program more efficient and transparent (e.g., environmental streamlining and program consolidation).

However, with those improvements in place, now it is time to have a public debate about how to create new revenue streams for the Highway Trust Fund (HTF).

As policymakers and transportation advocates are painfully aware, the gas tax and other highway user fee revenues are insufficient to support even current, inadequate investment levels. The revenue shortfall has necessitated tens of billions of dollars in transfers from the General Fund to the HTF in recent years. At the same time, the nation's transportation network is in desperate need of substantial, additional investment. According to the Texas Transportation Institute, traffic congestion (resulting in large part from inadequate capacity) costs the U.S. economy more than $100 billion per year in wasted fuel and lost productivity.

These issues will be front and center in the 113th Congress. MAP-21 expires on the end of FY 2014 and surface transportation programs must once again be reauthorized. At the same time, Congress and the president are set to embark on a once-in-a-generation tax and budget reform debate. AED has long argued that highway user fees should be increased as part of a broader tax and budget deal.

In late 2012, as part of our ongoing effort to help policymakers better understand the problems they are being asked to solve, AED commissioned an economic research team at the College of William and Mary to examine the HTF's revenue shortfall (particularly those related to increased fuel efficiency standards and alternative fuels) and explore new ways to fund surface transportation infrastructure investment.

The researchers from W&M's Thomas Jefferson Program in Public Policy (TJPPP) drew some interesting conclusions. What resonated for me (as someone who has been involved in highway issues for almost two decades) are the long-term consequences of failing to do the right thing when you have the chance. A case in point: The researchers determined that indexing the federal gas tax for inflation in 1993 (the last time it was increased) would have generated an additional $64.4 billion in revenue over the last two decades.

But the W&M report is also a wake-up call for lawmakers today. The TJPPP team projects that higher fuel efficiency standards will further erode the value of the gas tax, and that failing to change the existing tax structure could lead to a $365.50 billion shortfall for the HTF (between current spending and anticipated revenues) over the next 23 years.

Our objective in commissioning this study was to help document the challenges facing the HTF and to encourage creative thinking about how to fund federal infrastructure programs. While we are pleased with the data and ideas our researchers have brought to the table, the conclusions and proposals contained herein are those of the researchers, not AED. As such, this document should not be regarded as a statement of association policy, objectives, or recommendations for highway and transit reauthorization legislation. We merely wish to inform the debate and give lawmakers fresh perspectives on the federal infrastructure crisis and how to solve it.

We thank our researchers – Devin Braun, Ryan Endorf, and Stephen Parker – for their thorough analysis. Thanks also to William and Mary professors Sarah Stafford, Rui Pereira, and Admasu Shiferaw for supervising and coordinating the project.

Finally, this report would not have been possible without the support of equipment distribution companies throughout the United States, who – by belonging to AED – have allowed the association to play a leadership role in the continuing surface transportation debate. We thank them for their involvement in the association, their financial support, and their confidence.

Christian A. Klein
Vice President of Government Affairs & Washington Counsel
Associated Equipment Distributors
Washington, D.C.
January 2013

Executive Summary

This project, on behalf of Associated Equipment Distributors (AED) and the Thomas Jefferson Program in Public Policy at the College of William and Mary, examines the fiscal condition of the federal Highway Trust Fund (HTF). Since the 1956 Federal-Aid Interstate Highway Act, federal fuel taxes have nearly exclusively gone to the Highway Account within the HTF, which then distributes funds to states by formula. The states subsequently execute highway maintenance and construction projects. This scheme was designed so that federal highway expenditures would be self-funded and would not contribute to national debt. In recent years, though, the all-important federal fuel tax revenues have not kept up with highway financing needs, resulting in the projection of large future supplements from general revenues to meet HTF obligations. Two distinct trends are responsible for this. First, federal gas and diesel tax rates (18.44 and 24.44 cents/gallon, respectively) have not been changed since 1993. Despite the fact that gas prices themselves have essentially tripled since 1993, stagnant tax rates mean that motorists are paying less per-mile, in real terms, for highway use than they did in 1956. Second, modest increases in historical fuel efficiency have meant that, while the total vehicle miles traveled (VMT) has increased overall since 1993, fuel consumption, particularly with respect to gasoline, has stagnated.

Historical Findings

- If fuel tax rates were indexed to inflation in 1993, the Highway Account would have received \$64.40 billion in additional revenue than what the Highway Account actually received.
- Implementing a vehicle mileage-based user fee (VMBUF) would have generated \$17.80 billion in additional revenue for the Highway Account during that period even if not indexed to inflation.
- Indexing a VMBUF would bring in \$136.80 billion additional revenue over the same span.
- There is a strong indication that increases in fuel efficiency and inflation have hurt the Highway Trust Fund's investment capabilities in recent years.

Findings of Future Projections

- Rising fuel efficiencies because of increasing Corporate Average Fuel Economy (CAFE) standards suggest that gasoline consumption will fall in the long-run, meaning that fuel tax revenues will also decline.
- Vehicle miles traveled is projected to increase over the same span, which suggests that a tax structure based on mileage-based user fees may be a more stable revenue source.
- Failing to change the existing tax structure could cause the Highway Account to incur a deficit of \$365.50 billion over the next 23 years.
- Indexing current fuel taxes to inflation reduces the projected deficit to \$186.70 billion over the 23-year span.
- Switching to a revenue-neutral VMBUF in 2021 leads to a deficit of \$183.60 billion.
- Indexing the VMBUF starting in 2021 leads to a deficit of \$78.0 billion, a \$287.0 billion savings.

However, we also consider adjusting current fuel tax rates to what they would have been if they had been indexed in 1993, which amounts to 25 cents/gallon for the gas tax and 33 cents/gallon for the diesel tax, a seven and nine cent/gallon increase, respectively.

- Inflation-indexed fuel tax rates would result in $167.0 billion in surplus – defined as total HTF revenues above and beyond expenditure projections – through year 2035.
- A non-inflation adjusted VMBUF starting in 2021 would lead to a total surplus of $168.0 billion.
- An inflation-indexed VMBUF would lead to a $320.0 billion surplus over the 23-year span.

At the end of our Results section, we evaluate what the necessary initial fuel tax rate increase would be to guarantee revenue neutrality. We also illustrate the per-year and per-week effects of these various taxing scenarios on the average motorist (in terms of fuel efficiency).

With this in mind, it seems clear that on a purely revenue-enhancing basis, transitioning to a VMBUF system is a very attractive option, but there are numerous, though not-insurmountable, challenges. VMBUF systems typically rely on some kind of mileage-monitoring infrastructure, be it transponders or electronic odometers. Valid concerns have been – and would continue to be – raised about possible government intrusion on motorists' privacy. As pilot projects in the state of Oregon and others illustrate, though, efforts can be made to limit the quantity of information communicated by these monitoring systems, and motorists could even choose to pre-pay for an estimated quantity of miles. Others may be concerned that a VMBUF strips away the initiative to buy fuel-efficient cars, since motorists would now be charged by the mile instead of by the gallon. Our project does not address or dispute the broader policy goals of fuel efficiency but instead reminds readers that fuel taxes and user fees are designed primarily to pay for highway use, not automotive emissions. Additionally, is a VMBUF overly regressive in its application? Lower-income motorists may on average drive a greater distance to work or as a condition of work, leaving them a proportionately greater tax burden. Definitively resolving this question is not feasible within the span of this project, but we do note that lower-income motorists may also have older, less fuel-efficient cars and so are already the victims of an arguably more regressive taxation system. We thoroughly address these and other potential objections to a VMBUF system in our report.

In this day of record budget deficits and structural debt burdens, a significant policy goal should be to make the HTF fiscally self-sufficient once again. Our report does not quantitatively evaluate all possible innovations to highway financing but instead focuses on proposals that address the two most striking trends in current-law HTF financing: Stagnant federal fuel tax rates and soon-to-be dramatically increasing fuel efficiencies. We hope that our report may serve as a starting point for policymakers in future highway reauthorizations and broader tax reform conversations.

Section 1: Status of the Highway Trust Fund

Section 1.1. Introduction

How should Americans pay for highway use in a time of increasing transportation costs and dramatic future shifts in automobile fuel efficiency? The answers to this question will have profound impacts on people, businesses, and governments across the United States. Associated Equipment Distributors (AED) represents approximately 500 construction equipment distribution companies, many of whom support highway construction and maintenance projects. These projects are to a significant degree financed through federal aid from the federal Highway Trust Fund (HTF) to state departments of transportation, and this aid is mostly funded through federal fuel taxes. Charges levied on liquefied natural gas, large tires, and heavy vehicle use also feed into the HTF's highway account. Once supplied to states, based on DOT formulas, these funds are available for building projects. With modifications, this is the system that has been in place since the creation of the HTF in President Dwight Eisenhower's landmark 1956 Federal-Aid Highway Act.

In recent years, however, receipts from fuel taxes, the HTF's largest revenue sources, have not kept up with the country's present, much less future, highway and infrastructure needs. Increasingly large gaps between federal highway expenditures, which many feel are already insufficient, and fuel tax revenues have necessitated General Fund supplements at a time when our nation's fiscal house can ill-afford additional burdens. Even though HTF expenditures have at minimum kept up with inflation throughout the various federal highway reauthorizations, the fuel tax rates have stayed constant since 1993. Furthermore, higher average automobile fuel efficiencies mean that for every mile of highway use, motorists are paying less in fixed, per-gallon fuel taxes. The result has been that in 2010 the HTF took in only $2.5 billion more than it did in 1998, and somewhat less than in 2006, despite a total mileage difference of 300 billion miles and markedly higher gasoline prices. Figure 2 in our next section shows this trend accelerating in the coming years.

Not only are fuel tax revenues insufficient to maintain current and future federal commitments, they are incapable of meeting the agreed-upon future demands of a hobbled infrastructure. The American Society of Civil Engineers notes in their most recent national report card that 26% of the country's bridges are either "structurally deficient" or "functionally obsolete," and one-third of America's roads are in poor or mediocre condition ("Report Card for America's Infrastructure"). All told, the reliance of the states and the federal government on stagnant fuel tax rates has left the country over $100 billion short of its annual infrastructure investment needs ("Report Card for America's Infrastructure"). A serious, long-term investment in the nation's highways thus requires a thorough look at ways to modernize the country's present financing scheme.

It is apparent that there are two dominant trend lines explaining the inefficacy of current federal fuel taxes: Stagnation of tax rates with respect to inflation and the recent prevalence of more fuel-efficient automobiles (Environmental Protection Agency, p. 6) ("Table 4-23: Average Fuel Efficiency of U.S. Light Duty Vehicles"). Any potential remedy for the HTF will have to address at least one, optimally both, of these realities. Our report evaluates a couple of such proposals, namely the idea of keeping fuel tax rates pegged to inflation and the concept of charging motorists a Vehicle Mileage-Based User Fee (VMBUF). For some of the reasons evaluated in this report, many feel that highways are best financed through the fuel tax framework rather than a pure user fee/mileage tax. Others, however, see even an inflation-indexed fuel tax as a stopgap solution that will fail to capture the shift away from traditional motor fuels.

After an explanation of the history of the HTF and of its current financial woes, this report will evaluate these various financing scenarios, including the status quo, since the last fuel tax revision in 1993. This historical analysis will for the moment ignore the administrative details of the alternative financing schemes, especially those of the VMBUF system, as well as potential consumer responses to any fuel tax overhauls. The primary question in this phase will be: Given that all scenarios achieve the same revenue in 1993, which ones would have accumulated the most revenue up to the present day? The answer to this question will get at the broader question of whether the HTF's funding stagnation stems more from inflation or from the fact that potential revenues from VMT increases have been masked by a system that charges motorists by the gallon and not by the mile.

The second and more rigorous phase of this report will project, into the medium-term future, revenue totals from the various highway financing scenarios based on government assumptions of fuel use and miles driven. Not only do these projections necessarily involve a complex juggling of automobile industry trends, evolving motorist behaviors, and government efficiency mandates, but they will also have to allow for an admittedly basic consideration: If alternative financing systems have the effect of charging motorists more for their highway use, then highway use, in the form of gallons of fuel consumed or miles driven, should at least minimally decline. In economic terms, how price-elastic is the demand for fuel and mileage? This point becomes even more salient for those who believe that mileage taxes offer clearer price signals to motorists because it more accurately reflects the cost of driving. While the effect on consumption of a fuel/mileage tax increase may be dwarfed by generally increasing fuel prices, it is not something a careful analysis could ignore.

Finally, our report will address common logistical and ethical objections to our alternative financing systems. States have implemented forms of both of our featured proposals, and much can be gleaned from their experiences. Whether it's the appearance of nominal tax increases or the fear of governmental monitoring of motorists' driving tendencies, a serious policy proposal in this field should carefully consider any and all political obstacles to implementation. We also briefly entertain a discussion of the supposed normative goals of fuel taxes, such as encouraging environmental efficiency. While we feel that many of these critiques are valid, none are insurmountable to the goal of re-securing the financial footing of America's federal highway program.

Section 1.2. The Context of the Highway Trust Fund's Present and Projected Shortfall

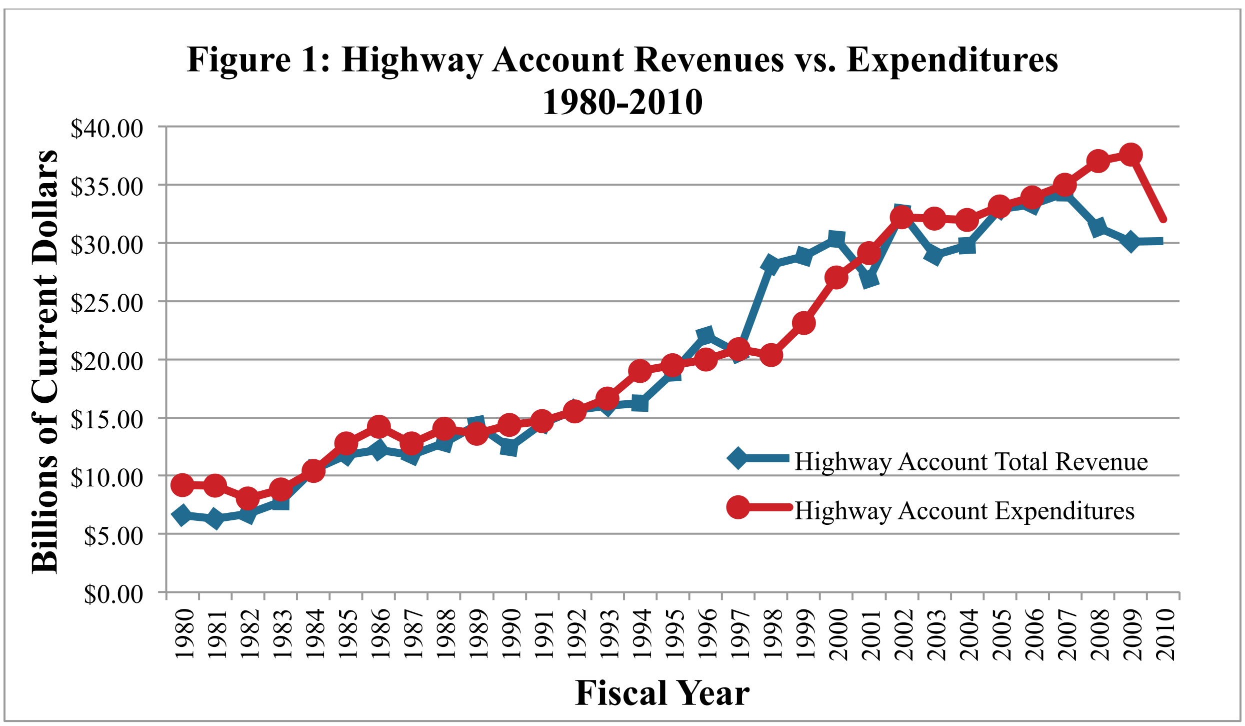
After decades of state and local provision of roads through the collection of tolls, the federal government first adopted a one cent/gallon gasoline tax in 1932 as part of a broader Depression-era revenue package. It was not until 1956, however, that a distinct federal Highway Trust Fund was created to finance Interstate construction as part of the Federal-Aid Highway Act. It is this bill that is the parent of all subsequent highway reauthorizations and federal fuel taxations ("Highway History"). Set at 3 cents/gallon in 1956, the gas tax would only rise to 4 cents/gallon until 1982, when then-President Reagan raised the fee to 9 cents/gallon as part of the Surface Transportation Assistance Act. This measure had the important effect of creating a Mass Transit Account within the HTF that would siphon off some fuel tax revenue from the Highway Account. This was the first of several steps in recent history that have broadened the policy mandate of fuel tax collection beyond simply caring for road maintenance. A 0.10 cent/gallon increase was added later in Reagan's term to finance the Leaking Underground Storage Tank Trust Fund ("Highway History"). Half of the 5 cent increase (bringing the gas tax to 14.10 cents/gallon) in the 1990 Budget Reconciliation Act went directly to deficit reduction.

The most recent increase in fuel taxes came as part of a budget reconciliation bill in 1993, the first year of then-President Clinton's term. A 4.34 cent/gallon increase in the gas tax was authorized, but all of the new revenue was completely redirected toward deficit reduction. Only four years later, though, Congress ended the deficit reduction purpose of the gas tax increase and brought the effective gas tax rate to 18.44 cents/gallon, where it stands today ("Highway History"). Through a parallel history of rate changes, the diesel tax now stands at 24.44 cents/gallon, with roughly 3 cents/gallon diverted to other HTF accounts. To this day, only 15.44 cents of the 18.44 cents/gallon gas tax actually go to highway construction and maintenance projects.

A significant peculiarity in federal fuel taxes is that they are not in percentages, but rather a fixed cent value per gallon. Thus, without some other form of correction, these taxes are extremely vulnerable to the effects of inflation. Consider that 18.44 cents represented a different value in 1993 than it does now, and this is especially true in the context of gasoline prices, which have skyrocketed since 1993. In fact, as explained later in our report, if pegged to inflation starting in 1993, the 2010 gas tax would have been 25 cents/gallon instead of 18.44, and the diesel tax would be 33 cents/gallon instead of 24.44. As elaborated in our historical data analysis section, this disparity underscores a tremendous loss in potential revenue for the Highway Account. Additionally, Americans drove 2.3 trillion miles in 1993 but drove 3 trillion miles in 2010. Due to modest increases in fuel efficiency over this period, though, this increase in mileage amounted to another missed opportunity for federal highway programs. To get a sense of the stagnation of fuel tax revenue, consider that in 2005 the Highway Account received $28.3 billion in fuel tax revenue and $25.7 billion in 2000 but only $27.3 billion in 2010, perhaps partly due to the onset of the Great Recession. As has been observed, when one considers the rising costs in transportation and construction separate from the rest of the economy, the gas and diesel taxes have lost more than 40% of their 1993 purchasing power (Institute on Taxation and Economic Policy, p. 5).

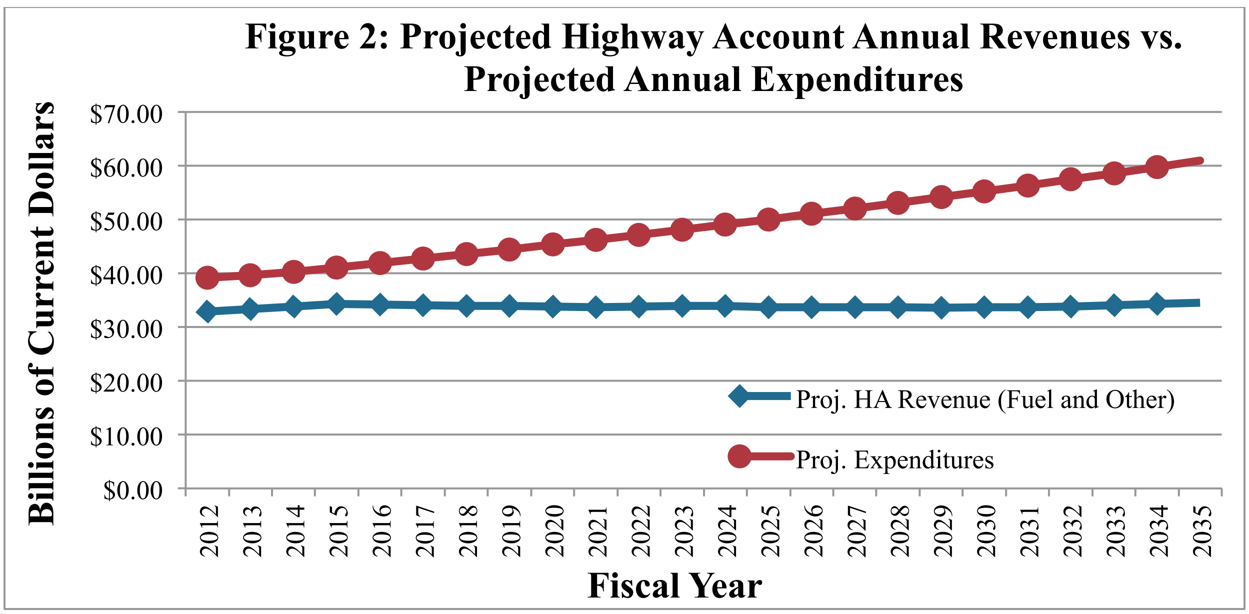
The topic of revenue enhancement as it relates to increased investments has been noticeably absent in recent federal highway reauthorizations. The most recent MAP-21 legislation in 2012 called for only an inflation adjustment to spending levels from SAFETEA-LU, the previous highway authorization (H.R. 4348). Even what amounted to a continuation of the status quo was hard-fought following nearly three years of temporary extensions and continuing resolutions. In the House-passed version, amendments were offered that would have limited highway spending to just fuel tax revenues (Laing) and that would have forbidden congressional study of potential financing alternatives, like a VMBUF (Kasperowicz).

Figure 1 compares Highway Account revenues to expenditures since 1980. We can see that over the last few decades, revenues and expenditures have been close to each other. In the last decade however, expenditures have been greater than revenues. That gap has been closing in recent years possibly because of the recession and subsequent emphasis on controlling government spending. Nonetheless, it is instructive to look at recent trends prior to looking at future revenue/expenditure projections.



Source: Federal Highway Administration, Table FE-210

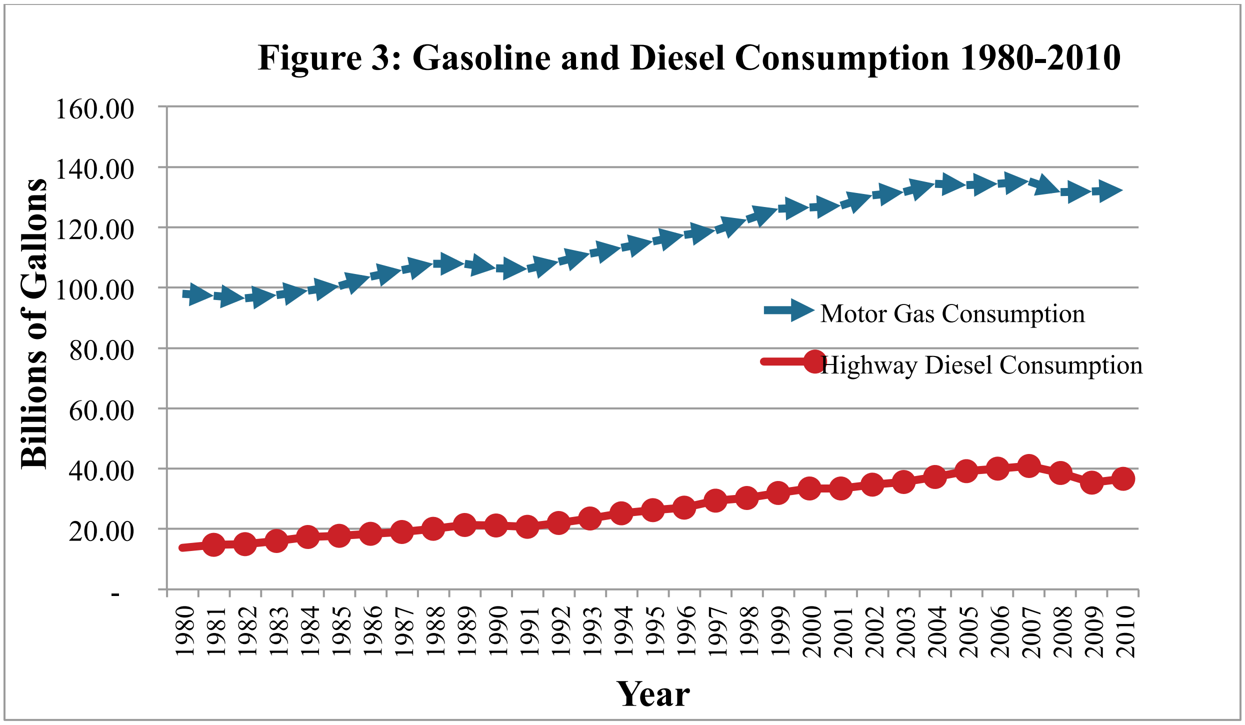
Figure 2 shows a projection of fuel revenues vs. expenditures in the Highway Account of the HTF for the next 23 years. The assumptions and methodology used to create this chart will be detailed in the Methodology section; however, in short, the revenues line is based off of energy consumption projections from the 2012 Annual Energy Outlook from the Department of Energy. The expenditure projections assume that costs are equivalent to the obligation limitations set in MAP-21 and are adjusted at a constant rate of inflation. The figure shows that fuel revenues will be greatly outweighed by expenditures over the next couple of decades. The cumulative deficit is projected to be over $500 billion even given our strong assumption that expenditures will only rise with inflation. When other highway account revenues from tire taxes truck sales, and other sources are included, this cumulative shortfall is reduced to $365 billion but still represents a dramatic burden on general revenues and, consequently, national debt. To the extent that increasingly large General Fund transfers place unnecessary burdens on the rest of the federal budget, innovation in highway financing will become a more salient topic in future highway reauthorizations.



Sources: Energy Information Administration (for fuel consumption patterns, Table 37), Danton Noriega (for revenue calculating equation) and MAP-21 (for obligation limits for Highway Account for FY 2013 and FY 2014)

Section 1.3. Historical and Projected Fuel Use and Vehicle Miles Traveled Trends

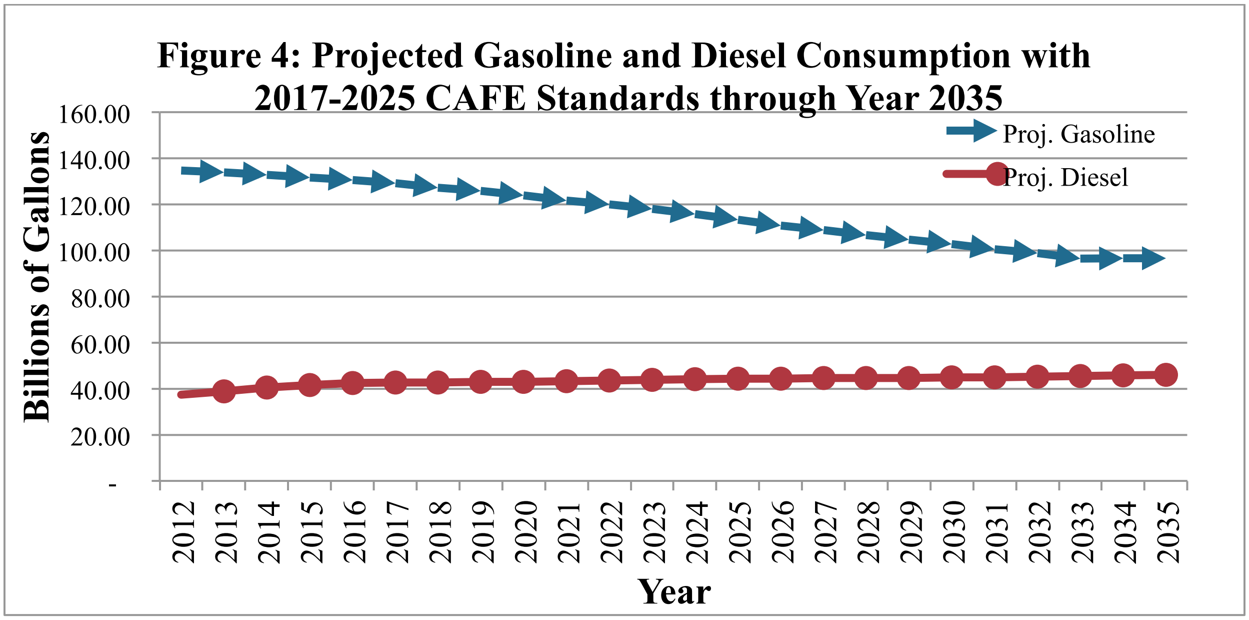
What's clear, however, is that federal fuel tax revenues will not be nearly enough to meet the authorized $40.44 billion in FY 2013 highway spending ("AED Highway Reauthorization Action Center"). Since the fuel tax revenues primarily come from taxes on gasoline and diesel, it is useful to consider trends in consumption of both commodities. Figure 3 shows historical gasoline and diesel consumption in gallons. We can see that over the last 30 years, gasoline and diesel consumption have increased, although gasoline consumption seems to be increasing at a slower rate than before. This is likely due to the increased emphasis on the CAFE standards which have increased fuel efficiency. Increased fuel efficiency will decrease fuel tax revenues since the tax is levied at the pump and more fuel-efficient cars need to fill up less frequently.



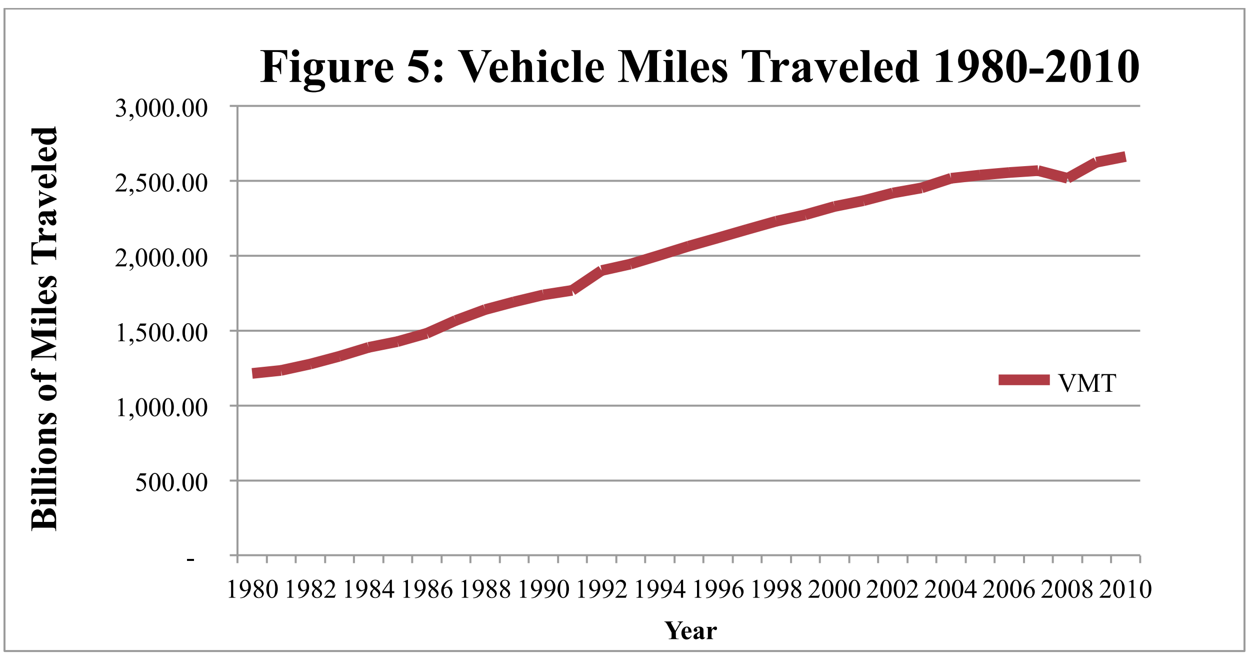
Source: Federal Highway Administration Highway Statistics Series Table MF-221 and MF-21

The Energy Information Administration recently published its 2012 Annual Energy Outlook, which provides projections on fuel (gas and diesel) demand, vehicle miles traveled, fuel prices, and other transportation energy trends through year 2035 (Annual Energy Outlook 2012). What's novel about the most recent projections is that they include estimated effects of the CAFE standards for new cars and trucks. Figure 4 illustrates that gasoline demand is projected to peak in 2013 at 133.8 billion gallons and steadily decline annually until bottoming out at 96.7 billion gallons in 2035. Likely due to more constant commercial demand, diesel demand shows a slight increase from 37.3 billion gallons in 2012 to 46 billion gallons in 2035, though this increase is dwarfed by the steady decline in gasoline demand.

We can also look at another measure of highway use: vehicle miles traveled. Using data from Table VM-1 of the Highway Statistics Series from the Federal Highway Administration, we plot vehicle miles traveled for each year from 1980 to 2010 in Figure 5. Figure 5 clearly shows that vehicle miles traveled have been steadily increasing over the last 30 years.

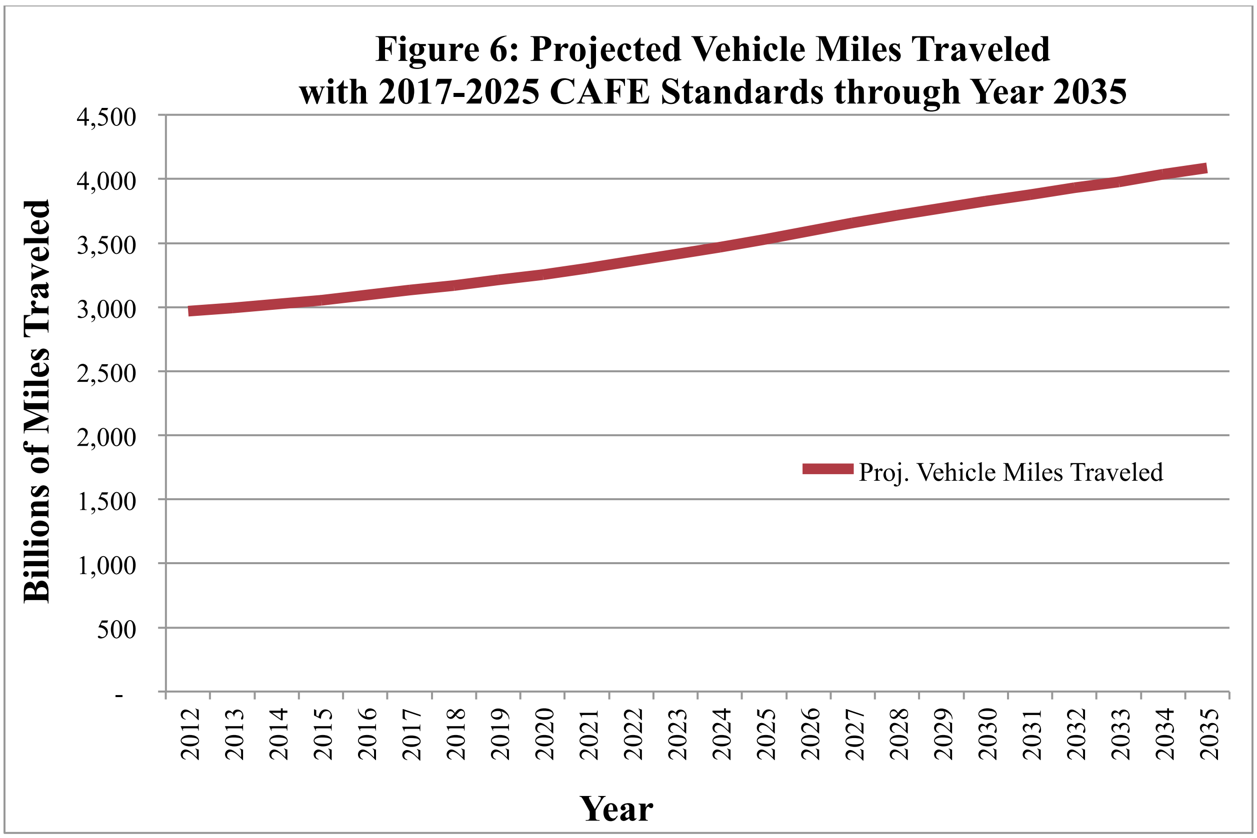


Source: Energy Information Administration, 2012 Annual Energy Outlook, Table 37



Source: Federal Highway Administration Highway Statistics Series Table VM-1

As Figure 6 shows, total VMT is projected to increase from just over 3 trillion miles in 2012 to more than 4 trillion miles in 2035, so while gasoline consumption will be decreasing by over one-third during this time, mileage demand will be increasing by over one-fourth. This represents an aggravation of historical trends, where according to the Federal Highway Administration, total VMT since 1993 (the year of the most recent fuel tax revision) has grown by over 27%, while gasoline demand grew by only 18%. These trends suggest that, while having a fixed per-gallon tax rate over the last two decades has undoubtedly harmed the HTF's purchasing power, something more fundamental may be afoot. These historical and projected trends have serious implications for future highway financing. At the least, these figures suggest that having a fixed per-gallon tax rate over the last two decades may have harmed the HTF's purchasing power. Going forward, the trends imply that a tax system based on charges by the mile could generate more revenue than maintaining the current system.



Source: Energy Information Administration 2012 Annual Energy Outlook Table 7

Since the fuel tax rates have remained stagnant since 1993, one seemingly obvious route to explore with financial reform of the HTF is the practice of pegging fuel tax rates to annual inflation. Several states have accomplished this in varying forms. Illinois, Indiana, and Michigan have taken the modest step of applying the standard sales tax to all gasoline and diesel purchases, which are currently exempt from sales taxation in most states. Eight other states, including

California and New York, are more adventurous in that they allow fuel taxes to vary in relation to fuel prices (Institute on Taxation and Economic Policy, p. 8). It may be that the rise in fuel prices is the most relevant type of inflation to consider with regard to fuel taxes, since the price tag of highway projects is significantly influenced by rising asphalt and construction costs. Insofar as opposition to new taxes at the federal level runs rampant, though, this proposal seems least politically palatable. A third path that follows the template set with other fixed-cent taxes is the one chosen by Florida: Simply indexing fuel tax rates to changes in the Consumer Price Index. As a tool for modest growth in revenue, the CPI allows for predictable, less violent swings in revenue as economy-wide inflation tends to be far more stable than the price changes in fuel markets (Institute on Taxation and Economic Policy, p. 9). For this reason and for ease of analysis, our first alternative financing scenario will follow these lines. If pegged to the CPI in 1993, how much revenue would federal fuel tax rates be sending to the HTF? If inflation has been the main cause of the HTF's stagnation in recent years, then this revenue gap should be quite significant.

However, gallon-based fuel taxes may be a more imprecise method of compensating for highway use. An increasingly examined set of proposals known as Vehicle Mileage-Based User Fees (VMBUF), also known as VMT taxes, would transform the nation's highway taxing system into a mileage-based one. Depending on the sophistication of the technology used, motorists would log their miles driven into an odometer-like device or an On-Board Unit (OBU). Total mileage would be observed either at annual automobile inspections or by sensors at local refueling stations. A per-mile fee, which could potentially vary to capture a host of related policy concerns outlined later in this report, would then be assessed on these mileage totals to determine the motorist's tax liability, thereby replacing the fuel tax surcharge system currently in place.

While no states have fully implemented VMBUFs, some states have recently given considerable study to the measure. The most noteworthy case was the state of Oregon's pilot program in 2006-2007, in which hundreds of light cars in greater-Portland experimented with paying regular mileage fees at refueling stations using then-primitive OBUs akin to what have now become commercially popular GPS devices. Despite the many concerns opponents have raised, participants reported surprising logistical ease in paying the fees, and more than 90% said they would support permanently switching away from the current fuel tax system (Whitty 2007,

p. vi). Indeed, commercial truck drivers already work with OBUs as part of industry-wide hours of service regulations, not to mention the millions of new cars that come automatically equipped with such tracking technology. More relevant to this report, though, is the revenue potential from a VMBUF system. As described earlier, VMT growth since 1993 has been modestly higher than gasoline gallon consumption growth, meaning that an otherwise revenue neutral mileage tax in 1993 could have, assuming no dramatic changes in motorist behavior, raised significantly more revenue over the last 18 years. Beyond political objections based on privacy concerns with the OBUs, the obvious caveat is the administrative timeline of such a program. As the Oregon report recommended, to prevent major retrofitting costs OBUs would need to be phased in over time with new automobiles while older models use more primitive mileage-logging devices or, alternatively, stay with the current fuel tax regime (Whitty 2007, p. vii).

The next section of our report presents our methodology for both our historical comparisons and our future projections. Following the methodological section, we present our results which compare these various scenarios in terms of their theoretical revenue potential since the date of the last fuel tax increase, 1993. We also present our projections for future revenue based upon various tax rates and structures. We then discuss the implications of a VMBUF system both politically and in terms of implementation. Finally, we conclude with a recap of our results as well as suggestions for further research.

Section 2: Methodology

Section 2.1. Historical Methodology

The Highway Statistics Series[1] published by the Federal Highway Administration of the Department of Transportation provided the historical data we used throughout this project. Using Table MF-221 (for 1955-1995) and Table MF-21 (1996-2010), we acquired data on gasoline and diesel consumption for each calendar year (Office of Highway Policy Information). From Table VM-201 (1955-1995) and Table VM-1 (1996-2010), we obtained data on vehicle miles traveled (OHPI Quick Find: Vehicle Miles of Travel). Finally, we acquired data on Highway Account revenues from Table FE-210 from Highway Statistics 2010 (Status of the

[1] The Highway Statistics Series provides data from 1955 through 2010.

Highway Trust Fund 1957-2010). From the FHWA website, we also found information on historical fuel tax rates for gasoline and diesel (Federal Excise Taxes of Highway Motor Fuel).

Using the data on historical gasoline and diesel consumption along with the historical tax rates, we projected Highway Account fuel tax revenues from 1980 to 2010. These projections could then be compared to the actual revenues as recorded by the FHWA. Using the following equation, we multiplied gallons of gasoline/diesel by their respective tax rate to create a total fuel revenue sum for each fiscal year.

Equation 1: $\textit{Fuel Revenue} = (0.252*\tau_{t-1}*c_{-1}) + (0.748*\tau_t*c)$[2]

where: τ = tax rate

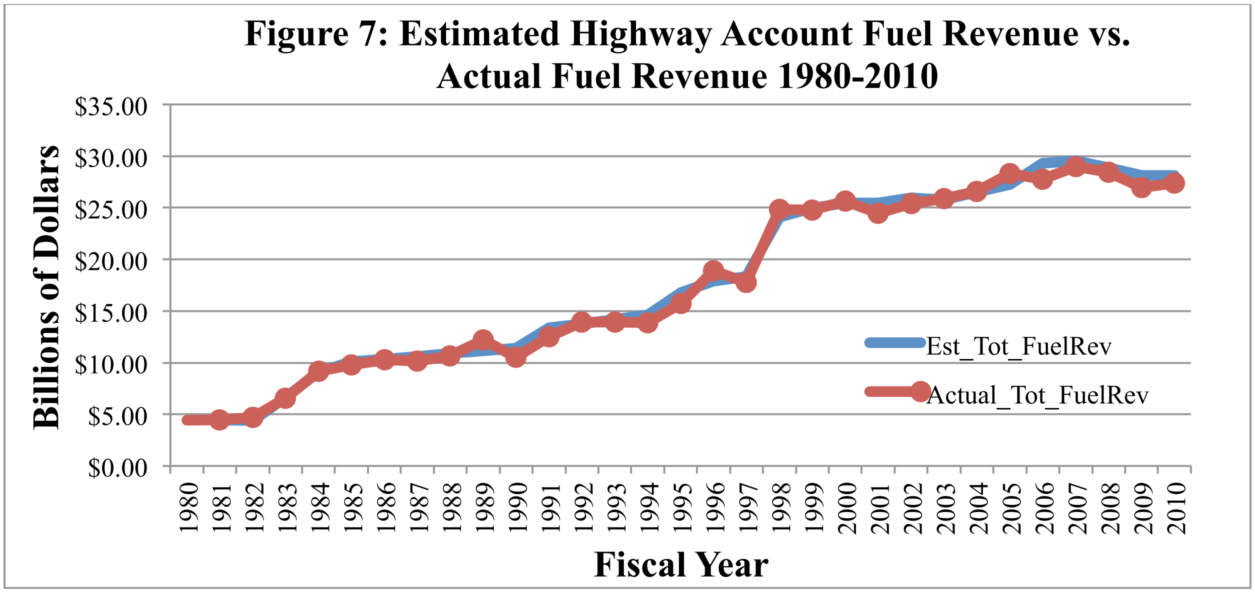
c = consumption (gasoline or diesel)

As shown in the above equation, we want revenues to be reflected by fiscal year because budgets are made by fiscal year; therefore, it is more appropriate for our revenue estimates to be by fiscal year for easy comparison to reported data on actual revenues. Because the data on gasoline/diesel consumption reflects calendar year numbers, we need to take approximately a quarter of the revenue from the previous year (since the fiscal year begins on October 1 of each year), and add that to the revenue for the first 9 months of the current year. Repeating this process for both gasoline and diesel gives us a sum of total revenue as the result of gasoline and diesel. After summing them, we have a projected total fuel revenue that we compared to the actual numbers reported to FHWA.

Figure 7 shows the comparison of our estimated revenue vs. actual revenue. Our projected fuel revenues were within a few percentage points of the actual fuel revenues, a difference that we attribute to rounding. This result gives us confidence that our estimation equation is suitable for use going forward. We should note that all of our graphs and projections throughout this paper only refer to the Highway Account of the Highway Trust Fund. The Mass

[2] This equation was provided courtesy of Danton Noriega. He created the initial Excel spreadsheet that much of this project is based on. That initial spreadsheet included data and data sources (including relevant tables) that have been invaluable to this project. He developed this methodology to project previous and future Highway Account revenue and has granted us permission to use it to further research in this field. We are deeply grateful for his previous work and his permission to build on the work that he started.

Transit Account is a much smaller portion of the Highway Trust Fund and the primary concern of this paper is the effect of highway financing schemes on revenues that fund highway projects. As the Highway Account is the main source of funding for these projects, we limit our projections to that account.



Source: Federal Highway Administration-Data on historical consumption patterns of gasoline and diesel and tax rates. We thank Danton Noriega for the estimation equation used to project historical revenues.

Using the above model structure from Equation 1, we examined three different financing scenarios as if they had been implemented starting in 1993. Examining these scenarios allows us to address whether inflation or the increase in fuel efficiency is the reason behind the insufficiency of the gasoline and diesel taxes. In the first scenario, we pegged the fuel tax to inflation starting in 1993. This scenario is useful because it shows the effect that inflation has had on revenues under the same tax system. To calculate how the fuel taxes would change as the result of inflation, we used the CPI calculator from the Bureau of Labor Statistics website. We then used the same equation listed above to get projected revenues.

Our second scenario was a projection of revenues if we switched to a vehicle mileage-based user fee (VMBUF) starting in 1993, which was not adjusted for inflation. This scenario is primarily useful because it allows us to explore how increased fuel efficiency over the last two decades have decreased potential revenues. To do this, we set the tax in 1993 to be revenue neutral; that is, we made sure that the tax was set at a level so that in 1993 it would bring in the same revenue as the fuel taxes did. Doing this means that any revenue difference we observe is directly attributable to fuel efficiency increases. Again, we use the same equation listed above just substituting vehicle miles traveled for c instead of gasoline/diesel consumption. Our initial VMBUF rate in 1993 was set at 0.968 cents per mile.

Our final scenario projected revenues if we had switched to a VMBUF system in 1993 and indexed that tax rate to inflation. We started the tax at the revenue neutral rate in 1993, which was 0.968 cents per mile, and then adjusted the rate for inflation each year ending at a rate of 1.41 cents per mile in 2010. This scenario allows us to project how both inflation and increases in fuel efficiencies have interacted to affect revenue for the Highway Account.

Section 2.2. Future Methodological Assumptions and Techniques for Future Projections

Section 2.2A. Data

For our future projections, the Annual Energy Outlook 2012 published by the Energy Information Administration of the Department of Energy provides our data.[3] From this source, we gathered data on fuel consumption patterns (Table 37: Energy Use by Fuel Type within a Mode), vehicle miles traveled (Table 7: Transportation Sector Key Indicators), projected gasoline and diesel prices (Table 12: Petroleum Product Prices), and conversion factors[4] (Table 76: Conversion Factors) through year 2035 (Annual Energy Outlook 2012). For all of our data, we used the side case scenario that included the proposed CAFE standards from 2017-2025 because of the expectation that the Obama Administration would continue to push for implementation of those higher standards. Using this data implies that our projections for gasoline and diesel consumption will be lower than under the reference case.

Table 37 contained data on fuel consumption patterns for different types of vehicles in the form of British Thermal Units (BTUs). We summed the values of each mode (Light Duty Vehicles, Commercial Light Trucks, Freight Trucks, Transit/Inter-city/School buses) for both

[3] The EIA uses the National Energy Modeling System (NEMS) to create the projections for the Annual Energy Outlook. NEMS is based on component modules that solve for energy prices and quantity consumed by product and sector. Exogenous variables such as projected GDP, income, petroleum supply are used to help reach this equilibrium. More information about the NEMS assumptions can be found here: http://www.eia.gov/forecasts/aeo/assumptions/pdf/introduction.pdf. Additionally, documentation of the Transportation Demand Module can be found here: http://www.eia.gov/forecasts/nemsdoc/transportation/pdf/m070(2012).pdf

[4] These conversion factors are from physical units into British Thermal Units. For gasoline and diesel, the conversion factor is given in millions of British Thermal Units per barrel.

gasoline and diesel for each year. This number (in trillions of BTUs) was then converted into gallons of gasoline/diesel by using the conversion factors found in Table 76. For gasoline, we used the Motor Gasoline Average (row 23) for each year, and for distillate fuel, we used the distillate fuel transportation category (row 12) for each year. This calculation gave us a projected number of gallons of gasoline and diesel for the future, which we could use in our Equation 1 listed above. Using the same equation, we took vehicle miles traveled and multiplied by the tax rate in order to project the revenues for each year.

Section 2.2B. Elasticity

Many studies have examined the potential effects that an increase in fuel prices might have on fuel consumption. To the extent that our alternative financing scenarios represent tax increases, and therefore increases in fuel prices above what would be the case under current law taxation, our study must try to settle on appropriate numbers for this measure. How elastic can we expect the demand for fuel (and mileage) to be with respect to price? The reader should keep in mind, though, that the relative price changes incurred by these alternative financing scenarios are likely to be very small (5-10 cents/gallon out of nearly $4/gallon fuel prices) during the study period.

For ease of calculation and explanation, we chose to settle on two constant elasticity rates for our projections: -.2 for short-run elasticity and -.4 for long run elasticity.[5] In other words, a 10% increase in the price of fuel would suggest a 2% decrease in fuel consumption in the short run and a 4% decrease in the long run. We feel these numbers are justified by several inputs from the existing literature. The first is in response to an increasingly prominent econometric practice in the fuel demand field known as Error Correction Models (ECM). These models attempt to tease out the changing nature of the relationship between the independent variable (fuel price) and the dependent variable (fuel use). Relative to other time-series and cross-sectional elasticity studies, the early ECM projects generated significantly lower long-run price elasticities of fuel demand, albeit in the international context (Bentzen 1994; Samimi 1995; Eltony and Al-Mutairi 1995). Short-run price elasticities seemed to center around -.3, while long-run elasticities were between -.3 and -.4. Ramanathan (1999) uses similar techniques in a long-term study of Indian

[5] These numbers were chosen based off of the discussion of the literature below.

fuel consumption behavior and finds elasticities of -.21 and -.32 for the short and long run, respectively. Similarly, Park and Zhao (2010) find an average price elasticity of -.25 within the American context. Thus, in part, our estimates reflect a caution to incorporate a range of estimates over time.[6]

A key way that we implement our elasticity estimates is in distinguishing between the short and long runs. In considering the non-ECM literature on the subject, a five-year span is recommended for fuel consumption markets. In other words, long-run behavioral responses to significant gas price changes seem to take five years to occur (Goodwin 1992, p. 156; Eltony 1993; Ramanathan 1999). Setting a firm chronological distinction between short- and long-run price elasticities may seem questionable, but we do so in light of sector-specific observations with regard to fuel demand.

An additional caveat rests in our use of price elasticity of *fuel* consumption as being synonymous with price elasticity of *mileage* consumption. Conceivably, motorists' behavior responses to fuel price changes with regard to their mileage may be quite different than with regard to their raw fuel consumption. Indeed, much of our project rests on this departure in consumption trends between fuel quantity and mileage. However, the available literature regarding elasticity of mileage demand was quite varied, due in part to the relatively recent awareness of the impacts of fuel efficiency on fuel demand markets (Graham and Glaister 2002). What little consensus there is suggests that mileage demand is somewhat more price-inelastic than fuel demand. Johansson and Schipper (1997) found the price elasticity of "travel demand" to be -.35 in the long run, roughly half their figure for fuel demand (p. 290), and Goodwin (1992) similarly found travel demand to be more price-inelastic both in the short run and in the long run. Thus, we believe our elasticity estimates respond well to (1) studies that have used ECM techniques over long periods of time and have found price elasticities at the low end of the academic spectrum, (2) studies that attempt to specify a distinction between short- and long-run

[6] One possible criticism is that we do not present our results under a number of varied elasticity rates. Our reasoning for not doing this is that the effect of fuel consumption elasticity with respect to price on overall revenues is very small. Switching the short run elasticity to -0.25 and the long-run elasticity to -0.5 would lead to a change in revenue of $538 million over the 23 years under the indexed fuel taxes scenario, 0.055% of the revenue over this time. Under the VMBUF scenario, that number increases to $710 million, still a very small percentage of the total revenue earnings.

elasticity in the fuel demand sector, and (3) those few studies that have tried to pin down the price elasticities of mileage/travel demand.

It should be noted, though, that our notion of behavioral responses to fuel price increases omits one key consideration: The effect that monitoring techniques for the VMBUF scenarios might have on mileage consumption. Because VMBUF systems are so new, there have been no estimates suggesting how having a transponder or electronic odometer in the car might affect one's decision to drive. It might be reasonable to suspect, though, that having such a constant reminder of being charged for the miles one drives would bring about some decrease in miles driven. This consideration should be kept in mind when reviewing our subsequent revenue projections for the VMBUF scenarios.

We measured the impact of inflation on gasoline/diesel consumption by finding the percentage increase in average price as the result of the tax increase. This percentage increase was multiplied by our short-run (-0.2) or long-run (-0.4) elasticity, which gave us a number that could be multiplied by our projected gasoline/diesel consumption to find the size of the decrease in consumption as the result of the tax. For the first six years of our projections (year 1=first tax increase plus the next five years after that), there was no perceived long-run elasticity effect. Starting in the seventh year, we had both a short-run impact and a long-run impact as the result of elasticity.

A final necessary consideration for the VMBUF scenarios, namely the inflation-indexed VMBUF, is how to convert a mileage taxation system into per-gallon price changes for purposes of elasticity calculations. Absent a more fine-tuned mechanism, we elected to use average fuel efficiencies. Each year's per-mile fee would be multiplied by the average number of miles per gallon from the beginning of the study period in order to get the average per-gallon price increase observed by motorists. To calculate the average fuel efficiency, we first separated vehicle miles traveled into miles traveled using gasoline and miles traveled using diesel. To do this, we used data on vehicle miles traveled from Table 7 of the Annual Energy Outlook 2012 and assumed that miles traveled by light duty vehicles fell into the gasoline category and miles traveled by commercial trucks and freight trucks fell into the diesel category. Then we divided vehicle miles traveled by the projected number of gallons of gasoline/diesel. This left us with two numbers, one for gasoline fuel efficiency and the other for diesel fuel efficiency. We then multiplied these fuel efficiencies by the per-mile tax rate to get a new effective "tax rate" which we could add to the average price. Then we divided the change in tax rate by the new average price to get the percentage change in price, which we multiplied by our projected elasticity (-0.2 for the short run and -0.4 for the long run). That quantity was then multiplied by the total vehicle miles traveled to find the total decrease in miles traveled, and thus the loss in potential revenue, as a result of the tax increase.

Section 2.2C. Other Relevant Assumptions

We also project consumption for alternative fuels such as E85 ethanol, compressed natural gas (CNG) and liquefied petroleum gases. Similar to the data for gasoline and diesel, this data comes from Table 37 of the Annual Energy Outlook 2012. Again, we sum up the total BTUs for each mode of highway transportation and then use Table 76 (Conversion Factors) to convert into gallons of each fuel. Using tax rates listed on the FHWA website, we computed the projected revenue assuming no change in these tax rates (Federal Excise Taxes on Highway Motor Fuels).[7] These revenue projections are then combined with the gasoline and diesel revenue projections to create a total fuel revenue projection.

The Highway Account also receives revenue from other taxes besides the motor fuel taxes. Currently, the Highway Account receives revenues from a tire tax, a tax on heavy vehicle use and from a sales tax on trucks and trailers (FHA Fact Sheets on Highway Provisions). Based upon data from the Highway Statistics 2010 Table FE-210, we gathered data on Highway Account revenues from these three additional excise taxes. We were able to find data from the 2012 Annual Energy Outlook on projected truck sales (Table 49, row 97). Using historical data on truck sales from Table 5.3 of the Transportation Energy Data Book, we could divide sales tax revenue by the number of truck sales to get an average sales tax (Transportation Energy Book, Chapter 5). We could then multiply that average tax rate by the projected truck sales in order to get a projected revenue value for truck sales. For the tire tax and the heavy vehicle use tax, we could not find data on future projections. Instead, we used historical revenue data to forecast

[7] For each of the fuel types listed on that page, we use the tax rate that goes into the Highway Account. We use the General Rate for the E85 tax (15.44 cents/gallon). For Compressed Natural Gas, the tax rate is listed per 1000 cubic feet. Footnote 8 states that 18.3 cents per 126.67 cubic feet since 126.67 cubic feet of CNG are assumed to be equivalent to 1 gallon of gasoline. We convert the 134.76/1000 cubic feet of CNG into cents per gallon by dividing 134.76 by 1000 and multiplying the resulting number by 126.67.

future revenue. We then summed these three projections of other excise tax future revenue to get a value for total future revenue from non-fuel taxes. These numbers would then be added to motor fuel revenue to get a total revenue projection for the Highway Account for each fiscal year.

An additional assumption we make is that, with a national retrofitting program, a VMBUF could be implemented starting in 2022. This is based on the fact that VMBUF pilot projects have forecast that an industry-wide retrofitting program, assuming practicable technological conversions, could be conducted over a 10-year period with federal support (Frisman 2012). Of course, technical or financial road-bumps during the phase-in period would delay implementation and thus reduce revenue potential from a VMBUF system. These factors should be considered by policymakers when determining the ultimate feasibility of a VMBUF program. It's also the case that retrofitting, rather than waiting for new cars already equipped with transponder technology to saturate the market, would nominally raise the cost of a nationwide VMBUF program. On the other hand, it would stimulate a significant commercial interest in improving and ultimately in winning contracts for OBU technology patents.

Finally, we assume that expenditures will only rise with inflation. This assumption is consistent with assumptions made by the Congressional Budget Office (CBO) in the Budget and Economic Outlook 2012-2022. In that report, the CBO assumes that spending will be restricted to no more than the federal obligations limit, which is set by Congress in each authorization bill, and that number is assumed to be adjusted each year for inflation (CBO Budget and Economic Outlook 2012-2022, p.126). We use a 2% rate of inflation for our cost estimates.

Section 3: Results

Section 3.1. Results from Historical Scenarios

Figure 8 shows the results of what would have happened to revenues since the last fuel tax rate revision if our multiple scenarios had been implemented at the time. It should be noted that until 1997, the additional revenue from the 4.3 cent tax increase signed into law in 1993 was channeled straight to general deficit reduction (Sullivan). Thus, our analysis picks up in 1997, when additional revenues would have actually been benefiting the HTF. The vertical axis of the graph shows cumulative surplus each year over what the historical revenues actually were during this period. Therefore, the horizontal axis can be thought of as the historical status quo. These results for the time being assume that motorists would have consumed the exact same quantities of fuel and mileage during the study period; the only change that occurs is with the taxing method.

As one can see, both the effects of post-1993 inflation and increases in fuel efficiency have been at work. Merely indexing the fuel tax to inflation in the 1993 reauthorization could have generated *$64.4 billion* in additional total revenue for the Highway Account, accounting for the 1993-1997 diversion of extra funds into the General Fund that would have taken place. This would have represented an 18.6% increase over the $345 billion in revenue actually collected during this time. Separately, a constant VMBUF set at revenue-neutral levels in 1993 could have garnered an additional *$17.7 billion* over the study period. This increase is by far the most modest of the scenarios but does suggest that, even before the era of the CAFE standards, mileage was theoretically a more efficient basis for user fee charges than fuel gallon consumption. Not surprisingly, combining the two prior proposals into an inflation-indexed VMBUF (still set at revenue-neutral levels for 1993) could have attracted an additional *$133.9 billion* in revenue during the post-General Fund diversion years, a 39% increase over the levels historically seen. We again stress that thus far no elasticities or significant behavioral changes to the differing tax levels have been included, though we will drop this assumption in our more salient future projections.

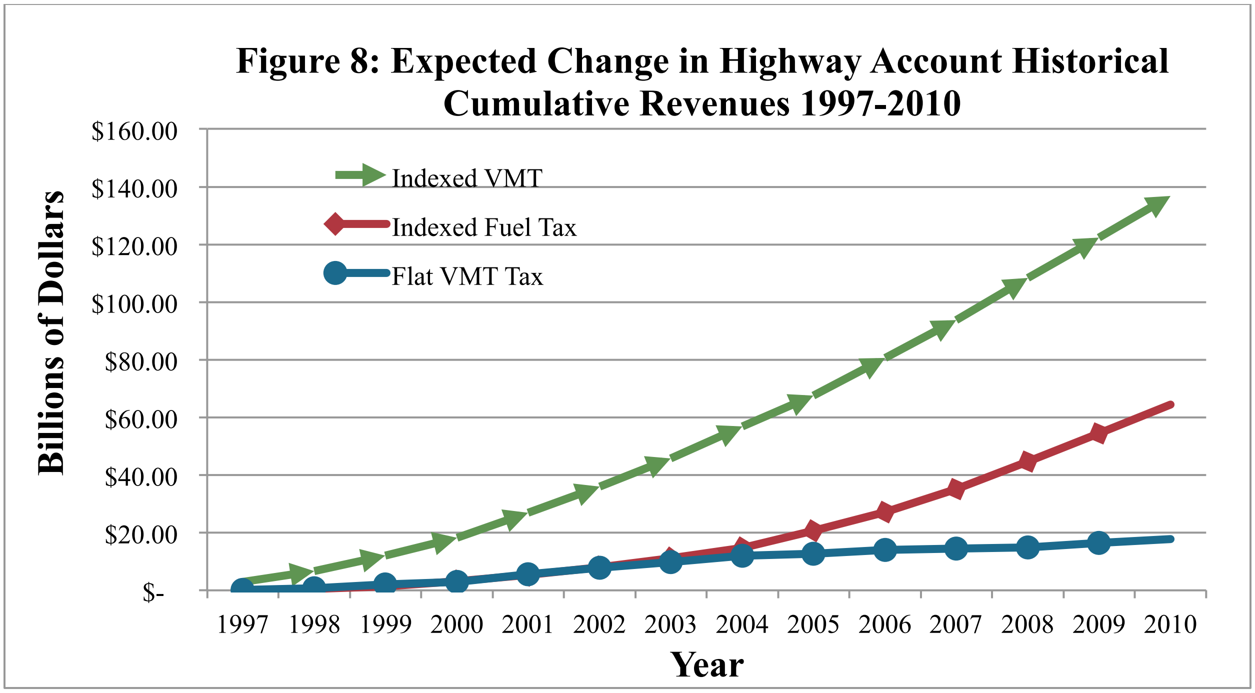


Figure 8: Expected Change in Highway Account Historical Cumulative Revenues 1997-2010

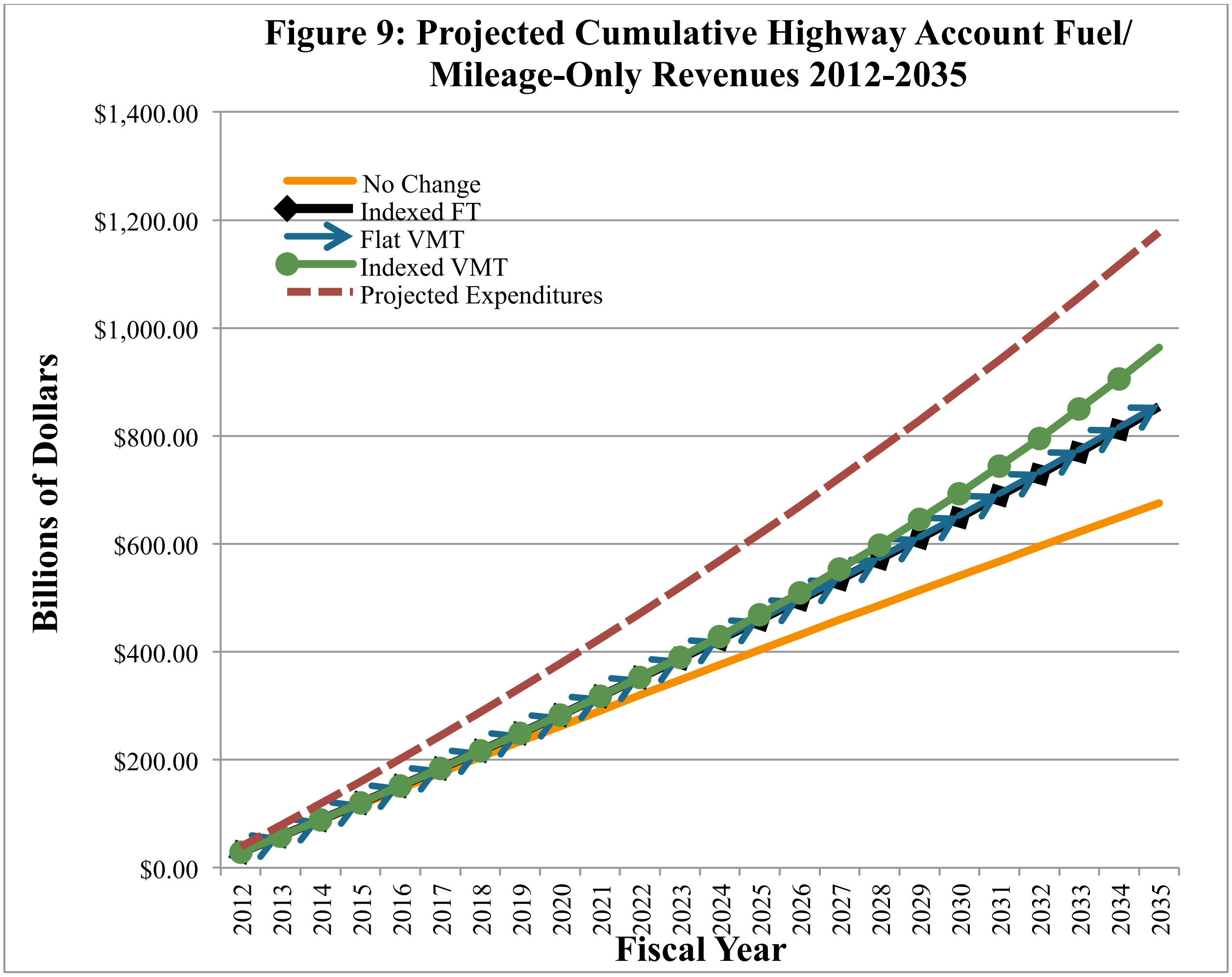
Source: Federal Highway Administration (for fuel consumption and VMT patterns)

That indexing a tax rate to inflation brings in more revenue is hardly surprising, but the most noteworthy comparison is between the indexed fuel tax and indexed VMBUF revenue streams. Using the same indexing, a mileage taxing scheme could theoretically have achieved significantly greater revenues than could traditional fuel taxes. This revenue gap is generated despite the fact that fuel efficiency increases over the study period were quite modest ("Table 4-23"). The potential for greater future revenue gaps between the tax systems is underscored by the fact that by 2025, CAFE standards will mandate that new cars achieve an average fuel efficiency of 54.5 miles per gallon for cars and light duty trucks, a dramatic increase from the current level of roughly 34 miles per gallon (NHTSA). In following sections we develop a more economically-nuanced approach for making future revenue projections with these policy scenarios against current-law projections, followed by a political and administrative analysis of the complications posed by these proposals.

Section 3.2. Results for Future Projections

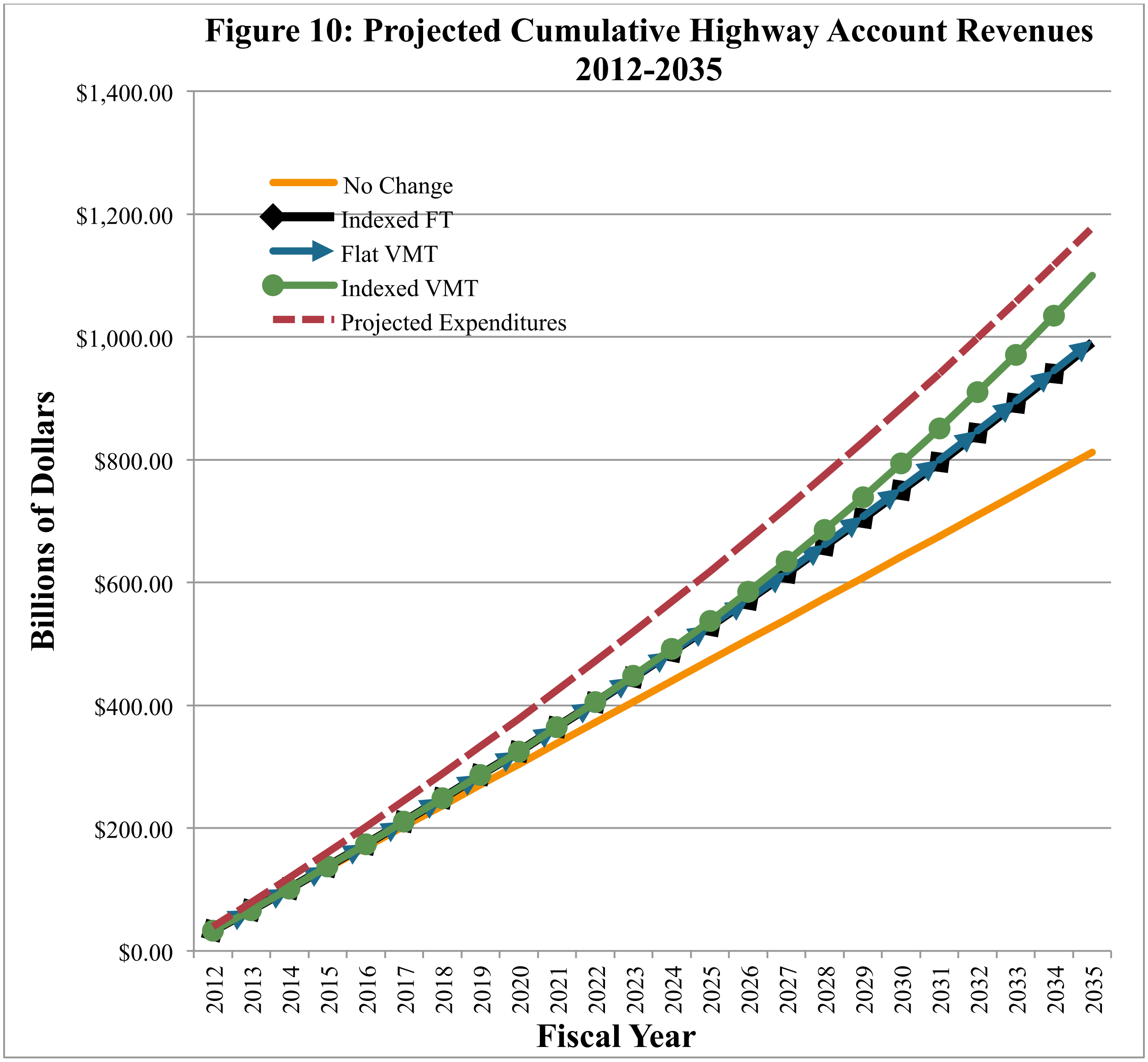
Before evaluating our various alternative financing scenarios, it is worth revisiting the projected fiscal imbalances under current law. Assuming that expenditures only increase with inflation, we project that revenues from current fuel tax rates will be a combined *$501.8 billion* short over the next 23 years. Making the more generous assumption that supplemental revenues from tire taxes truck sales, and other nominal sources will continue at their current pace, we can project that total Highway Account revenues will be inadequate by *$365.5 billion* through year 2035. Granting that General Fund dollars would be forced to supplement HTF spending, this can be seen as an additional $365.5 billion in federal debt over the next two decades. The questions for us in this section are: Do any of the alternative financing schemes make the Highway Account self-sustaining over the study period? What tax changes would be required under these scenarios to achieve balanced Highway Account budgets? What effects would these scenarios have on the individual motorist?

Figure 9 shows cumulative dollar amounts for projected Highway Account expenditures, fuel-only revenues from the current law/status quo policy, and fuel/mileage-only revenues from our three financing alternatives. A key point to remember is that, as noted earlier, due to the projected eight-year phase-in required for a national VMBUF, all three alternatives assume a simple indexing of fuel tax rates until year 2021. One can spot graphically the roughly $500 billion gap by year 2035 between projected fuel tax revenues and Highway Account expenditures under current law. Indexing the current fuel tax rates to inflation, however, mitigates the impending debt somewhat. By 2035 the gas tax would be 28.6 cents/gallon, and the diesel tax would be 38.6 cents/gallon, generating an extra *$178 billion* in total revenue. Note that this still leaves a $323 billion shortfall over the next 23 years. Meanwhile, a 2012 revenue-neutral VMBUF, equaling 1.04 cents/mile, would, if kept constant, generate an extra *$182 billion* over the status quo, still amounting to a total deficit of $319 billion. The gains from a VMBUF are largely because of aforementioned trends showing a modest increase in mileage demand versus a significant decline in projected gasoline demand. These revenue gains occur despite holding the mileage tax constant over 23 years and despite our inclusion of price elasticity of fuel. The final scenario shows an inflation-indexed VMBUF, starting at 1.04 cents/mile in year 2021, achieving a *$288 billion* gain over current law projections through year 2035.



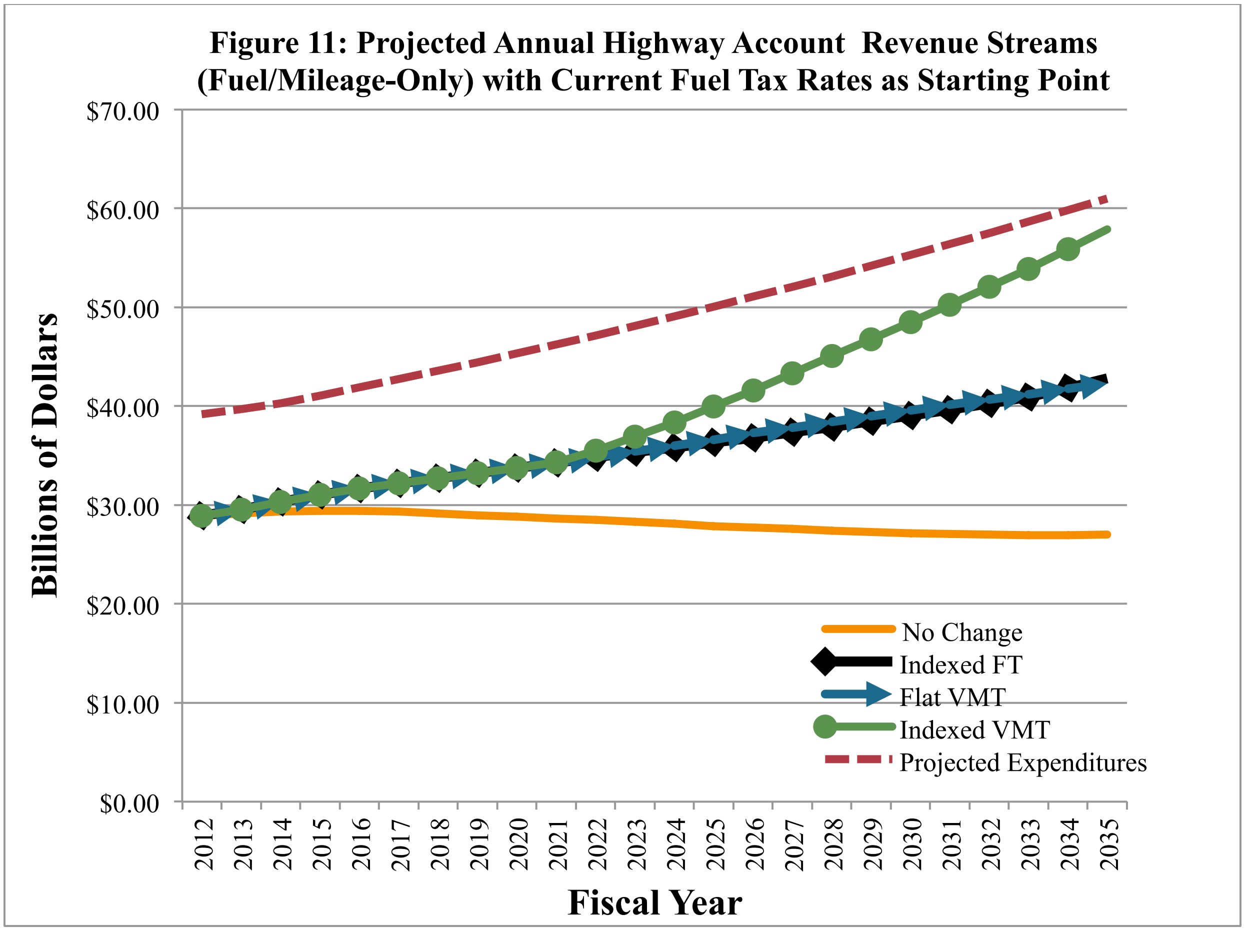
Source: Energy Information Administration 2012 Annual Energy Outlook, MAP-21 Legislation, Danton Noriega

When all other Highway Account revenue sources (tire taxes, heavy vehicle charges, etc.) are taken into consideration, as illustrated in Figure 10, the results are as follows: A *$186.7 billion* shortfall for the indexed fuel taxes; a *$183 billion* deficit for a constant VMBUF, and a noticeably-improved *$78 billion* deficit for an indexed VMBUF. **Appendix A** shows these *total* Highway Account revenue scenarios in table format.



Sources: Energy Information Administration 2012 Annual Energy Outlook, MAP-21 Legislation, Danton Noriega

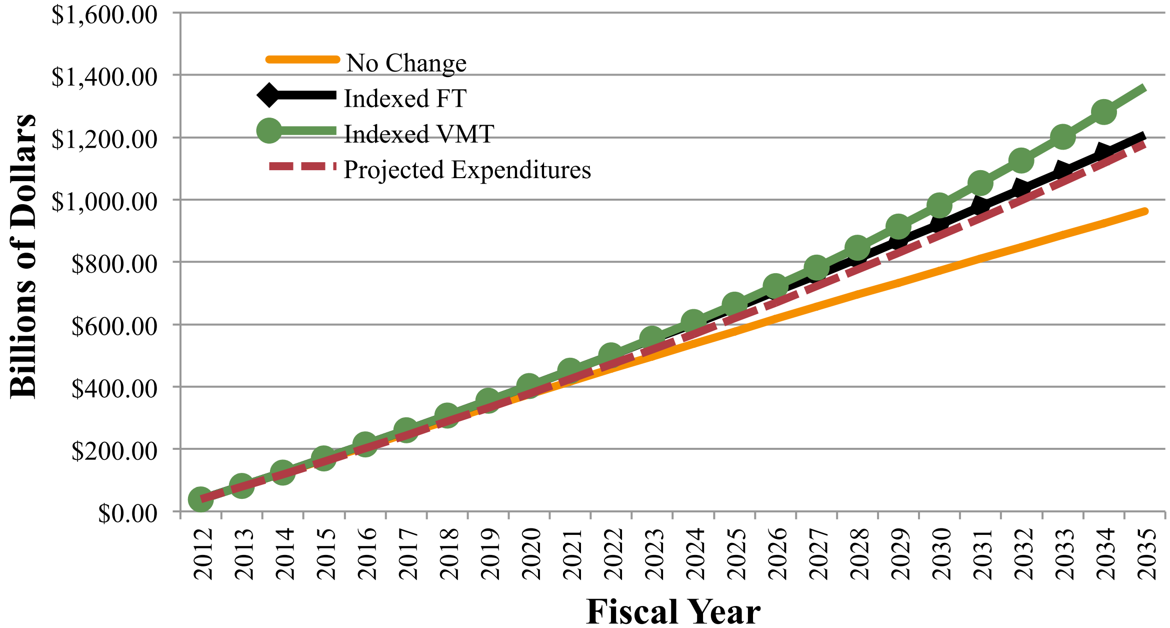
Figure 11 breaks down these trends on an annualized basis, only including fuel/mileage revenues. Even by year 2035, both the indexed fuel tax rate scenario and the constant VMBUF scenarios by themselves result in nearly $20 billion annual deficits. The indexed VMBUF scenario comes closest to an annual surplus by 2035 but is still insufficient. What should be clear then is that, if we assume current fuel tax rates as the starting point for future financing policy, none of our alternative scenarios achieves the stated goal of fiscal self-sufficiency for the Highway Account.



Source: Annual Energy Outlook 2012-Energy Information Administration, MAP-21 Legislation, Bureau of Labor Statistics CPI Calculator

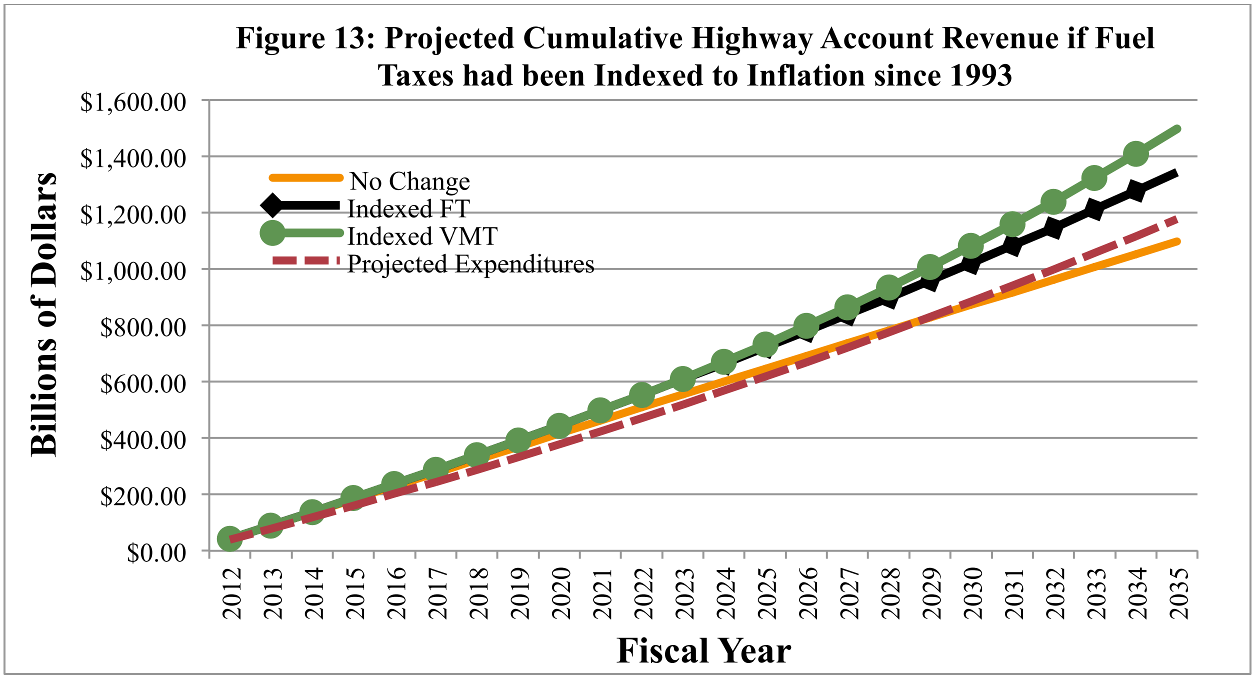
To provide a way forward, we took a look at using the fuel tax rates that would have been in effect presently if they had been indexed to inflation in 1993. Using our historical analysis from the previous section, we find that the gas tax rate would have been 25 cents/gallon (a 7-cent increase), while the diesel tax rate would have been 33 cents/gallon (a 9-cent increase). Next, we recalculate the same three alternative scenarios from before. If we take the inflation-adjusted fuel tax rates and continue to index them to inflation over the next 23 years, fuel revenues *by themselves*, shown in Figure 12, would give the Highway Account a *$30 billion surplus* and a *$167 billion in total surplus* (Figure 13) when paired with the supplementary sources of Highway Account revenue. If a constant VMBUF were implemented following the adjusted fuel tax rates, *$32 billion in total surplus* would result from mileage revenues alone (Figure 12), with *$168 billion in total surplus* when other Highway Account revenues are included (Figure 13). Finally, if we implement a VMBUF after the adjusted fuel tax rates and *then* indexed the VMBUF to inflation, the Highway Account would amass *$184 billion in total surplus* from mileage revenues alone (Figure 12) and *$321 billion in total surplus* through year 2035 (Figure 13).

Figure 12: Projected Cumulative Highway Account Fuel/Mileage-Only Revenue if Fuel Taxes Had Been Indexed to Inflation in 1993

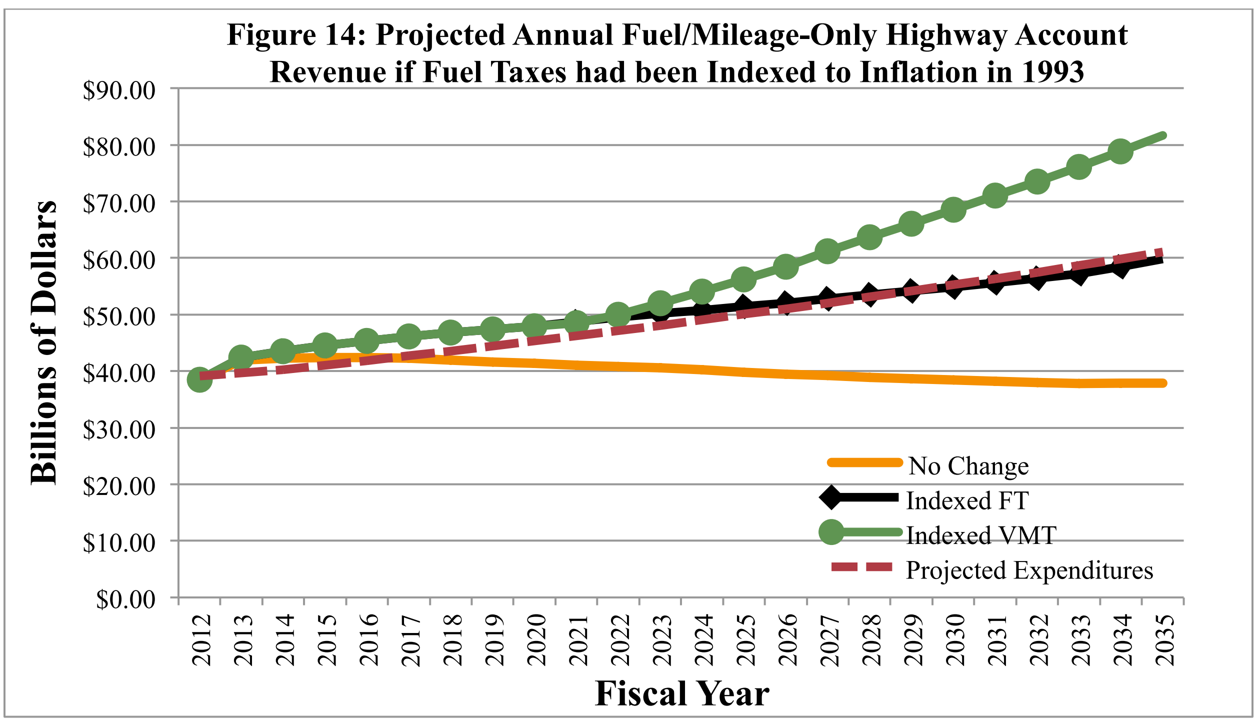


Source: Annual Energy Outlook 2012-Energy Information Administration, MAP-21 Legislation, Bureau of Labor Statistics CPI Calculator

What the results from Figure 13 indicate is that, with a modest increase in current fuel tax rates, the road to fiscal balance and additional investment from the HTF suddenly becomes more tenable. Namely, if motorists were asked to pay the same (real) amount today as they were in 1993, HTF solvency becomes quite achievable. At an annual pace, as shown in Figure 14, both a purely indexed fuel tax rate scenario and a flat VMBUF scenario, each not including supplementary Highway Account revenue sources, closely follow annual expenditures throughout the study period. Eventually, however, an indexed VMBUF scenario would generate more than $20 billion in annual surplus by 2035. **Appendix B**, which arguably tells the full story, shows these annualized revenue outcomes *including all Highway Account revenue sources*.



Source: Annual Energy Outlook 2012-Energy Information Administration, MAP-21 Legislation, Bureau of Labor Statistics CPI Calculator



Source: Annual Energy Outlook 2012-Energy Information Administration, Bureau of Labor Statistics CPI Calculator, MAP-21 Legislation

Having dealt with all of these revenue figures in the aggregate and in the abstract, we would like to illustrate the per-year and per-week effects that our surplus-generating scenarios would have on the average motorist. For our purposes, the average motorist is constituted as having the average fuel-efficiency vehicle, as deduced from the EIA's Annual Energy Outlook data (Annual Energy Outlook 2012). Assuming no changes whatsoever in highway financing, the average motorist will pay $96.14 in user fees in 2012 and $55.58 in 2035. By contrast, if fuel tax rates are raised to their 1993 purchasing power levels, then indexed for eight years, and followed by an indexed VMBUF starting in 2021, the average driver will pay $139.73 in user fees in 2012 and $276.63 in 2035. In year 2035, this is a *$221.05 difference and a $4.25 per-week difference from current law*. This difference represents the gap between the least-revenue scenario and the greatest revenue scenario and is therefore the most extreme change in tax incidence for the average motorist. Raising fuel tax rates to their 1993 purchasing power levels, indexing them for eight years, and implementing a flat VMBUF in year 2021 would raise average user fees by $145.63 ($2.80/week) in year 2035. It should be said that, during the 2021-2035 implementation of the flat VMBUF, average user fees would be increasing by less than $1.20 per year. Finally, raising fuel tax rates to their 1993 purchasing power levels and continuing to index those rates through year 2035 would increase the average user fees by $43.59 ($0.84/week) in year 2012, $58.71 ($1.13/week) in year 2021, and $75.84 ($1.46/week) in year 2035.

As we have shown, if tax rates are raised to where they would have been if indexed to inflation starting in 1993, the Highway Account would be in balance, and additional investment resources would be available. There would, however, be additional tax burdens facing the average motorist under the most successful revenue scenarios. Thus, seeing as an immediate 7 cent/gallon increase in the gas tax, for instance, may be too politically hostile in the current congressional environment, it is worth asking what the minimum necessary tax increases are in our scenarios in order to balance the Highway Account's costs and revenues. Put another way, what are the lowest tax increases we could implement to make the Highway Account self-sustaining once again?

According to our calculations, raising the gas tax by 3.5 cents/gallon and the diesel tax by 5.5 cents/gallon, followed by indexing both to inflation, would achieve Highway Account self-sufficiency and support current investment levels. If indexing fuel tax rates to inflation became a political non-starter, the gas and diesel tax rates would immediately need to go up by 9.5 and 11.5 cents/gallon, respectively, in order to balance costs and revenues through 2035. If policymakers decided to spread out these rate increases over time, a 5 cent/gallon increase could be implemented immediately with 3 cent/gallon increases in years 2018, 2023, 2028, and 2033 each. All of these scenarios assume that the Highway Account, not the Mass Transit Account, would receive all additional revenues as a result of the taxing policies.

Gauging the minimum necessary fuel tax rate changes is also necessary for our flat and indexed VMBUF scenarios. For a flat VMBUF, implemented in 2021, a 3 cent/gallon gas tax increase and 5 cent/gallon diesel tax increase, followed by eight years of inflation-indexing, could again achieve self-sufficiency. The subsequent, flat VMBUF could be as low as 1.30 cents/mile starting in year 2021. Alternatively, raising fuel tax rates to their 1993 purchasing power levels and indexing those for the first eight years would allow the subsequent VMBUF to be lower, at 1.16 cents/mile. What if the VMBUF itself were indexed starting in 2021? Current fuel tax rates would not have to change; they could merely be indexed to inflation. The VMBUF would then start at 1.17 cents/mile in 2021 and, through indexing, would balance the Highway Account's budget. Finally, raising fuel tax rates to their 1993 purchasing power levels, then indexing them for eight years, would achieve the same outcome but would allow the 2021 starting VMBUF rate to be 0.98 cents/mile.

Section 4: Vehicle Mileage-Based User Fee Issues

Section 4.1. Technological Limitations

More so than any other Highway Trust Fund revenue enhancer, a VMBUF will require an unprecedented investment in an advanced, nationwide technological infrastructure to collect mileage information from vehicles. The manpower and cost of installing an interoperable and national deployable system in every state that operates without impeding or slowing the flow of traffic will not only tax the resources of federal and, likely, state and local governments but be a long, time-consuming process that RAND estimates could take eight to 10 years to fully construct. (RAND Interim Report, 75)

In the Netherlands, where a successful nationwide VMBUF system is in the late stages of implementation, and in Oregon, where a wide-scale pilot project for a VMBUF system has been in place since 2006, drivers are charged a varying tax rate based on a variety of factors that include whether they drive during congested times (rush hour, holidays, etc.), whether they have fuel-efficient/hybrid vehicles, whether they drive on heavily travelled roads/highways, and whether they are residents of the state in which they are driving (Yglesias). These variations all contribute to the complexity of the technology needed for mileage collection. Although a VMBUF can be a flat fee in principle, it is these variations that enable it to achieve other desired policy goals, such as congestion easing and fuel efficiency incentives.

Technological options for collecting vehicle information required to calculate the VMBUF of individuals vary from basic odometer readings to in-vehicle GPS devices. Odometer checks would be a self-reported process that drivers would include with their annual registration to their state department of motor vehicles. Alternatively, odometer readings can be collected periodically during mandated state inspections. While this method would alleviate the need for the time-consuming installation of a new, nationwide technological infrastructure, it would also require more continued, sustained manpower to manually collect the information. The system would also be more susceptible to tampering with odometers and misreporting of information, whether intentional or accidental.

Another means of determining individual vehicle mileage without a significant technology investment is using fuel use estimations to project miles traveled. Using RFID chips or another form of short-range, over-the-air data technology installed at gas stations, a unique vehicle ID could be collected that contains the vehicle's emission class, average fuel economy, weight, make and model (Whitty 2007, p. 71). The vehicle characteristics would be paired with the amount of gasoline purchased to estimate the number of miles traveled and the corresponding fee would be charged to the driver along with the fuel purchase price. While this provides adequate protections against tampering, basing mileage on projections based on fuel is the most imprecise method of charging motorists per mile.

In Oregon and the Netherlands, a more precise means of collecting information is through the use of onboard units that connect to a vehicle's diagnostic port to collect fees. The device would track mileage based on vehicle speed over time that can be used to calculate the distance traveled. The device then wirelessly reports the collected information to a central data housing authority. The Dutch version of this system collects readings monthly and citizens receive a statement that resembles a cell phone bill (Yglesias).

Generally, these onboard units come in three categories. First is a basic transponder that provides only data on speed and distance, as well as time traveled. Second is a transponder with added cellular capabilities that allow variable rate taxing by region, specific counties or cities, congestion pricing or by certain features of a vehicle. This transponder can then report data via cellular signals to bill the driver directly or collect data and levy charges at gasoline pumps. Third, and the most advanced, is an onboard unit with high-resolution GPS with accuracy that would allow the most specificity in pricing with enough precision to price based on specific highways, be they primary or secondary roads. It would also allow refinement of revenue distribution for localities, as the precise number of miles traveled in a jurisdiction and on certain roads within a jurisdiction can be tracked. However, of all the technological options to collect information to levy a VMBUF, the cost of equipment and level of detail reported make the feasibility of GPS the weakest of them all.

The cost of investment in this technology also presents a significant roadblock to VMBUF implementation. An onboard unit in Oregon cost the state \$338 with \$55 to install the device in each vehicle. Gas pump collection devices to levy the VMBUF cost \$286 each. The total cost of the wide-scale trial in Oregon was \$33 million (including onboard units) (Whitty 2007, p. 11). This amount pales in comparison to the estimated \$2.5 billion it cost the Dutch government to install the infrastructure necessary to collect mileage information in their country (Yglesias). The Council of State Governments project that the baseline cost of a nationwide onboard unit system will be \$20 billion dollars, meaning that only a scenario in which fuel tax rates are first raised to 1993 purchasing power equivalents and are then followed by an inflation-indexed VMBUF starting in year 2021 would generate substantial surpluses over the study period.

A significant downside of the VMBUF financing alternative is the time of implementation of such a system and the lengthy phase-in period that will likely follow. The expectation is that if a VMBUF system is authorized by Congress, every new car produced for operation in the U.S. will come of the line with a transponder installed. However, the manpower, resources and training that will be required to install necessary transponders on the nearly 250 million passenger vehicles currently on U.S. roads will take a significant amount of time. As noted earlier, pilot projects expect that a national phase-in period would likely be eight to 10 years from the time implementation of a VMBUF system begins. There are also significant unanswered questions that include how to handle those vehicles on the road that do not have diagnostic ports for onboard units and how to avoid the likely backups at service stations that retrofit automobiles with the transponders.

Tampering and evasion of these fees has been a concern in many of the trials conducted internationally and domestically. In the initial small sample included in the Oregon trial, there were reports of tampering with devices to alter the rate at which miles were calculated or the amount charged per mile. Lawmakers in the state passed a penalty that forces violators to automatically revert to paying the gas tax and levying a fine that covers the cost of repairing or replacing the costly transponder that was modified. (RAND Final Report) Criticisms have also been raised due to the VMBUF system shifting the onus of tax from where it is now with the fuel tax – on wholesalers – to retail gas stations or directly with consumers increases the likelihood of tax evasion due to the larger base being responsible for collection and reporting. ("Implementable Strategies," p. 73)

Section 4.2. Political Realities

Governing in "panic mode" has become a trademark of Congress in recent years. Continuing resolutions funding federal government operations, raising the debt ceiling, and the fiscal cliff are only a handful of very prominent examples of how Congress and the president cannot agree until government is on the brink of disaster. Yet, even when action is taken, it is often simply to perpetuate the status quo. The age of bold, creative ideas coming from Congress has been interrupted by recent surges in party line politics. With this logic, it is not difficult to see why the gas tax has not been increased in 20 years. As a result, the HTF is soon becoming insolvent under current law, as you have witnessed in this paper. The lack of additional revenue into the HTF with the increase of fuel-efficient cars is one piece of the fiscal straits that are ahead for our nation's highways. The conservative Heritage Foundation estimates that only two-thirds of federal surface highway funds have actually been utilized for roads and highways. The rest goes to high-growth mass transit sectors as well as cultural and natural resource projects such as hiking trails and museums. For FY2010, these diversions totaled an estimated 38 percent of spending from the HTF. (Utt 2)

In the current Congress, any action that remotely appears as if taxes are being raised is quickly abandoned. The often-referenced Simpson-Bowles debt reduction plan called for a 15 cent-per-gallon increase, but that plea has been ignored. States have begun to take matters into their own hands. Maine, Nebraska, North Carolina and Wisconsin have all amended their state code to automatically increase the state gas tax as inflation increases (Institute on Taxation and Economic Policy). We have already pointed to Oregon's robust VMBUF pilot, but Iowa, Minnesota and Colorado are also actively participating in trials. However, indexing the gas tax is one that has not gained traction in Congress.

In a perfect storm that can be attributed to the rise of the Tea Party movement and the growing prominence of anti-tax SuperPACs, raising the gas tax, indexing it and creating any other form of new revenues for the Highway Trust Fund presents considerable political challenges. Grover Norquist, best known for his Americans for Tax Reform organization and its "No Tax" pledge, recently weighed in on indexing the gas tax, stating that linking the gas tax to inflation is violating a "no tax" pledge and referring to it as no more than a "job killing increase." ("Revamping gas tax violates pledge") With tax increases "off the table" in negotiations, the chances of the gas tax being indexed, let alone raised by Congress, appear dim.

Recently, there has been a glimmer of hope that a dialog would at least take place regarding the feasibility of a HTF revenue alternative in the form of VMBUFs. The National Surface Transportation Infrastructure Financing Commission stated in a 2009 report that "Direct user charges in the form of mileage-based user charges are the most viable and sustainable long-term 'user-pay' option for the federal government to raise adequate and appropriate revenues to provide the federal share of funding for the system" ("Paying Our Way," p. 154). Despite the recommendation being endorsed by the Secretary of Transportation, Ray LaHood, the Obama Administration has not endorsed a VMBUF system at the federal level.

In the summer of 2012 during the negotiations of MAP-21 (HR5972), the two-year transportation reauthorization bill, Congressman "Chip" Cravaack offered an amendment in the

House Appropriations committee that read as follows: “This amendment prohibits funding for DOT to research or implement a user fee based on Vehicle Miles Traveled.” (“House adds language to block development of mileage tax”). The amendment was adopted and ultimately passed the House as part of the larger authorization bill, but was not included in the final version signed by the president. Despite the amendment ultimately being excised, the fact that a prohibition on even researching VMBUF passed a house of Congress is an adverse sign for the future prospects of a VMBUF to be seriously considered by Congress. However, there are advocates on Capitol Hill; Congressman Earl Blumenauer and Senator Barbara Boxer in particular have continued a dialogue about a VMBUF. Education of members continues to be the best source of winning votes. Minnesota VMBUF advocates recently gave state legislators in the General Assembly the option to install a transponder temporarily in their cars as the first members of the pilot program and then provided them with access to the information collected by the state department of transportation (“States Explore New Ways to Tax Motorists for Road Repair”).

VMBUFs represent a dramatic new formula and method for collecting taxes that would require significant infrastructure additions to states and could significantly change the way states do business as well. States currently utilize the federal gas tax to tack on their own state gas tax. States would need to rethink their tax structure, and legislative action would likely be necessary in all states to determine whether to remain with a state gas tax or transition to a state VMBUF. Should Congress authorize a nationwide federal VMBUF, the biggest question remains: Who will manage this system and house the information? Would software companies be contracted at the local, state, or federal level? If a VMBUF program became a national reality in the next decade, there could be significant commercial gains to be made by contract bidders.

An additional political argument against a VMBUF program is that its fee structure may not necessarily incentivize fuel-efficient behavior the way that fuel taxes do (Frisman 2012). While not commenting on the broader public goal of encouraging fuel efficiency, we would simply reiterate from earlier in our report the point that, historically, fuel taxes were intended only pay for highway repairs and construction – not to penalize drivers for emissions. Furthermore, the debates over fuel efficiency have led to a significant polarization of highway finance politics. Eliminating the financial dependence on fuel taxes may end the currently antagonistic political relationships between highway finance advocates and environmentalists (O'Toole 2012, p. 10).

There is also the potential concern that changing the system of highway taxation will have significant distributional effects on motorists; a VMBUF system could be more regressive than the current fuel tax structure. A recent study, however, showed that the net effects of a VMBUF system are no more or less regressive than the current fuel tax system is. VMBUF "winners" would be drivers in rural areas with less fuel-efficient vehicles. "Losers" would likely be fuel-efficient motorists in urban areas or motorists in suburban areas with long commutes (Weatherford 2012). The same study found that any regressive features of fuel taxes or VMBUFs could be mitigated by simply raising the rates; lower income households have a higher price elasticity of travel and fuel demand and so would adjust their consumption patterns and endure less of the tax burden (Weatherford 2012, p. 67).

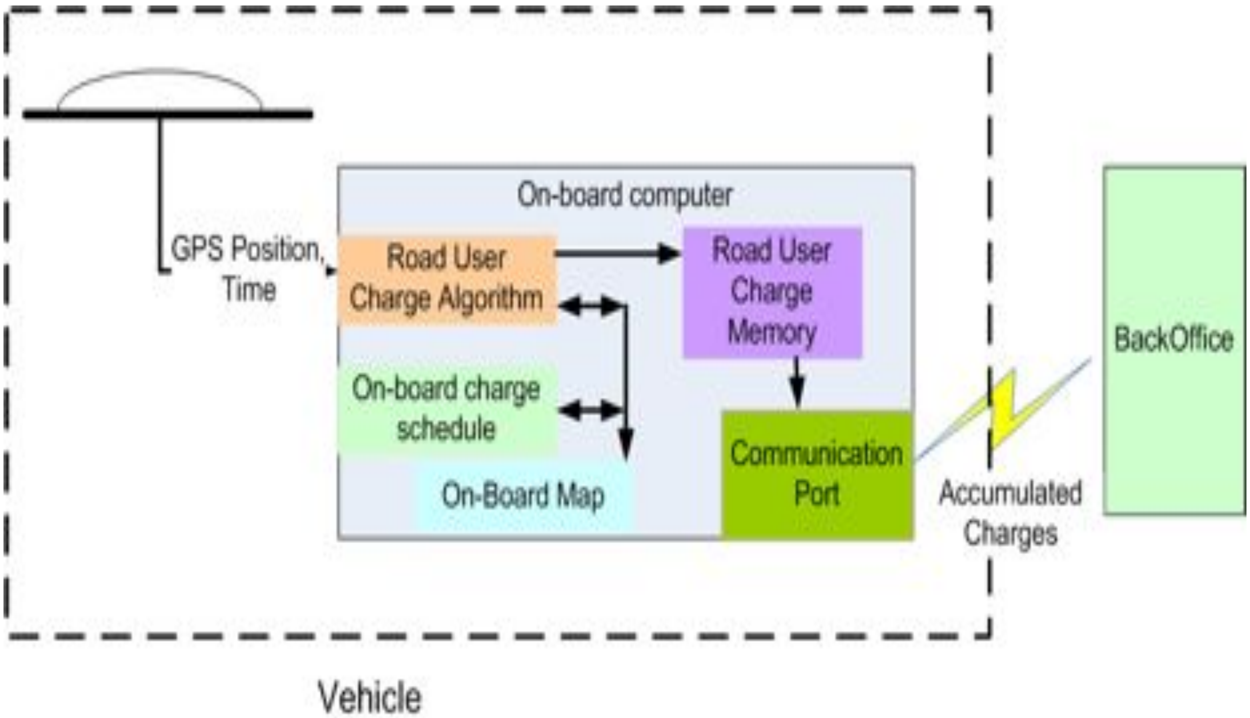
Section 4.3. Privacy Considerations

Perhaps the most oft-cited concern about a VMBUF system is the nature of the technology used to collect vehicle information in order to levy a miles-traveled fee. We have discussed the fact that advanced technological capabilities of various VMBUF systems and the location tracking feature on a number of onboard units have caused many critics of the VMBUF to have significant concerns over government as "big brother." With the development of such advanced tools for the collection of miles traveled, there can also be room to make government accountable for the information they will be able to access. Clear guidelines, limits, and intentions for use of the data must be communicated by the government or their contractor to citizens before transponders are installed in vehicles. Clear education must take place to ensure citizens that the government intends to only collect and report the absolute minimum amount of data needed to levy the mileage user fees and would delete the data once the information is used. (Bennett and Raab, p. 58)

In Oregon, routes traveled by vehicles are not tracked. The technology only records that drivers were in a certain jurisdiction using cellular technology akin to the RFID model, discussed earlier. However, even with the more precise high-resolution GPS, Minnesota researchers are using a less-intrusive onboard unit that still has the capability to charge for congestion pricing, exact primary/secondary road pricing and jurisdictional pricing without ever reporting the location of the vehicle. Transponders are designed to collect all information and calculate the amount owed based on the variables and send out only the dollar amount that should be charged to the driver. If states/localities need the data collected by onboard units to determine what roads were traveled most for equitable funding purposes, the memory and algorithm can be changed. If successful, this advance in technology will make it so that the driver can be charged for the most detailed variables based on driving habits, but none of those driving habits will be communicated beyond his/her vehicle.

Figure 15 indicates the basic framework for how OBUs and transponder systems would work. Positioning satellites communicate to the OBU within the car about the *current* location of the car, including potentially on what type of road and in what travel zone. The OBU then calculates fees based on the fee structure programmed by the jurisdiction (be it state or local VMBUF) and reports the accumulated fees to an office computer, either at a location like a fueling station, in which case fuel tax rates could be deducted from the posted fuel price before refueling, or at a tolling station. These establishments would then submit the motorists' bills to a centralized location that could collect ultimate payments via taxes or as part of annual vehicle inspections.

Figure 15: Implementing Distance-Based Road User Fees



Source: Enabling Near-Term Nationwide Implementation of Distance Based Road User Feed, ITS Institute, University of Minnesota

Section 5: Conclusion

This report investigates to what extent the Highway Trust Fund (HTF) has lost historical revenue and may miss out on future revenue as a result of its reliance on unindexed fuel taxes. We would first like to dispel any impression that this report somehow covers all the innovative financing ideas available to federal transportation policy officials. Notably, our report does not evaluate the impacts of congestion pricing or High Occupancy Toll (HOT) lane construction, both of which may be increasingly popular options for transportation officials at all levels. Depending on what one's goals for transportation policy are, our financing scenarios may seem quite limiting. Congestion pricing has the potential to alter driving patterns so that enormous productivity is not lost in eight-lane parking lots, while tolling may be a laudable way to make motorists pay for frequent use of specific, high-demand highways. More broadly, one might advocate for congestion pricing or increased tolls as a way of encouraging greater participation in mass transit systems or to incentivize Smart-Growth planning practices. Finally, there are many ways to increase the flexibility of a VMBUF, such as allowing for variable rates by region, by type of road, by time of day, and by type (fuel efficiency, for instance) of automobile. All of these variations on the VMBUF rate could address the aforementioned critiques of the VMBUF, and some may even enhance its revenue potential, but a full exploration of these policy intricacies is beyond the scope of this project.

Our project's normative goal is far less expansive and thus does not necessarily call for an array of financing techniques. Instead, our goal is to provide options that could restore the fiscal self-sufficiency of the federal HTF, and more specifically the HTF's Highway Account. The deficiencies in the Highway Account's financing scheme are twofold: Federal fuel tax rates have not been altered to reflect the economy-wide or gas price-specific inflation that has taken place since 1993, and motorists are being charged for highway use by the gallon of fuel used in an increasingly fuel-efficient landscape. It is these two problems that we attempted to address with our alternative financing scenarios. Would simply indexing current fuel tax rates to inflation correct for the Highway Account's projected fiscal imbalance, or is charging motorists by the gallon of fuel consumed a fundamentally flawed arrangement?

In analyzing historical data and the hypothetical potential of our various scenarios, it became clear that both inflation and modestly higher fuel efficiencies since 1993 have handicapped the Highway Account's revenue stream. Indexing fuel tax rates to inflation would have brought in an additional $64 billion in revenue between 1997-2010, while indexing an otherwise revenue neutral vehicle mileage-based user fee (VMBUF) would have brought in $138 billion more than what the Highway Account actually received during these years. The historical attractiveness of the VMBUF is mitigated by the administrative difficulties it surely would have incurred at the time, so the meat of the policy comparisons took place when we projected potential future revenues. After taking into account projected fuel-efficiency standards, the administrative phase-in period for a VMBUF system, and price elasticities of fuel demand, we evaluated the revenue potential from the present day through year 2035 of our three alternative financing scenarios.

All three scenarios make significant gains over the projected $365.5 billion in cumulative debt under status quo policies. Indexing current fuel tax rates would halve the projected deficit by 2035, while an inflation-indexed VMBUF system could nearly wipe out all the projected deficit through year 2035. If current fuel tax rates were adjusted to reflect the purchasing power they had in 1993, all three scenarios would generate revenues for the Highway Account above and beyond what is necessary to sustain current investment levels. The surplus would be as large as $321 billion if a VMBUF were indexed to inflation, representing the best-case fiscal scenario. Some administrative costs would surely be incurred if such a system were pursued nationally, but this degree of surplus is nonetheless impressive. Furthermore, unlike other federal trust funds, HTF surpluses would not automatically just cycle through the rest of the federal government. Subject to the congressional authorization and appropriations processes, these surpluses could be used to fund additional construction and maintenance projects and stimulate the economy. As past AED researchers found, a dollar in infrastructure spending generates a $1.92 economic impact over two years and a $3.21 impact over 20 years ("The Economic Impact and Financing of Infrastructure Spending"). Thus, the idea that a projected $365 billion in debt could be transformed into $321 billion in surplus investment through year 2035 should not be taken lightly.

Our report has described the several obstacles to both sets of financing alternatives. First, a generic opposition to increased tax revenue complicates this entire discussion. When one considers, though, that motorists are paying less federally per mile of highway use than at any point since the Federal-Aid Interstate Highway Act despite a massively more complicated highway infrastructure, perhaps the opposition would become less fervent. It's also the case that fuel taxes are among the few taxes that are not registered as percentages but rather as cent/unit (gallon) taxes, which leads to a loss in purchasing power if rates are not adjusted regularly. Given that gas prices have risen dramatically since the last gas tax rate revision, the federal gas tax is a dramatically lower percentage of gasoline sales than it was in 1993. Opposition to increases in fuel tax rates might also subside when such a policy is presented as lifting future debt burdens off the General Fund and as making the HTF more self-sustaining.

Opposition to a VMBUF system may be more potent. The basic infrastructure of a VMBUF usually involves some kind of in-car monitoring technology, which may provoke genuine concerns about governmental intrusion of privacy. We have outlined potential ways for policy officials to alleviate these concerns within the VMBUF framework that have been tested at the state level. Other concerns include the fear of a VMBUF being socio-economically regressive, how a VMBUF might be implemented at the state and local level, and whether a

VMBUF removes a powerful incentive to purchase more fuel-efficient automobiles. For reasons described above, these are all concerns that must be addressed but importantly *can* be addressed within the eight- to 10-year phase-in period that we allow for in our projections modeling.

The critical point is that, for a VMBUF to be most effective, the planning and conversations need to start now. Because of the phase-in period and the more general mathematical logic, we recommend that inflation-indexed fuel tax rates be implemented as soon as possible – either as part of contemporary tax reform or for the next federal highway reauthorization in 2014. Furthermore, the starting point for these rates should be the rates that would have occurred if fuel taxes had been indexed to inflation in 1993. Gains from such a policy would be immediate and would allow for the discussion and potential implementation of a VMBUF to be planned. In eight to 10 years, the country may feel less angst with a VMBUF system, but, if not, at least the HTF would be on the way toward greater fiscal solvency than is currently projected. While many transportation policy experts are understandably focused on the year-to-year actions of Congress, our report hopes to begin a conversation about longer-term financial viability. The Highway Trust Fund was designed to be a fiscally self-sustaining way to fund federal aid for highway projects, and with some key institutional reforms, it can remain so into the future.

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Section 7: Appendices

Appendix A: Annual Revenue Scenarios with Current Fuel Tax Rates As Starting Points

Appendix A Table 1: No Change under Current Law

Year	Fuel and Other Revenue	Projected Expenditures	Difference between Total Rev and Expenditures
2012	$32,828,701,004.89	$39,143,583,000.00	-$6,314,881,995.11
2013	$33,318,015,963.68	$39,699,000,000.00	-$6,380,984,036.32
2014	$33,888,827,863.97	$40,256,000,000.00	-$6,367,172,136.03
2015	$34,254,451,517.42	$41,061,120,000.00	-$6,806,668,482.58
2016	$34,225,782,478.68	$41,882,342,400.00	-$7,656,559,921.32
2017	$34,067,580,989.36	$42,719,989,248.00	-$8,652,408,258.64
2018	$33,960,594,325.50	$43,574,389,032.96	-$9,613,794,707.46
2019	$33,900,662,857.08	$44,445,876,813.62	-$10,545,213,956.54
2020	$33,775,477,758.85	$45,334,794,349.89	-$11,559,316,591.05
2021	$33,721,924,098.46	$46,241,490,236.89	-$12,519,566,138.43
2022	$33,858,910,722.49	$47,166,320,041.63	-$13,307,409,319.13
2023	$33,972,157,982.24	$48,109,646,442.46	-$14,137,488,460.22
2024	$33,909,465,999.11	$49,071,839,371.31	-$15,162,373,372.20
2025	$33,760,920,010.25	$50,053,276,158.74	-$16,292,356,148.49
2026	$33,686,417,681.78	$51,054,341,681.91	-$17,367,924,000.13
2027	$33,694,984,144.80	$52,075,428,515.55	-$18,380,444,370.75
2028	$33,681,877,234.79	$53,116,937,085.86	-$19,435,059,851.07
2029	$33,645,605,802.95	$54,179,275,827.58	-$20,533,670,024.63
2030	$33,662,658,476.28	$55,262,861,344.13	-$21,600,202,867.84
2031	$33,732,091,007.63	$56,368,118,571.01	-$22,636,027,563.38
2032	$33,824,726,288.28	$57,495,480,942.43	-$23,670,754,654.15
2033	$34,038,212,864.50	$58,645,390,561.28	-$24,607,177,696.78
2034	$34,311,128,852.16	$59,818,298,372.50	-$25,507,169,520.35
2035	$34,538,768,778.76	$61,014,664,339.95	-$26,475,895,561.19
Total	$812,259,944,703.90	$1,177,790,464,337.69	**-$365,530,519,633.79**

Appendix A Table 2: Indexed Fuel Taxes under Current Law

Year	Fuel and Other Revenue	Projected Expenditures	Difference between Total Rev and Expenditures
2012	$32,828,701,004.89	$39,143,583,000.00	-$6,314,881,995.11
2013	$33,747,482,494.01	$39,699,000,000.00	-$5,951,517,505.99
2014	$34,906,550,052.31	$40,256,000,000.00	-$5,349,449,947.69
2015	$35,874,078,345.96	$41,061,120,000.00	-$5,187,041,654.04
2016	$36,456,121,211.59	$41,882,342,400.00	-$5,426,221,188.41
2017	$36,911,227,097.26	$42,719,989,248.00	-$5,808,762,150.74
2018	$37,475,212,937.46	$43,574,389,032.96	-$6,099,176,095.50
2019	$38,115,083,494.11	$44,445,876,813.62	-$6,330,793,319.51
2020	$38,690,094,678.89	$45,334,794,349.89	-$6,644,699,671.01
2021	$39,329,025,326.41	$46,241,490,236.89	-$6,912,464,910.47
2022	$40,183,099,492.20	$47,166,320,041.63	-$6,983,220,549.43
2023	$41,008,606,097.73	$48,109,646,442.46	-$7,101,040,344.73
2024	$41,639,309,833.59	$49,071,839,371.31	-$7,432,529,537.72
2025	$42,177,408,486.00	$50,053,276,158.74	-$7,875,867,672.73
2026	$42,793,450,537.40	$51,054,341,681.91	-$8,260,891,144.51
2027	$43,504,791,206.46	$52,075,428,515.55	-$8,570,637,309.09
2028	$44,172,680,335.42	$53,116,937,085.86	-$8,944,256,750.44
2029	$44,830,178,831.08	$54,179,275,827.58	-$9,349,096,996.50
2030	$45,543,447,115.84	$55,262,861,344.13	-$9,719,414,228.29
2031	$46,312,959,401.65	$56,368,118,571.01	-$10,055,159,169.36
2032	$47,118,724,866.83	$57,495,480,942.43	-$10,376,756,075.60
2033	$48,014,767,838.02	$58,645,390,561.28	-$10,630,622,723.26
2034	$49,154,717,072.07	$59,818,298,372.50	-$10,663,581,300.44
2035	$50,309,485,457.92	$61,014,664,339.95	-$10,705,178,882.03
Total	$991,097,203,215.10	$1,177,790,464,337.69	**-$186,693,261,122.59**

Appendix A Table 3: Indexed FT + 2021 Flat VMBUF under Current Law

Year	Fuel and Other Revenue	Projected Expenditures	Difference between Total Rev and Expenditures
2012	$32,828,701,004.89	$39,143,583,000.00	-$6,314,881,995.11
2013	$33,747,482,494.01	$39,699,000,000.00	-$5,951,517,505.99
2014	$34,906,550,052.31	$40,256,000,000.00	-$5,349,449,947.69
2015	$35,874,078,345.96	$41,061,120,000.00	-$5,187,041,654.04
2016	$36,456,121,211.59	$41,882,342,400.00	-$5,426,221,188.41
2017	$36,911,227,097.26	$42,719,989,248.00	-$5,808,762,150.74
2018	$37,475,212,937.46	$43,574,389,032.96	-$6,099,176,095.50
2019	$38,115,083,494.11	$44,445,876,813.62	-$6,330,793,319.51
2020	$38,690,094,678.89	$45,334,794,349.89	-$6,644,699,671.01
2021	$39,355,214,313.23	$46,241,490,236.89	-$6,886,275,923.66
2022	$40,183,374,161.03	$47,166,320,041.63	-$6,982,945,880.60
2023	$41,040,511,892.37	$48,109,646,442.46	-$7,069,134,550.09
2024	$41,794,204,385.62	$49,071,839,371.31	-$7,277,634,985.69
2025	$42,497,137,196.25	$50,053,276,158.74	-$7,556,138,962.48
2026	$43,254,973,952.95	$51,054,341,681.91	-$7,799,367,728.96
2027	$43,975,607,953.98	$52,075,428,515.55	-$8,099,820,561.56
2028	$44,696,300,170.61	$53,116,937,085.86	-$8,420,636,915.25
2029	$45,400,107,071.15	$54,179,275,827.58	-$8,779,168,756.43
2030	$46,103,221,005.03	$55,262,861,344.13	-$9,159,640,339.10
2031	$46,798,527,454.52	$56,368,118,571.01	-$9,569,591,116.49
2032	$47,486,335,334.88	$57,495,480,942.43	-$10,009,145,607.55
2033	$48,253,741,550.80	$58,645,390,561.28	-$10,391,649,010.48
2034	$49,096,275,197.51	$59,818,298,372.50	-$10,722,023,174.99
2035	$49,840,263,186.31	$61,014,664,339.95	-$11,174,401,153.65
Total	$994,780,346,142.71	$1,177,790,464,337.69	**-$183,010,118,194.98**

Appendix A Table 4: Indexed FT + 2021 Indexed VMBUF under Current Law

Year	Fuel and Other Revenue	Projected Expenditures	Difference between Total Rev and Expenditures
2012	$32,828,701,004.89	$39,143,583,000.00	-$6,314,881,995.11
2013	$33,747,482,494.01	$39,699,000,000.00	-$5,951,517,505.99
2014	$34,906,550,052.31	$40,256,000,000.00	-$5,349,449,947.69
2015	$35,874,078,345.96	$41,061,120,000.00	-$5,187,041,654.04
2016	$36,456,121,211.59	$41,882,342,400.00	-$5,426,221,188.41
2017	$36,911,227,097.26	$42,719,989,248.00	-$5,808,762,150.74
2018	$37,475,212,937.46	$43,574,389,032.96	-$6,099,176,095.50
2019	$38,115,083,494.11	$44,445,876,813.62	-$6,330,793,319.51
2020	$38,690,094,678.89	$45,334,794,349.89	-$6,644,699,671.01
2021	$39,408,435,392.73	$46,241,490,236.89	-$6,833,054,844.16
2022	$40,851,928,868.00	$47,166,320,041.63	-$6,314,391,173.62
2023	$42,540,699,538.65	$48,109,646,442.46	-$5,568,946,903.81
2024	$44,172,610,590.65	$49,071,839,371.31	-$4,899,228,780.66
2025	$45,805,332,374.21	$50,053,276,158.74	-$4,247,943,784.52
2026	$47,546,116,271.30	$51,054,341,681.91	-$3,508,225,410.61
2027	$49,457,223,503.12	$52,075,428,515.55	-$2,618,205,012.43
2028	$51,309,253,497.73	$53,116,937,085.86	-$1,807,683,588.13
2029	$53,139,083,817.31	$54,179,275,827.58	-$1,040,192,010.27
2030	$55,017,295,252.19	$55,262,861,344.13	-$245,566,091.93
2031	$56,936,360,427.72	$56,368,118,571.01	$568,241,856.71
2032	$58,898,782,570.43	$57,495,480,942.43	$1,403,301,628.00
2033	$60,988,208,897.86	$58,645,390,561.28	$2,342,818,336.59
2034	$63,233,519,451.23	$59,818,298,372.50	$3,415,221,078.72
2035	$65,430,923,522.57	$61,014,664,339.95	$4,416,259,182.62
Total	$1,099,740,325,292.17	$1,177,790,464,337.69	**-$78,050,139,045.52**

Appendix B: Annual Revenue Scenarios If Fuel Tax Rates Had Been Indexed to Inflation in 1993

Appendix B Table 1: No Change if Fuels Taxes Indexed to Inflation from 1993

Year	Fuel and Other Revenue	Projected Expenditures	Difference between Total Rev and Expenditures
2012	$42,391,495,922.19	$39,143,583,000.00	$3,247,912,922.19
2013	$46,029,358,170.13	$39,699,000,000.00	$6,330,358,170.13
2014	$46,628,188,616.18	$40,256,000,000.00	$6,372,188,616.18
2015	$47,026,574,328.18	$41,061,120,000.00	$5,965,454,328.18
2016	$46,992,242,862.85	$41,882,342,400.00	$5,109,900,462.85
2017	$46,788,011,281.59	$42,719,989,248.00	$4,068,022,033.59
2018	$46,560,507,104.92	$43,574,389,032.96	$2,986,118,071.96
2019	$46,262,185,206.32	$44,445,876,813.62	$1,816,308,392.70
2020	$45,985,979,537.40	$45,334,794,349.89	$651,185,187.51
2021	$45,801,267,283.91	$46,241,490,236.89	-$440,222,952.98
2022	$45,849,426,573.10	$47,166,320,041.63	-$1,316,893,468.52
2023	$45,857,612,057.78	$48,109,646,442.46	-$2,252,034,384.68
2024	$45,656,613,417.54	$49,071,839,371.31	-$3,415,225,953.77
2025	$45,360,700,476.74	$50,053,276,158.74	-$4,692,575,682.00
2026	$45,146,230,368.78	$51,054,341,681.91	-$5,908,111,313.13
2027	$45,031,379,320.37	$52,075,428,515.55	-$7,044,049,195.18
2028	$44,871,568,748.55	$53,116,937,085.86	-$8,245,368,337.30
2029	$44,703,918,603.21	$54,179,275,827.58	-$9,475,357,224.37
2030	$44,593,028,108.58	$55,262,861,344.13	-$10,669,833,235.55
2031	$44,537,993,334.41	$56,368,118,571.01	-$11,830,125,236.60
2032	$44,517,237,033.97	$57,495,480,942.43	-$12,978,243,908.46
2033	$44,593,240,754.08	$58,645,390,561.28	-$14,052,149,807.20
2034	$44,862,875,754.91	$59,818,298,372.50	-$14,955,422,617.60
2035	$45,117,679,407.70	$61,014,664,339.95	-$15,896,984,932.26
Total	$1,091,165,314,273.36	$1,177,790,464,337.69	**-$86,625,150,064.33**

Appendix B Table 2: Indexed Fuel Taxes if Fuel Taxes Indexed to Inflation from 1993

Year	Fuel and Other Revenue	Projected Expenditures	Difference between Total Rev and Expenditures
2012	$42,391,495,922.19	$39,143,583,000.00	$3,247,912,922.19
2013	$46,644,140,111.48	$39,699,000,000.00	$6,945,140,111.48
2014	$48,084,577,140.42	$40,256,000,000.00	$7,828,577,140.42
2015	$49,343,710,659.17	$41,061,120,000.00	$8,282,590,659.17
2016	$50,182,438,624.23	$41,882,342,400.00	$8,300,096,224.23
2017	$50,854,782,857.55	$42,719,989,248.00	$8,134,793,609.55
2018	$51,586,042,022.98	$43,574,389,032.96	$8,011,652,990.02
2019	$52,263,181,736.86	$44,445,876,813.62	$7,817,304,923.24
2020	$52,972,177,636.25	$45,334,794,349.89	$7,637,383,286.36
2021	$53,766,962,195.54	$46,241,490,236.89	$7,525,471,958.65
2022	$54,828,872,470.79	$47,166,320,041.63	$7,662,552,429.16
2023	$55,843,346,099.39	$48,109,646,442.46	$7,733,699,656.93
2024	$56,620,837,271.18	$49,071,839,371.31	$7,548,997,899.87
2025	$57,292,694,017.71	$50,053,276,158.74	$7,239,417,858.97
2026	$58,050,725,679.28	$51,054,341,681.91	$6,996,383,997.37
2027	$58,925,181,174.84	$52,075,428,515.55	$6,849,752,659.29
2028	$59,723,123,666.74	$53,116,937,085.86	$6,606,186,580.88
2029	$60,530,974,483.76	$54,179,275,827.58	$6,351,698,656.19
2030	$61,398,150,340.17	$55,262,861,344.13	$6,135,288,996.04
2031	$62,325,601,061.12	$56,368,118,571.01	$5,957,482,490.11
2032	$63,305,131,219.79	$57,495,480,942.43	$5,809,650,277.36
2033	$64,336,820,984.88	$58,645,390,561.28	$5,691,430,423.60
2034	$65,823,889,753.92	$59,818,298,372.50	$6,005,591,381.41
2035	$67,380,570,247.87	$61,014,664,339.95	$6,365,905,907.92
Total	$1,344,475,427,378.10	$1,177,790,464,337.69	**$166,684,963,040.41**

Appendix B Table 3: Indexed FT + 2021 Flat VMBUF if Fuel Taxes Indexed to Inflation from 1993

Year	Fuel and Other Revenue	Projected Expenditures	Difference between Total Rev and Expenditures
2012	$42,391,495,922.19	$39,143,583,000.00	$3,247,912,922.19
2013	$46,644,140,111.48	$39,699,000,000.00	$6,945,140,111.48
2014	$48,084,577,140.42	$40,256,000,000.00	$7,828,577,140.42
2015	$49,343,710,659.17	$41,061,120,000.00	$8,282,590,659.17
2016	$50,182,438,624.23	$41,882,342,400.00	$8,300,096,224.23
2017	$50,854,782,857.55	$42,719,989,248.00	$8,134,793,609.55
2018	$51,586,042,022.98	$43,574,389,032.96	$8,011,652,990.02
2019	$52,263,181,736.86	$44,445,876,813.62	$7,817,304,923.24
2020	$52,972,177,636.25	$45,334,794,349.89	$7,637,383,286.36
2021	$53,458,317,431.03	$46,241,490,236.89	$7,216,827,194.14
2022	$54,382,585,251.65	$47,166,320,041.63	$7,216,265,210.03
2023	$55,469,013,223.89	$48,109,646,442.46	$7,359,366,781.43
2024	$56,461,354,679.43	$49,071,839,371.31	$7,389,515,308.12
2025	$57,422,028,618.20	$50,053,276,158.74	$7,368,752,459.47
2026	$58,446,136,395.71	$51,054,341,681.91	$7,391,794,713.80
2027	$59,200,910,437.92	$52,075,428,515.55	$7,125,481,922.37
2028	$60,090,289,106.23	$53,116,937,085.86	$6,973,352,020.37
2029	$61,028,391,317.70	$54,179,275,827.58	$6,849,115,490.13
2030	$61,957,528,168.15	$55,262,861,344.13	$6,694,666,824.02
2031	$62,870,730,657.03	$56,368,118,571.01	$6,502,612,086.02
2032	$63,771,305,082.42	$57,495,480,942.43	$6,275,824,139.99
2033	$64,741,008,377.99	$58,645,390,561.28	$6,095,617,816.71
2034	$65,816,986,779.61	$59,818,298,372.50	$5,998,688,407.11
2035	$66,784,180,465.28	$61,014,664,339.95	$5,769,516,125.32
Total	$1,346,223,312,703.37	$1,177,790,464,337.69	**$168,432,848,365.68**

Appendix B Table 4: Indexed FT + 2021 Indexed VMBUF if Fuel Taxes Indexed to Inflation from 1993

Year	Fuel and Other Revenue	Projected Expenditures	Difference between Total Rev and Expenditures
2012	$42,391,495,922.19	$39,143,583,000.00	$3,247,912,922.19
2013	$46,644,140,111.48	$39,699,000,000.00	$6,945,140,111.48
2014	$48,084,577,140.42	$40,256,000,000.00	$7,828,577,140.42
2015	$49,343,710,659.17	$41,061,120,000.00	$8,282,590,659.17
2016	$50,182,438,624.23	$41,882,342,400.00	$8,300,096,224.23
2017	$50,854,782,857.55	$42,719,989,248.00	$8,134,793,609.55
2018	$51,586,042,022.98	$43,574,389,032.96	$8,011,652,990.02
2019	$52,263,181,736.86	$44,445,876,813.62	$7,817,304,923.24
2020	$52,972,177,636.25	$45,334,794,349.89	$7,637,383,286.36
2021	$53,559,621,219.08	$46,241,490,236.89	$7,318,130,982.19
2022	$55,356,404,439.62	$47,166,320,041.63	$8,190,084,398.00
2023	$57,609,819,596.39	$48,109,646,442.46	$9,500,173,153.93
2024	$59,834,312,410.07	$49,071,839,371.31	$10,762,473,038.76
2025	$62,099,243,775.53	$50,053,276,158.74	$12,045,967,616.80
2026	$64,501,886,986.99	$51,054,341,681.91	$13,447,545,305.08
2027	$67,308,100,341.74	$52,075,428,515.55	$15,232,671,826.19
2028	$69,917,205,700.81	$53,116,937,085.86	$16,800,268,614.95
2029	$72,439,617,559.16	$54,179,275,827.58	$18,260,341,731.59
2030	$75,020,905,126.64	$55,262,861,344.13	$19,758,043,782.51
2031	$77,653,365,077.20	$56,368,118,571.01	$21,285,246,506.19
2032	$80,343,513,238.37	$57,495,480,942.43	$22,848,032,295.94
2033	$83,168,187,863.42	$58,645,390,561.28	$24,522,797,302.14
2034	$86,211,747,338.42	$59,818,298,372.50	$26,393,448,965.92
2035	$89,216,026,165.75	$61,014,664,339.95	$28,201,361,825.80
Total	$1,498,562,503,550.33	$1,177,790,464,337.69	**$320,772,039,212.64**

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