# Commission Briefing Paper 6C-04
# Revenue Implications of Scenarios: Highways

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## Introduction

This paper is part of a series of briefing papers to be prepared for the National Surface Transportation Policy and Revenue Study Commission authorized in Section 1909 of SAFETEA-LU.

Section 1909 requires the final report of the Commission to include an assessment of future needs over 15-, 30-, and 50-year time horizons. A number of alternative scenarios are being developed that make different assumptions about future transportation system emphasis. Selected observations concerning five scenarios were presented in Papers 6B-01, 6B-02, 6B-03, 6B-04 and 6B-05, while paper 6C-01 presented a set of summary tables with a guide to interpreting them. These observations focused on how alternative sets of assumptions were projected to affect a set of future system performance indicators. While the papers presented a set of alternative future funding levels, they did not address how such investment would be financed.

The sheer size of the funding levels (with cumulative highway capital investment reaching the tens of trillions of dollars in nominal terms) presented in the scenarios makes it difficult to adequately put them into perspective. The purpose of this paper is to provide a sense of scale and perspective for the scenario results, by translating the funding levels into a cost per VMT and cost per equivalent gallon of fuel basis. This paper also addresses the revenue-generating implications of Scenario 2, which includes a significant highway pricing element.

## Background

Paper 6C-01 had presented the average annual capital investment for the scenarios as follows:

| Average Annual Capital Investment (billions of 2006$) | | Base Case | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 |
|---|---|---|---|---|---|---|---|
| 2005 to 2020 | Current Sustainable | $68 | $68 | $68 | N/A | N/A | $68 |
| | Medium | $130 | $130 | $130 | $146 | $166 | TBD |
| | High | $208 | $207 | $207 | $222 | $240 | $207 |
| 2005 to 2035 | Current Sustainable | $68 | $68 | $68 | N/A | N/A | $68 |
| | Medium | $159 | $158 | $133 | $174 | $188 | TBD |
| | High | $218 | $220 | $182 | $235 | $250 | $207 |
| 2005 to 2055 | Current Sustainable | $68 | $68 | $68 | N/A | N/A | $68 |
| | Medium | $178 | $178 | $146 | $188 | $195 | TBD |
| | High | $259 | $263 | $185 | $272 | $276 | $214 |

Looking at the Base Case, the Medium funding level for highways through 2020 represents a near doubling of the current sustainable highway investment level, while the High funding level through 2020 represents a tripling of the current highway level.

## Highway Capital Investment Per VMT

While the amount of investment required to achieve a given level of performance will tend to grow over time, the potential base on which user charges could be applied will also increase. The table below represents capital investment per VMT, based on the average VMT projected for the time periods shown. It should be noted that for any given time period, projected VMT varies by scenario, depending on the underlying assumptions implicit within the scenario. In addition, VMT varies by funding level within each scenario, reflecting the impact that significant improvements or degradation of the performance of the highway system might be expected to have on short- and long-term use of the system. (Note that these values can not be directly computed using the VMT values shown in Paper 6C-01, as the 6C-01 values represented VMT at a particular point in time, while the VMT values used in the table below represent average VMT across time).

| Average Annual Capital Investment per VMT (2006 $) | | Base Case | Scenario 1 | Scenario 2* | Scenario 3 | Scenario 4 | Scenario 5 |
|---|---|---|---|---|---|---|---|
| 2005 to 2020 | Current Sustainable | $0.021 | $0.021 | $0.021 | N/A | N/A | $0.021 |
| | Medium | $0.040 | $0.040 | $0.040 | $0.045 | $0.051 | TBD |
| | High | $0.063 | $0.062 | $0.062 | $0.067 | $0.073 | $0.062 |
| 2005 to 2035 | Current Sustainable | $0.019 | $0.019 | $0.019 | N/A | N/A | $0.018 |
| | Medium | $0.042 | $0.042 | $0.036 | $0.046 | $0.051 | TBD |
| | High | $0.056 | $0.057 | $0.047 | $0.061 | $0.065 | $0.045 |
| 2005 to 2055 | Current Sustainable | $0.016 | $0.016 | $0.016 | N/A | N/A | $0.015 |
| | Medium | $0.039 | $0.039 | $0.033 | $0.041 | $0.043 | TBD |
| | High | $0.054 | $0.055 | $0.040 | $0.057 | $0.059 | $0.044 |

*Note: The amount shown in this table for Scenario 2 should not be confused with the congestion charges imposed on a per VMT basis under Scenario 2 which are discussed later in this paper.

Since the current sustainable funding amount represents a fixed dollar amount (in constant dollar terms) over time, it would translate into a gradually lower amount per VMT over time as VMT rises. For the base case, it would drop from an average of 2.1 cents per VMT for the 2005 to 2020 period to an average of 1.6 cents per VMT for the 2005 to 2055 period. However, this reduction would have been offset to a large degree by inflation if the results were to be reported in nominal dollar, rather than constant dollar, terms (constant dollars are used in this analysis because all scenario costs and revenues are developed in terms of their equivalent value in 2006 dollars).

As described in Paper 6C-01, the mutually reinforcing travel demand strategies included within Scenario 2 are projected to result in a lower level of future VMT than would otherwise occur. However, the relative size of the reduction in the projected level of future investment to achieve the performance targets of the Medium and High funding levels would be larger than the relative

size of the reduction in VMT, so that the average annual capital investment per VMT would be lower in Scenario 2 than the Base Case.

### Highway Capital Investment Per Gallon (equivalent)

Each of the scenarios assumes improvement in fuel efficiency over time; however, due to the large increases in projected VMT, total motor-fuel gallonage (or its energy equivalent) is projected to rise over time under each of the scenarios. Increases in fuel efficiency will necessarily increase the capital investment per gallon consumed. Hence, if fuel efficiency were to rise more quickly than is assumed in the scenarios, the cost per gallon of each of the scenarios would be higher. Obviously, over a 50-year period, the basic means of propelling motor vehicles on highways may have changed; thus these gallonage figures should be thought of in energy equivalent terms when considering that time frame.

The table below reflects capital investment per gallon based on the average fuel consumption projected for the time periods shown. (Note that these values cannot be directly computed using the gallonage figures shown in Paper 6C-01, as the 6C-01 figures represented fuel consumption at a particular point in time, while the fuel consumption values used in the table below represent average consumption across time).

| Average Annual Capital Investment per gallon (2006 $) | | Base Case | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 |
|---|---|---|---|---|---|---|---|
| 2005 to 2020 | Current Sustainable | $0.36 | $0.35 | $0.35 | N/A | N/A | $0.35 |
| | Medium | $0.67 | $0.67 | $0.67 | $0.75 | $0.87 | TBD |
| | High | $1.06 | $1.05 | $1.05 | $1.13 | $1.25 | $1.05 |
| 2005 to 2035 | Current Sustainable | $0.33 | $0.33 | $0.33 | N/A | N/A | $0.32 |
| | Medium | $0.74 | $0.73 | $0.62 | $0.81 | $0.90 | TBD |
| | High | $1.02 | $1.02 | $0.86 | $1.10 | $1.20 | $0.81 |
| 2005 to 2055 | Current Sustainable | $0.30 | $0.29 | $0.30 | N/A | N/A | $0.29 |
| | Medium | $0.73 | $0.73 | $0.62 | $0.77 | $0.84 | TBD |
| | High | $1.06 | $1.07 | $0.78 | $1.11 | $1.18 | $0.86 |

The Current Sustainable funding level was computed based on the variety of user and non-user based revenue sources that currently support highway capital investment by all levels of government. Thus, 36 cents per gallon (equivalent) figure identified for the Base Case Current Sustainable funding level for 2005 to 2020 does not represent the represent the current tax imposed, but instead represents the cost per gallon of achieving the all-sources funding level over this time period assuming the entire scenario was funded in this manner.

For the Base Case, the Medium funding level would translate into a cost of 73 cents per gallon in constant dollar terms on average for the 2005 to 2055 period, while the High funding level would translate into a cost of $1.06 per gallon for this time period. For Scenarios 2 and 5, the cost per gallon would be lower, as the relative reduction in the capital investment level to achieve a given performance target under these scenarios would exceed the relative gains in fuel economy.

**Interstate and NHS Capital Investment per Gallon (equivalent)**

The Interstate and National Highway System components of the Base Case, Scenario 1, Scenario 2, and Scenario 3 are depicted in the charts contained in Paper 6C-03. The tables below translate those values into cents per gallon basis, based on fuel consumption on all roads (as opposed to fuel consumed on the Interstate or NHS themselves).

| Average Annual Interstate Capital Investment per gallon (2006 $) | | Base Case | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|---|---|
| 2005 to 2020 | Current Sustainable | $0.11 | $0.10 | $0.10 | N/A |
| | Medium | $0.21 | $0.20 | $0.17 | $0.28 |
| | High | $0.30 | $0.29 | $0.25 | $0.37 |
| 2005 to 2035 | Current Sustainable | $0.10 | $0.10 | $0.09 | N/A |
| | Medium | $0.21 | $0.21 | $0.15 | $0.28 |
| | High | $0.27 | $0.27 | $0.20 | $0.34 |
| 2005 to 2055 | Current Sustainable | $0.09 | $0.09 | $0.08 | N/A |
| | Medium | $0.20 | $0.19 | $0.15 | $0.23 |
| | High | $0.26 | $0.26 | $0.18 | $0.30 |

| Average Annual Total NHS Capital Investment per gallon (2006 $) | | Base Case | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|---|---|
| 2005 to 2020 | Current Sustainable | $0.17 | $0.18 | $0.17 | N/A |
| | Medium | $0.37 | $0.36 | $0.31 | $0.44 |
| | High | $0.56 | $0.55 | $0.47 | $0.63 |
| 2005 to 2035 | Current Sustainable | $0.16 | $0.16 | $0.15 | N/A |
| | Medium | $0.38 | $0.38 | $0.28 | $0.45 |
| | High | $0.50 | $0.50 | $0.37 | $0.58 |
| 2005 to 2055 | Current Sustainable | $0.14 | $0.15 | $0.14 | N/A |
| | Medium | $0.36 | $0.36 | $0.28 | $0.40 |
| | High | $0.50 | $0.51 | $0.34 | $0.54 |

## Scenario 2: Revenues from Efficient Pricing

The base case and the individual scenarios were largely developed to be neutral from a revenue point of view, reflecting that the same level of performance could be achieved via a variety of potential funding mechanisms. The analyses did assume some linkage between highway spending and highway user charges (consistent with the portion currently funded via user

charges) in order to reflect the impact that increased user charges would have on future highway travel demand.

Scenario 2 differs from the other scenarios in that it incorporates a highway pricing element that would generate a large amount of revenue. Highway pricing was included within the scenario as a travel demand management strategy, and Paper 6B-02 focuses on the travel demand elements of such a strategy. However, although Scenario 2 itself makes no direct assumption about how the revenues generated by highway pricing would be utilized, and does not account for the incremental costs of establishing and operating such a universal congestion pricing system, their potential magnitude as a future revenue source can not be ignored.

As described in Paper 6B-02, the pricing mechanism used in Scenario 2 would tie congestion charges to the economic cost of the delay and other costs imposed by each additional driver on a congested facility on all other drivers on that facility. It should be noted that such an approach will yield higher charges if congestion were relatively more extensive (as would be the case if a lower amount were invested in new capacity) than it would if congestion were relatively less expensive (as would be the case if a larger amount was invested in new capacity). The table below summarizes the congestion charges applied under each of the alternative funding levels under this scenario.

| Average Annual Capital Investment (billions of 2006$) | | Average Congestion Charge Applied (2006 $) | VMT to which charge is applied (billions) | Revenue Generated by Congestion Charge ($ billions) | | Highway Capital Investment Level ($ billions) | Transit Capital Investment Level ($ billions) |
|---|---|---|---|---|---|---|---|
| 2020 to 2035 | Current Sustainable | $0.465 | 219 | $102 | | $68 | N/A |
| | Medium | $0.391 | 193 | $75 | | $133 | $25 |
| | High | $0.344 | 202 | $69 | | $182 | $31 |
| 2020 to 2055 | Current Sustainable | $0.437 | 293 | $128 | | $68 | N/A |
| | Medium | $0.378 | 266 | $101 | | $146 | $40 |
| | High | $0.363 | 282 | $103 | | $185 | $46 |

The analysis for the Current Sustainable funding level suggests that the average congestion charge applied for the 2020 to 2035 period under such an approach would be 46.5 cents per VMT, and would be applied to an average of 219 billion VMT per year, yielding $102 billion of revenue. The range of congestion charges per mile applied under this scenario would be wide, extending from near zero on some sections with mild congestion issues to several dollars per VMT on other congested sections where widening is not feasible. It should be noted that this amount of revenue would exceed combined current highway and transit capital investment.

The analysis for the Medium funding level suggests that the average congestion charge applied for the 2020 to 2035 period under such an approach would be 39.1 cents per VMT, and would be applied to an average of 193 billion VMT per year, yielding $75 billion of revenue. This level of revenue would be sufficient to support a little less than one-half of the combined highway and

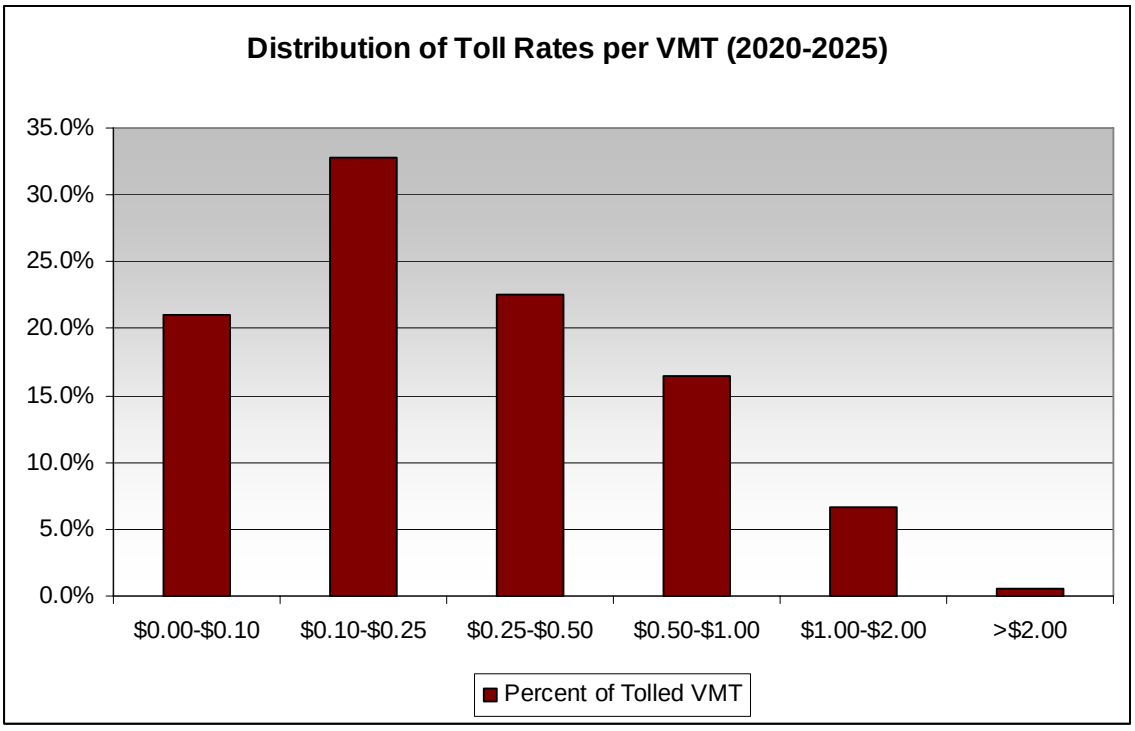
transit capital investment level, were it to be dedicated to such purposes. (The scenario analyses themselves made no such direct assumption).

The analysis for the High funding level suggests that the average congestion charge applied for the 2020 to 2035 period under such an approach would be 34.4 cents per VMT, and would be applied to an average of 202 billion VMT per year, yielding $69 billion of revenue. This level of revenue would be sufficient to support a little less than one-third of the combined highway and transit capital investment level, were it to be dedicated to such purposes.

Note that the average congestion charges cited here apply only to roads where the charges would be applied; the average congestion pricing revenue per systemwide VMT would be much lower. For the 2020 to 2035 period, the average congestion toll (considering both tolled and untolled sections) would be 2.5 cents for the Current Sustainable funding level; 1.8 cents for the Medium funding level; and 1.6 cents for the High funding level.

## Distribution of Efficient Congestion Toll Rates

While the average toll rates are informative, it is also helpful to look at the distribution of the efficient tolls being assessed in HERS. The following chart shows such a distribution for the high funding level during the first funding period (2020-2025) in which congestion tolls are assumed to be charged:




The average toll rate on all tolled sections in this period is $0.37 per mile. However, the chart indicates that the majority of tolled traffic is subject to congestion tolls below 25 cents per mile. At the other end, roughly 7 percent of traffic would be subject to toll rates over $1.00 per mile.

## Toll Rates and Revenues by Urbanized Area Size

The most severe congestion problems, both today and in the future, occur in large urbanized areas, and this is reflected in the toll rates and revenues from different areas.

**Scenario 2 Congestion Pricing Analysis**
**Average Congestion Tolls and Revenues by Urbanized Area Size**
**High Funding Scenario 2020-2035**

| Population Group | Percent of Total Toll Revenues | Percent of Tolled VMT | Average Toll per VMT (Tolled Sections) | Average Toll per VMT All Sections) |
|---|---|---|---|---|
| Rural | 1.3% | 3.5% | $0.128 | $0.001 |
| Small Urban (5-50k) | 1.8% | 2.8% | $0.216 | $0.004 |
| Small Urbanized (50-200k) | 3.6% | 5.6% | $0.219 | $0.007 |
| Large Urbanized (200k-1 million) | 12.7% | 20.0% | $0.220 | $0.012 |
| Major Urbanized (Over 1 million) | 80.6% | 68.1% | $0.407 | $0.037 |
| **Total** | 100.0% | 100.0% | $0.344 | $0.016 |

Under the congestion tolls charged at the high funding level major urbanized areas (those with populations over 1 million) account for 68 percent of the total VMT and 81 percent of total congestion pricing revenues. Other large urbanized areas over 200,000 account for an additional 13 percent of revenues and 20 percent of VMT. The average toll rates on tolled sections in major urbanized areas, at 40.7 cents per mile, are also higher than the average for all areas. Looking at averages across all VMT (including that which does not occur under congestion conditions and thus would not be assessed a congestion toll), the average toll rates in all areas would be 1.6 cents per mile, and 3.7 cents per mile in major urbanized areas.

## California

Additional analyses were also done to look at toll rates and revenues in different states. As might be expected, California accounts for a disproportionate share of the amount of congestion tolling that would be assumed under this scenario. Average toll rates on tolled sections in California over the same 2020-2035 period would be 51 cents per mile, higher than any other state. Averaged over both tolled and untolled VMT, the average toll rate in California would be 4.0 cents per mile. At the other extreme, average tolls on tolled sections in Wyoming would be just 9.1 cents per mile, and average tolls across all VMT would be just 0.02 cents.

Within California, average toll rates would vary across urbanized areas of different sizes in a similar fashion to the national average, albeit at higher levels. Urbanized areas in California over 1 million in population would see average toll rates of 58.7 cents per mile. California's projected total of $21.9 billion in average annual gross revenues that could be generated by universal congestion pricing under this scenario accounts for 32 percent of total congestion pricing revenues in the U.S., with major urbanized areas contributing $19.8 billion of the state's total.

**Scenario 2 Congestion Pricing Analysis**
**Average Congestion Tolls and Revenues by Urbanized Area Size**
**State of California**

| Population Group | Average Annual Toll Revenues (billions) | Average Toll per VMT (Tolled Sections) |
|---|---|---|
| Rural | $0.2 | $0.121 |
| Small Urban (5-50k) | $0.2 | $0.263 |
| Small Urbanized (50-200k) | $0.4 | $0.223 |
| Large Urbanized (200k-1 million) | $1.3 | $0.265 |
| Major Urbanized (Over 1 million) | $19.8 | $0.587 |
| **Total** | $21.9 | $0.510 |