ALDOT Economic Sustainability

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16. Abstract

This research used quantitative methods to document 15-year trends in various economic factors, from the very detailed (e.g., cost per ton for aggregate) to the very broad (total ALDOT annual receipts and expenditures), and for categories of receipts and expenditures as found in ALDOT annual reports. Based on these trends and accepted statistical forecasting methods, forecasts are developed and presented in tabular and graphical form for the 19-year period 2012-2030, with particular interest in 2020 and 2030. Econometric methods were used on monthly and quarterly records of Alabama gasoline consumption 1992-2011 to identify causal variables, such as Alabama employment levels, income, and gasoline tax rate, and their elasticities. The overall objective of this research was to provide an unbiased analysis of the Department's ability to sustain its current program of maintenance and new construction, or to expand the construction expenditures to create transportation system enhancement. Where expenditure reductions could fund shortfalls in forecasted baseline budget, the impact (difficult trade-offs) of absorbing the shortfall in alternative ways has been quantified. Growth in demand for construction activity is analyzed as a factor affecting ALDOT's economic sustainability, as is the projected decline in gasoline consumption in the state. Both of these factors in ALDOT's future were shown to create huge shortfalls in total revenue that cannot be absorbed by cost cutting; an increase in the fuel tax rate, or new sources of revenue, are clearly needed to sustain ALDOT in the next nineteen years.

Conclusions and recommendations of this research include:

- The slow increase in vehicle miles traveled (vmt) in Alabama over the period 2012-2030 will not offset the rapid decline in gallons per mile brought on by the U.S. CAFÉ Standards, and gasoline consumption is forecast to decline from the 2011 level of 2.584 billion gallons by 8% in 2020, and by 33% in 2030.
- State receipts under two gasoline consumption decline models are forecast to decrease 2012-2030, in stark contrast to the baseline forecast which shows an increase from $514M in 2011 to $810M by 2025. Specifically, the two gasoline consumption decline models forecast State receipts in 2025 to decline to the range of $393-475M.
- The Baseline forecast of ALDOT Total Receipts has them increasing from $1330M in 2011, to $1750M in 2020, $2046M in 2025, and $2379M in 2030. However, using the gasoline consumption decline models, Total Receipts will decline from $1330M to a range of $957-1210M in 2020, $780-976M in 2025, and $624-747M in 2030.
- Over the past six years, the average unit costs quoted by ALDOT winning bidders for three construction materials have been increasing sharply: Asphalt Concrete Pavement, 5.25% annual increase in unit cost; Rebar, 6.84% annual increase in unit cost; Aggregate Base, 7.22% annual increase in unit cost. These same materials have shown decreases in unit costs to TXDOT over these same years, although Texas separates the cost of asphalt into aggregate and liquid, so those comparisons may be invalid.

- As for Bridges Let, the cost per square foot has been increasing $4.11 per square foot per year from 1997 to 2011. Projecting this cost increase into the future, the $87.66/square foot cost in 2011 increases to $187.30/square foot in 2030, slightly more than doubling for an average annual escalation factor of 4.1%. To let the same average total square footage of new bridges in 2012-2030 as the past 15 years (942,630 sq.ft.) requires the New Bridge expenditure commitments to grow from $82.63M in 2012, to $137.81M in 2020, to $176.56M in 2030.
- Baseline Revenue shortfalls, based on subtracting forecast Baseline Total Expenditures from forecast Baseline Total Receipts, are forecast for FY 2012-2030 and include:

Year	Shortfall	Shortfall as Percent of Total Expenditures	
2012	-$144.54M	-10.55%	
2020	-$139.99M	-7.66%	
2030	+ $52.34M*	+2.18%	*Cross-over point in FY 2029.

- Sensitivity study found that: in 2020, Total Expenditures under the 5, 15, and 25% Construction Expenditure increase alternatives would grow respectively from $1884M baseline to $1959M, $2110M, and $2260M; in 2030, Total Expenditures under these same three alternatives would grow respectively from $1904M baseline to $2440M, $2631M, and $2821M. In 2020, budget shortfalls under the 5, 15, and 25% Construction Expenditure increase alternatives are forecast to grow respectively from -$145M to -$209M, -$360M, and -$510M; in 2030, budget shortfalls under these same three alternatives would grow respectively form a baseline surplus of $52M to deficits of -$43M, -$233M, and -$424M.
- Under either of these two gasoline consumption decline scenarios, the maximum ALDOT budget shortfall during 2012-2030 just to fund Baseline Expenditures is an order of magnitude larger ($1.5B vs. $150M) than it was under the Baseline Total Receipts forecast. Clearly, new sources of revenue would be needed.
- In a final sensitivity study, we combined the reduced revenues due to gasoline consumption declines with the stated ALDOT need to increase its Construction Expenditures by a substantial amount annually in order to meet System Enhancement needs. We have chosen a 10% increase in Construction Expenditures as a representative increase, which would amount to an increment in Baseline and Total Expenditures of around $120M in 2012, growing to $190M by 2030. Under either gasoline consumption decline, with this 10% construction expenditure increment, the ALDOT budget shortfall is around $1.5B in by 2025 and approaches $2B in 2030. The need for new sources of revenue is even more pressing under this scenario, which moderately funds System Enhancement (SE) needs.
- Econometric analysis showed: in the long run a 1% increase in the price of gasoline causes anywhere from a 0.045 to 0.087 percent decrease in the amount of gasoline purchased; that is, the demand for gasoline is very inelastic, and is so insensitive to price that one can assume there is no change in quantity demanded when taxes are raised. Also, for every 1% increase in total wages and salaries in Alabama, there is approximately a 0.38 percent increase in revenue from the gasoline tax.
- Econometric forecasts show that by 2020, revenue from the gasoline tax will only have grown from $402 million in 2012 to about $416 million per year assuming that employment grows at a rate of 1.1% per year, using the point estimate of the employment elasticity of revenue. If we assume, that employment grows by 2% per year for the next 5 years and then reverts back to the 1.1% growth rate, then revenues in 2020 will be only $6 million higher.
- Our econometric forecasts imply that there is very little chance of an economicially meaningful increase in revenues from the gasoline tax unless the tax is increased. Therein, we created forecasts of revenue based on the assumption that there is 5¢ per gallon increase in the state gasoline tax beginning in October of 2013. This will raise an additional $110 million dollars per year initially, but increasing only to an extra $120 million by 2029.
- The additional revenue earned from the 1992 increase in the gasoline tax has been completely eroded by inflation. If the tax is increased by only 5¢ per gallon beginning in October 2013, the additional revenue earned would be completely eroded away by 2029 if the rate of inflation in these future years equals current consensus forecasts.

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Executive Summary

The past fifteen fiscal years (1997-2011), total receipts at the Alabama Department of Transportation (ALDOT) have increased from $817.95M to $1329.61M, a compound growth rate of 3.29% per year which exceeded the average rate of inflation 2.28% essentially by 1%. Receipts increased at an average rate of $34.1M per year. Total expenditures have increased over this fifteen year span at a compound growth rate of 3.76% per year, or an average rate of $46.1M per year. With expenditures growing faster than receipts, as one might expect, needed construction is being postponed and back-logs of projects are growing. In fact, at the start of the Bentley administration in 2011, the ALDOT Division Engineers identified $6B in System Enhancement needs, which today can only be funded at $150M per year. A realistic funding of these needs would require a substantial increase in ALDOT's annual construction expenditures, over at least 10 and perhaps 20 years. Additionally, the U.S. CAFÉ fuel efficiency standards are phasing in. As that happens, even if Alabama continues to see the typical slow growth in total vehicle miles traveled, there is a concern that gasoline consumption (essentially flat the past 8 years) could turn downward. Baseline forecasts of ALDOT receipts assume that gasoline consumption will continue on its upward, essentially linear trend evident in the past; this provides some hope that ALDOT total expenditures could move upward with total receipts, as in the past fifteen years. Forecasts of ALDOT receipts based on gasoline consumption declines, however, could return ALDOT revenues to levels last seen in the late 1990s, and might generate annual budget shortfalls of $1.5B by 2030. With the System Enhancement needs combined with declining gasoline tax receipts, there is a concern that shortfalls could reach the $2B annual level. A $2B shortfall is essentially equal to baseline total expenditures if one extrapolates the past nineteen years linearly to 2030, which is alarming. Answers to these sorts of concerns are needed before ALDOT can determine what sorts of increase in the gasoline tax rate, or funding from other revenue sources, are needed, and are the reason this research project was requested.

This research used quantitative methods to document 15-year trends in various economic factors, from the very detailed (e.g., cost per ton for aggregate) to the very broad (total ALDOT annual receipts and expenditures), and for categories of receipts and expenditures as found in ALDOT annual reports. Based on these trends and accepted statistical forecasting methods, forecasts are developed and presented in tabular and graphical form for the 19-year period 2012-2030, with particular interest in 2020 and 2030. Econometric methods were used on monthly and quarterly records of Alabama gasoline consumption 1992-2011 to identify causal variables, such as Alabama employment levels, income, and gasoline tax rate, and their elasticities. The overall objective of this research was to provide an unbiased analysis of the Department's ability to sustain its current program of maintenance and new construction, or to expand the construction expenditures to create transportation system enhancement. Where expenditure reductions could fund shortfalls in forecasted baseline budget, the impact (difficult trade-offs) of absorbing the shortfall in alternative ways has been quantified. Growth in demand for construction activity is analyzed as a factor affecting ALDOT's economic sustainability, as is the projected decline in gasoline consumption in the state. Both of these factors in ALDOT's future were shown to create huge shortfalls in total revenue that cannot be absorbed by cost cutting; an increase in the fuel tax rate, or new sources of revenue, are clearly needed to sustain ALDOT in the next nineteen years.

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- As for Bridges Let, the cost per square foot has been increasing $4.11 per square foot per year from 1997 to 2011. Projecting this cost increase into the future, the $87.66/square foot cost in 2011 increases to $187.30/square foot in 2030, slightly more than doubling for an average annual escalation factor of 4.1%. To let the same average total square footage of new bridges in 2012-2030 as the past 15 years (942,630 sq.ft.) requires the New Bridge expenditure commitments to grow from $82.63M in 2012, to $137.81M in 2020, to $176.56M in 2030.

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1.0 Introduction

1.1 Background on Alabama Department of Transportation Revenues

1.1.A Overview

The model for revenue sources that was developed decades ago to fund the road systems across the country, primarily based on fuel sales and consumption, is resulting in significant shortfall between the annual revenues and ever increasing expenditures. Increasingly fuel efficient modes of transportation, resulting in declining fuel sales and consumption, are not generating sufficient revenues for the Alabama Department of Transportation (ALDOT) and their counterparts across the country to fund their current and future needs. Given these trends, ALDOT's current gap between revenues and expenditures of about $50 million could escalate to over $1 billion by the year 2025, as this study will show.

Excise taxes on gasoline and diesel have not kept up with ever-escalating highway construction and maintenance costs in recent years. Furthermore, greatly increased fuel efficiency of vehicles and increasing use of hybrid and electric cars results in lower fuel usage and therefore reduced revenues based on gasoline sales. The effect of the U.S. CAFÉ standards on average miles per gallon for all vehicles on the road has just begun, and as this study will show, the impact on gasoline tax receipts will be staggering. Federal tax rates, at 18.4 cents for gasoline and 24.4 cents for diesel have not changed since 1993. Similarly, Alabama's excise tax of 18 cents on gasoline (16 cents excise tax, plus 2 cents for the Petroleum Commodities Fee) and 19 cents on diesel has not changed since 1992.

Different states have enacted various measures to help plug the shortfall in revenues. Some of these measures include more reliance on registration and tag fees, road usage fees depending on miles driven, and/or sales taxes. According to the Congressional Budget Office, gas tax revenues nationwide will most likely fall by approximately $57 billion over the next 10 to 11 years. This study will attempt to quantify the gas tax revenue decline that can be expected in Alabama, and its potential impact on ALDOT's ability to fulfill its mission.

As shown in Figure 1-1, fuel use per vehicle in Alabama is currently at the same level as it was in the early 1990, slightly above 700 gallons per year. Figure 1- 2, shows fuel usage per vehicles in Alabama compared to other states. Figures 1-3 and 1-4 show the volume of diesel sales in Alabama and the total volume of sales compared to other states. At approximately 712 million gallons, diesel sales have experienced a drop in recent years. Figures1-5 and 1-6 show gasoline sales in Alabama (approximately 2.6 billion gallons in 2010) and a comparison of gasoline sales in other states, respectively.

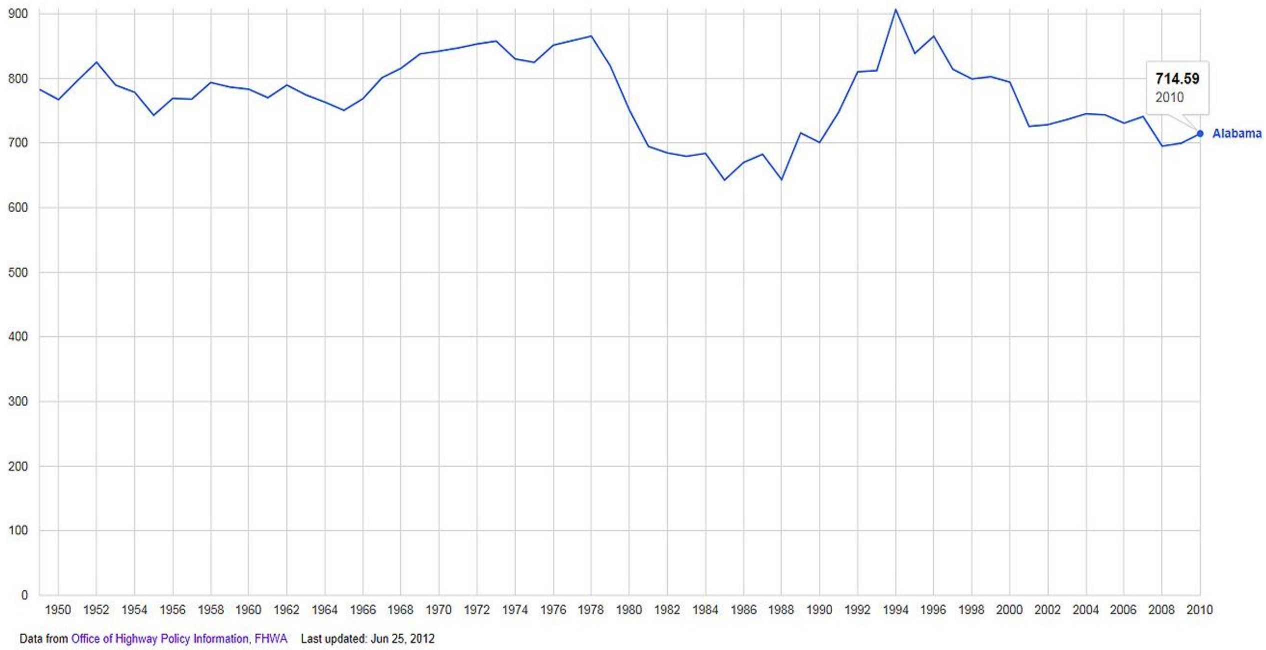

Figure 1-1. Alabama Fuel Use per Vehicle, 1950-2010 (Gallons, M)

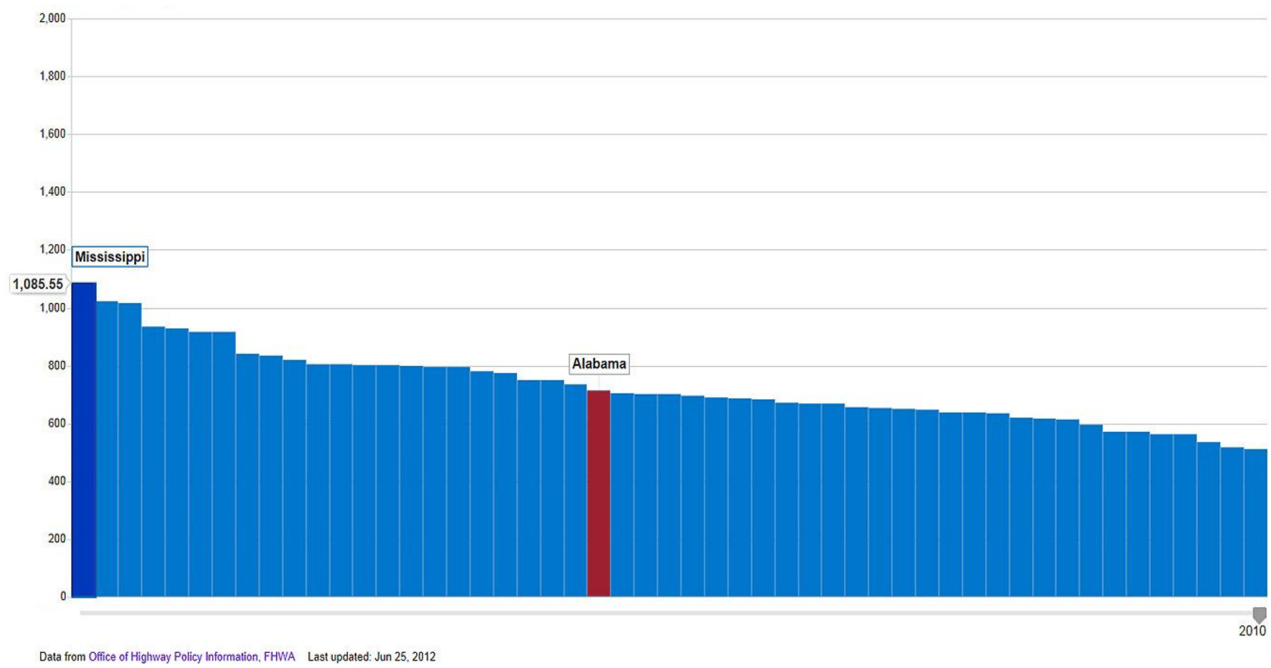

Figure 1-2. Fuel Use per Vehicle by State, 2010 (Gallons, M)

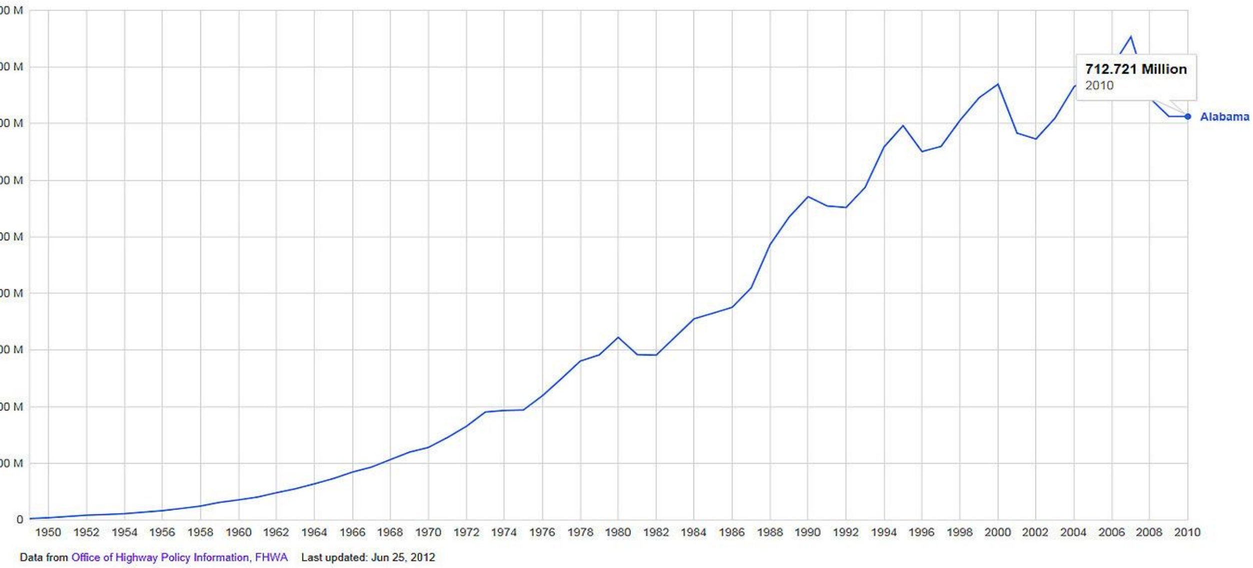

Figure 1-3. Alabama Diesel Sales, 1950-2010 (Gallons, M)

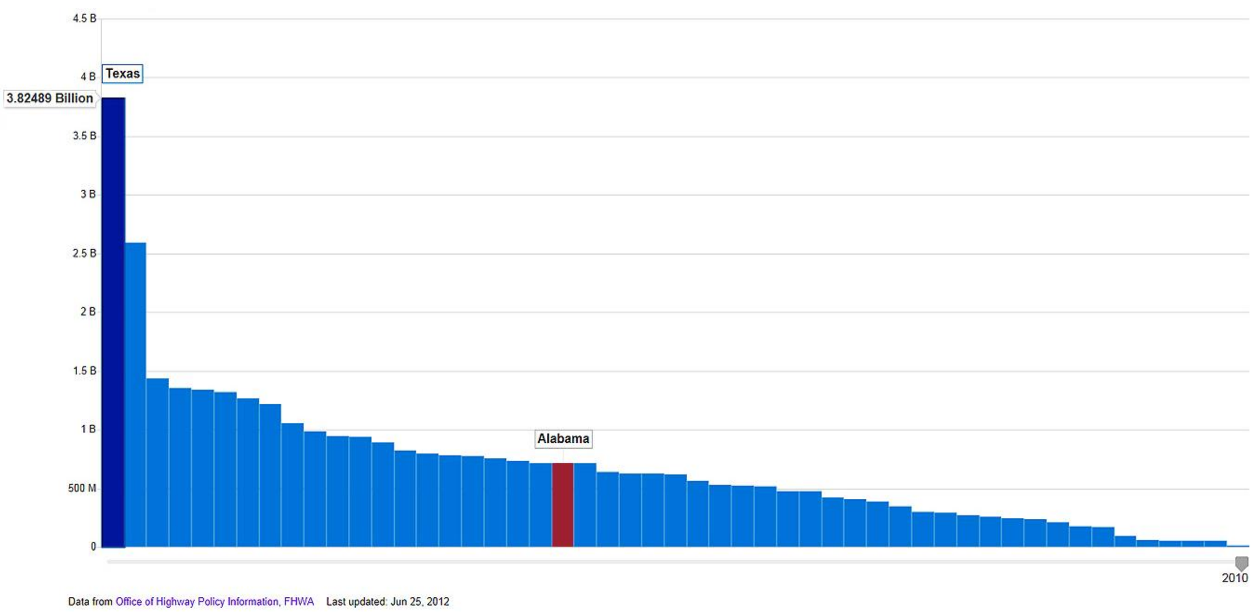

Figure 1-4. Gallons (B) of Diesel Sold by State, 2010

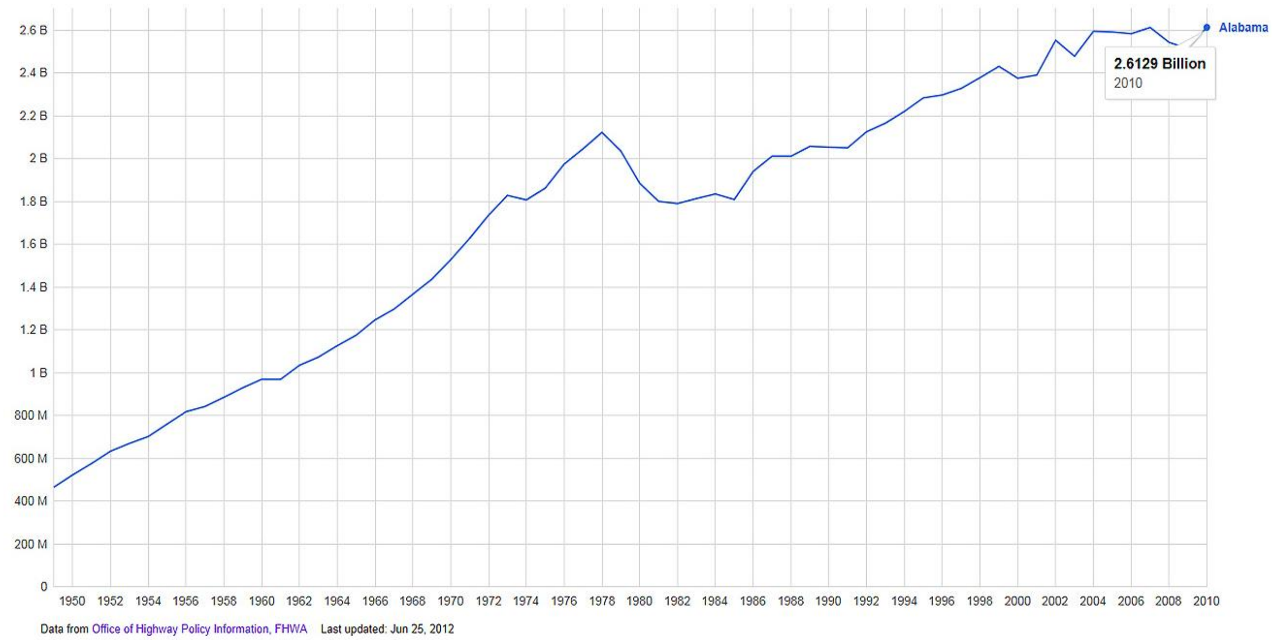

Figure 1-5. Alabama Gasoline Sales, 1950-2010 (Gallons, M)

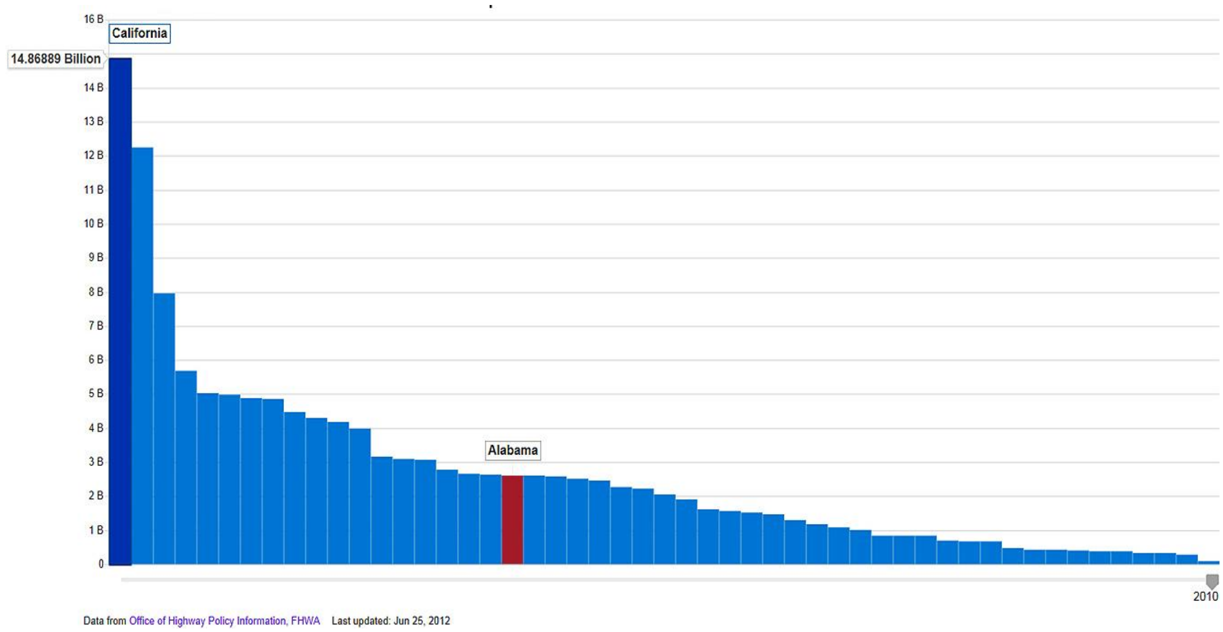

Figure 1-6. Gallons (B) of Gasoline Sold by State, 2010

1.1.B ALDOT Revenue Sources

This section presents a baseline projection using ALDOT's current sources of in-state revenues and the forecasts of the federal funds allocated to Alabama. A structural equations modeling system was developed with a set of regression equations for each source of revenue stream that determines the total funds to be received by ALDOT, including funds provided by the federal government.

The equations were based on following assumptions:

- U.S. and Alabama economic conditions that have an impact on such factors as transportation activity (trucking, shipping etc.)
- Gasoline prices.
- Consumer and business spending,
- Consumer spending on gasoline.
- Demand for alternative sources of energy and fuels.

Most of the variables used are susceptible to changes in economic conditions and therefore have a direct impact on gasoline prices and other ALDOT sources of revenue.

1.1.C ALDOT Revenues 1988-2010

ALDOT revenues on a historical basis are presented in Table 1-1 (nominal, current, or then-year dollars) and Table 1-2 (real or inflation adjusted dollars). Inflation adjusted or real dollars estimates were based on consumer price index (CPI) using 2005 as a base year, the main purpose was to remove the effects of price changes on revenues. Revenues from in-state sources and those received from federal government are also shown in Figures 1-7 and 1-8 (in both nominal and real terms). As shown in Figure 1-8, the significant increase in revenues in 1992 was primarily due to structural changes in tax sources.

1.1.D ALDOT Revenue Forecasts 2011-2030

The baseline projections are presented in Table 1-1 for every 10-year interval (annual projections are used in Sections 2.2 and 2.5 of this report). As shown in this table, given current sources of revenue, total revenues for ALDOT are expected to increase from $1.3 billion in 2010 to $1.8 billion in 2020, and $2.4 billion in 2030. However, these revenues also include the funds received from the federal government. Excluding the funds received from the federal government, ALDOT's receipts are expected to total approximately $685 million in 2020, up 37.3 percent from 2010. By 2030, these receipts are forecasted to be slightly over $963 million. But during the same period, growth in expenditures for general maintenance and other needs is expected to grow at a much faster pace than revenues. The magnitude of this shortfall or gap will be estimated in

Table 1-1. ALDOT Baseline Revenues and Projections (Current or Nominal Dollars)

	2005	2010	2020	2030	2040
Gasoline Excise Tax $0.05	95,954,976	98,861,280	161,544,992	264,628,705	432,312,418
Gasoline Excise Tax $0.04	44,949,994	44,721,335	51,616,858	59,677,735	69,028,618
Motor Fuel Tax $0.06	42,675,146	35,627,835	53,549,263	80,406,721	120,712,653
LPG Gas Vehicle Permits	140,948	97,344	102,541	108,061	113,811
Motor Vehicle License	81,357,173	109,131,388	157,134,570	226,337,752	326,140,934
Gasoline Excise Tax $0.07	76,849,327	75,965,342	82,374,491	89,313,640	96,842,790
Lubrication Oil Tax	591,407	497,374	817,927	1,344,910	2,211,393
Oversize Hauling Permits	2,936,092	3,488,393	4,932,037	6,974,681	9,860,324
Motor Carrier Mileage Taxes, Fees	521,334	603,184	986,165	1,613,763	2,637,677
Motor Fuel Tax $0.13	100,401,300	81,690,779	121,387,778	180,081,656	267,555,509
Truck Identification Decals	953,320	852,528	1,393,028	2,278,860	3,729,003
Petroleum Products Inspection Fees	49,515,365	47,340,251	48,895,420	50,527,125	52,203,900
Outdoor Advertising Permit Fee	67,398	67,863	73,841	80,124	87,070
Total Revenue Receipts	**496,913,780**	**498,944,894**	**684,808,912**	**963,373,734**	**1,383,436,099**
Federal Aid	**630,383,267**	**763,069,001**	**1,027,703,399**	**1,384,237,798**	**1,863,272,196**
Other Receipts	98,521,054	28,319,154	37,501,031	49,726,869	65,851,737
Subtotal	728,904,321	791,388,155	1,065,204,430	1,433,964,667	1,929,123,934
Total Receipts	**1,225,818,101**	**1,290,333,049**	**1,750,013,342**	**2,397,338,401**	**3,312,560,032**

Table 1-2. ALDOT Baseline Revenues and Projections (Inflation Adjusted Dollars)

	2005	2010	2020	2030	2040
Gasoline Excise Tax $0.05	95,954,784	89,290,665	132,690,878	197,146,356	293,058,060
Gasoline Excise Tax $0.04	44,949,904	40,394,543	42,466,236	44,647,517	46,951,479
Motor Fuel Tax $0.06	42,675,061	31,702,939	37,281,887	43,787,790	51,483,969
LPG Gas Vehicle Permits	140,948	88,621	91,403	94,374	97,392
Motor Vehicle License	81,357,010	97,215,691	109,879,664	124,205,438	140,719,363
Gasoline Excise Tax $0.07	76,849,173	69,041,400	72,408,933	76,064,125	79,870,932
Lubrication Oil Tax	591,406	449,157	666,668	990,240	1,472,591
Oversize Hauling Permits	2,936,086	3,141,749	3,910,575	4,869,290	6,062,960
Motor Carrier Mileage Taxes, Fees	521,333	543,780	791,002	1,151,874	1,677,106
Motor Fuel Tax $0.13	100,401,099	73,177,376	90,460,939	111,756,670	138,072,921
Truck Identification Decals	953,318	768,861	1,119,169	1,628,520	2,371,881
Petroleum Products Inspection Fees	49,515,266	43,150,744	44,068,776	45,013,403	45,999,328
Outdoor Advertising Permit Fee	67,398	61,746	65,236	68,916	72,848
Total Revenue Receipts	496,912,786	449,027,272	535,901,367	651,424,513	807,910,828
Federal Aid	630,382,006	689,355,995	840,843,932	1,026,231,869	1,250,119,806
Other Receipts	98,520,857	69,253,326	82,227,038	97,683,687	116,072,057
Subtotal	728,902,863	758,609,321	923,070,970	1,123,915,556	1,366,191,863
Total Receipts	1,225,815,649	1,207,636,593	1,458,972,337	1,775,340,069	2,174,102,692

Source: Alabama Department of Transportation, University Transportation Center for Alabama, and Center for Business and Economic Research, The University of Alabama

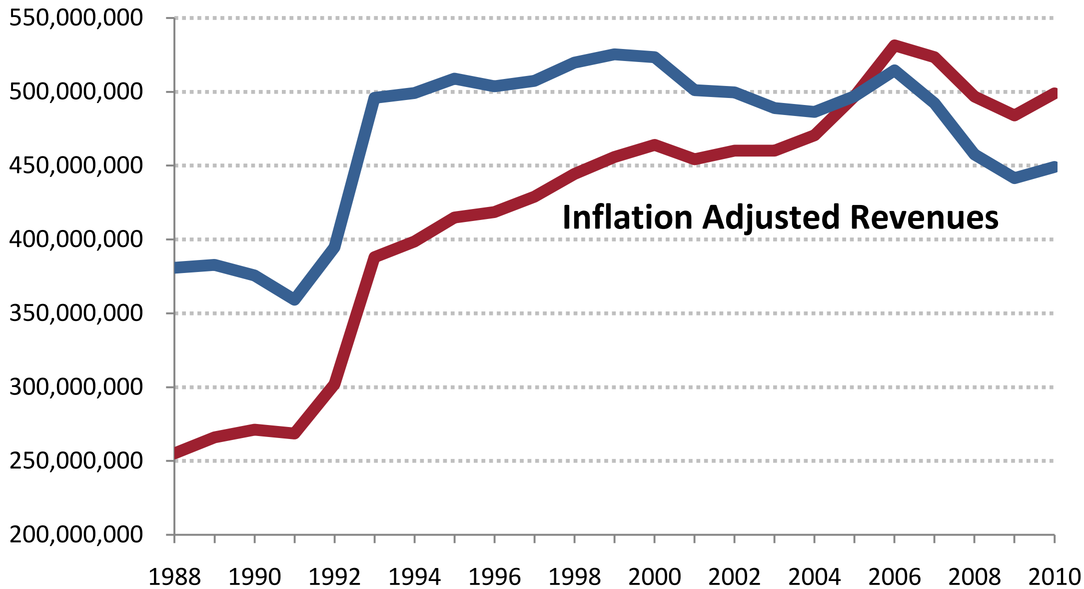

Figure 1-7. ALDOT Revenues from State Sources (Excluding Federal Funds), 1988-2010 (Nominal or Current Dollars and Inflation Adjusted or Real Dollars)

Source: Alabama Department of Transportation, Transportation Center for Alabama, and Center for Business and Economic Research, The University of Alabama.

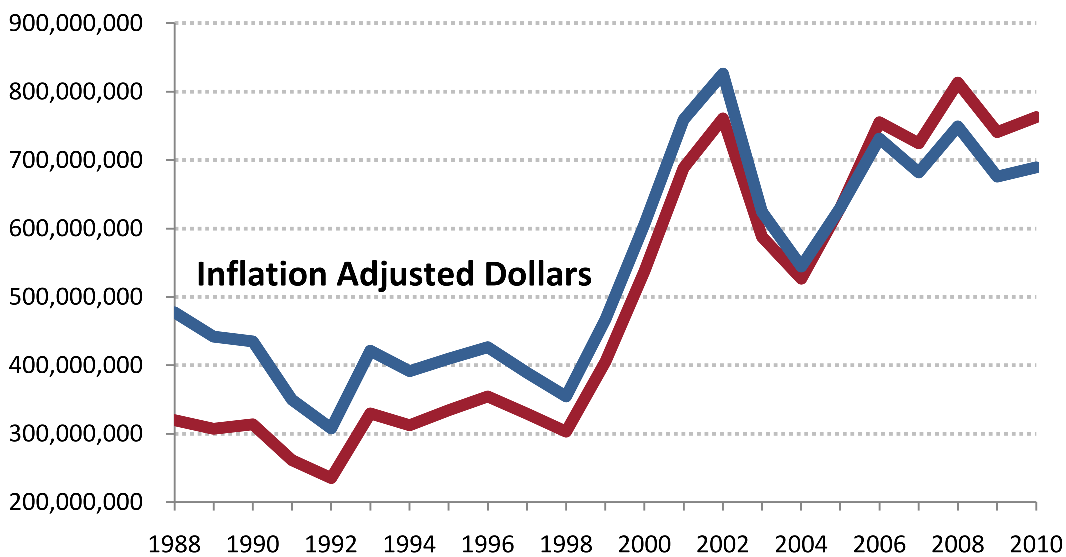

Figure 1-8. Federal Funds Received by ALDOT, 1988-2010
(Current and Inflation Adjusted Dollars)

Source: Alabama Department of Transportation, Transportation Center for Alabama, and Center for Business and Economic Research, The University of Alabama.

Section 2.5, and of course depends on certain assumptions about the future. Under baseline assumptions, the gap is forecast to grow as large as $150M in 2015 and then shrink back to zero by 2029. Under less favorable assumptions, the gap between the expected revenues and expenditures increases considerably over time to perhaps $1-1.5B by 2030, one reason being the increasing cost of maintaining infrastructure and the other is the slowdown in revenues from current sources as motor vehicles become much more fuel efficient. Revenue projections are also presented in Table 1-1 for each component of taxes that ALDOT receives in its revenues.

The baseline revenue forecasts on an inflation-adjusted basis were also made in order to remove the impact of prices changes on revenue projections. Inflation adjusted or real dollar projections are presented in Table 1-2, and were estimated using consumer prices index with 2005 as base year. As shown in the table, if the changes in revenues due to change in prices levels are accounted for, total ALDOT revenues are only estimated to increase from $1.2 billion in 2010 to approximately $1.5 billion in 2020, and $1.8 billion by 2030. If the funds received from the federal government are excluded total receipts from in-state sources will increase from about $450 million in 2010 to approximately $536 million in 2020, and $651 million by the year 2030. Forecasts for in-state revenue sources are presented in Figure 1-9, in both real and nominal dollars.

The baseline projections for the federal funds are also presented in Table 1-1. As shown in the table, given trends over the recent past, federal sources of funds are estimated to increase from $763 million in 2010 to about $1 billion in 2020, an increase of about 35 percent or an average annual increase of 3.5 percent. From 2020 to 2030, federal funds will increase from approximately $1 billion to about $1.4 billion. The basic assumption behind all baseline projections is that the current level of funding continues into the future based on the rate at which it has increased over time, or the past trend.

The baseline projections for the federal funds in inflation adjusted or real dollars is presented in Table 1-2. As shown in this table, based on the past history and changes in price level, federal sources of funds are estimated to increase from $689 million in 2010 (real dollars) to about $841 million in 2020, an increase of approximately 22 percent, or an average annual increase of around 2.0 percent. From 2020 to 2030, federal funds in inflation adjusted dollar is expected to increase from approximately $841 million to $1.0 billion. The projections for federal funding are presented in Figure 1-10, in both current and real dollars. Finally, projections for ALDOT total revenues, 2011-2030 are presented in Figure 1-11, in both current and real dollars.

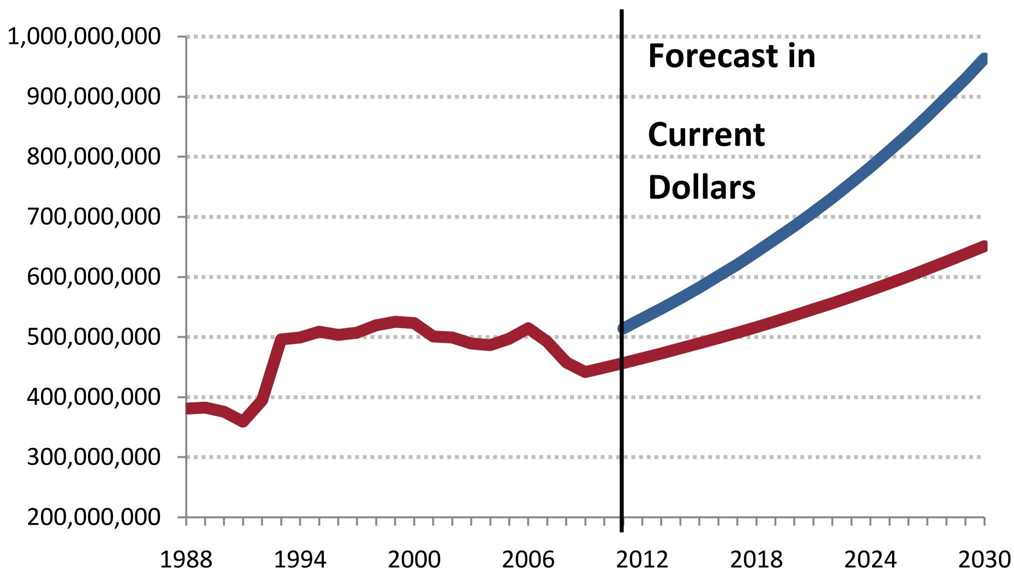

Figure 1-9. ALDOT Revenue Forecasts (Excluding Federal Funds), 2011-2030 (Nominal vs. Inflation Adjusted Dollars)

Source: Alabama Department of Transportation, Transportation Center for Alabama, and Center for Business and Economic Research, The University of Alabama.

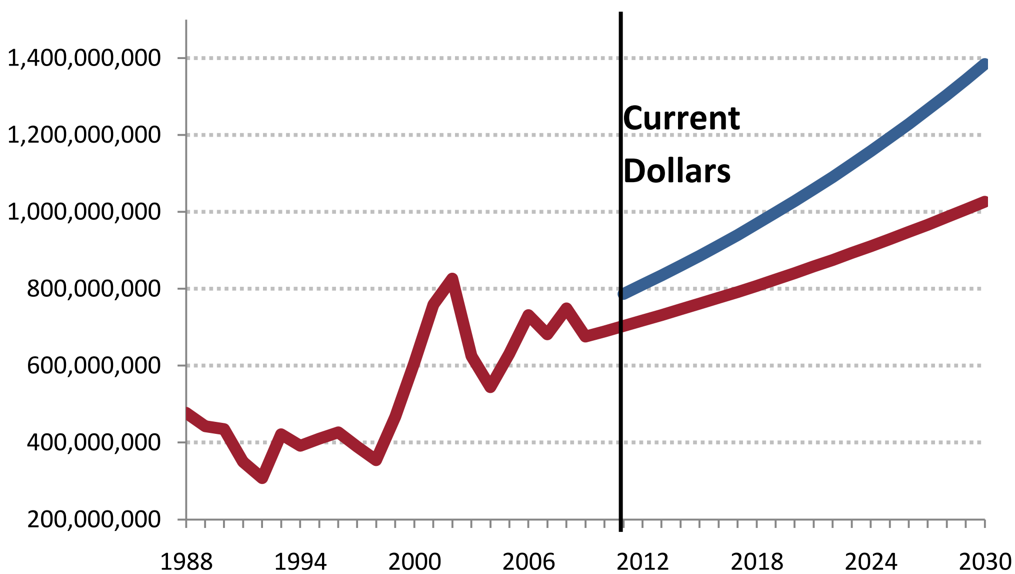

Figure 1-10. Forecasts of Federal Funds Received by ALDOT, 2011-2030 (Current Dollars and Inflation Adjusted Dollars)

Source: Alabama Department of Transportation, Transportation Center for Alabama, and Center for Business and Economic Research, The University of Alabama.

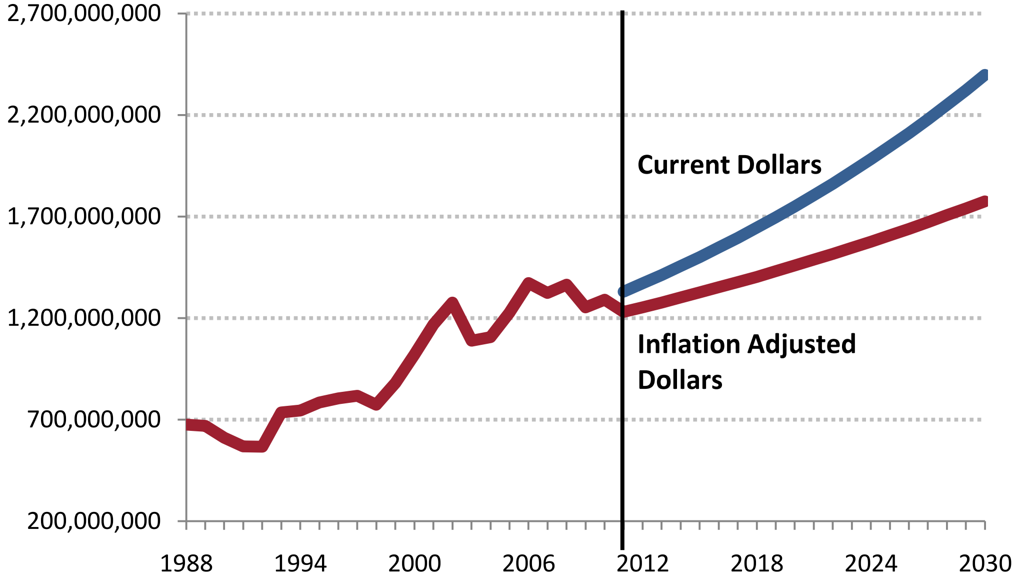

Figure 1-11. Forecasts of ALDOT Total Revenues From All Sources, 2011-2030
(Current Dollars and Inflation Adjusted Dollars)

Source: Alabama Department of Transportation, Transportation Center for Alabama, and Center for Business and Economic Research, The University of Alabama.

This study will show that ALDOT's revenues will continue to fall short of expenditures, even under the most optimistic assumptions. Under the current tax structure in the state, several changes could be made to tax structure, rate, or distribution to ALDOT in order to meet the department's current and future obligations. Some of these options are listed below and are the subject of another study, but are outside the scope of research here:

- Indexing the taxes based on consumer price index.
- Indexing the taxes based on increase in construction costs.
- Replacing excise tax by sales tax.
- Applying a sales tax in place of excise tax
- Increasing the excise tax on gasoline and diesel fuels. Currently Alabama ranks 29th in the nation based on the excise tax levied on gasoline and 25th in the nation based on the excise tax levied on diesel fuel.
- Levying some form of addition tax on electric and hybrid vehicles.
- Increase in general vehicle sales tax from current 2.0 percent to perhaps 3.0 percent or even 4.0 percent.
- Eliminating or reducing fuel tax exemptions.
- Applying some form of road use tax.
- Increasing tax on oil or gasoline at the distributor level.
- Tolls on state or federal highways.

1.2 Motivation for and Scope of the Research

The past fifteen fiscal years (1997-2011), total receipts at the Alabama Department of Transportation (ALDOT) have increased from $817.95M to $1329.61M, a compound growth rate of 3.29% per year which exceeded the average rate of inflation 2.28% essentially by 1%. Receipts increased at an average rate of $34.1M per year. Total Expenditures have increased over this fifteen year span at a compound growth rate of 3.76% per year, or an average rate of $46.1M per year. This study predicts a baseline funding gap in the range of $150M per year (around 10.5% of receipts) starting immediately in FY 2012 and remaining above $100M for the next decade. There are limits to borrowing, and this study initially assumes that future expenditures will be forced to the level of forecasted receipts—that is, the revenue shortfall will force an equivalent reduction in expenditures. A detailed sensitivity analysis of expenditure reduction options to absorb this shortfall is performed. This study also explores other scenarios encompassing increased construction expenditures due to system enhancement and decreasing receipts due to declining gasoline consumption.

If ALDOT was forced to scale back expenditures by $100-150M per year the next decade, there would be serious consequences. The Alabama highway transportation system supports Alabama's economy, promotes economic growth such as has occurred with the influx of automotive assembly plants and their suppliers, and creates jobs. Using a U.S. Department of Commerce statement, an average reduction in investment in transportation infrastructure of $100M would reduce job growth by 3,000 jobs annually. There are three approaches to solving ALDOT's projected baseline funding shortfall:

- Enhanced state revenues
- Reduction in one or more categories of expenditures
- Reduced unit costs for materials, labor, and equipment in ALDOT contracts, attempting to offset receipt shortfalls with cost reductions.

Another ALDOT-funded study underway at the University of Alabama (UA) is considering alternative mechanisms to enhance state receipts to ALDOT. Given a concern over whether new revenue mechanisms can be enacted, it is prudent to consider how expenditures would have to be adjusted to minimize the impact of revenue shortfalls on the ALDOT mission. Another pressing concern is gasoline consumption declining due to more fuel efficient vehicles pushing the average gallons per mile down faster than the total annual miles traveled will increase, resulting in decreased gasoline tax receipts. Expenditure reductions may not be able to absorb declining gasoline-related receipts.

The scope of this research is as follows:

- Baseline forecasts of revenues and expenditures for the next 19 years (2012-2030) are based on the most recent 15 years (1997-2011);

- No new revenue sources or mechanisms—revenue continues to grow at a pace based on the U.S. and State economic forecasts and current approaches to funding transportation infrastructure in the State of Alabama;
- Growth in demand for construction and/or maintenance activities is excluded as a factor affecting the baseline expenditures forecasts, but will be addressed in sensitivity analyses;
- Baseline revenue shortfalls will in general be absorbed by reduced expenditures in one or more categories;
- Where possible, we comment on potential cost savings implications found in analyses of:
    - Unit costs of construction materials
    - Cost per mile of resurfacing vs. resurfacing and widening;
- We have forecast dramatic changes in Alabama gasoline consumption for 2011-2030. The fact that consumption has been essentially flat the past eight years was just a prelude to significant declines due to CAFÉ standards pushing the average mpg up (gallons per mile down) much faster than total miles driven will increase. Revenue shortfalls of significant magnitude will be forecast under scenarios of declining gasoline consumption when combined with either baseline or enhanced construction expenditures.
- Econometric analysis will be applied to monthly and quarterly time series of Alabama gasoline consumption to estimate useful sensitivity and elasticity rates.

1.3 Project Objectives

This research will use quantitative methods to document 15-year trends in various economic factors, from the very detailed (e.g., cost per ton for aggregate) to the very broad (total ALDOT annual receipts and expenditures), and for categories of receipts and expenditures as found in ALDOT annual reports [1]. Based on these trends and accepted statistical forecasting methods, forecasts are developed and presented in tabular and graphical form for the 19-year period 2012-2030, with particular interest in 2020 and 2030. The overall objective is to provide an unbiased analysis of the Department's ability to sustain its current program of maintenance and new construction, and where reductions appears inevitable, to quantify the impact (difficult trade-offs) of absorbing the shortfall in alternative ways we have identified. Growth in demand for construction activity is analyzed as a factor affecting ALDOT's economic sustainability, as is the projected decline in gasoline consumption in the state.

An Interim Report was delivered at the end of October 2012, representing a concerted effort during the months of September and October 2012 to capture data from ALDOT Annual Reports and other sources, conduct a variety of trend analyses and forecasts, and present preliminary results in a timely manner to ALDOT administrators. During November 2012, the research team developed forecasts for gasoline consumption 2012-2030, assessed the impact of those forecasts on ALDOT revenues, and forecast revenue shortfalls under various scenarios of gasoline tax decline combined with baseline or enhanced construction expenditures. All research results and conclusions are presented in this Final Report.

2.0 Study Process and Results

To accomplish the project objectives described in the Introduction, a study process was created and implemented using the following principles:

- Records from the past fifteen fiscal years, 1997-2011, concerning the economics of state departments of transportation (primarily ALDOT, but also TXDOT and CALTRANS) were collected and form the basis for various trend analyses and forecasts presented here.
- In some cases, where long-term trends do not seem representative of today's environment *or* where data was available for recent years only, forecasts are based on the more recent trends the past five-to-eight years. This is particularly true for some expenditure categories and for trends in unit costs for some highway construction materials.
- Forecasts are for fiscal years 2012-2030—that is, the next 19 years—with years 2020 and 2030 selected as milestones. When the FY 2012 ALDOT annual report is published, the various categories and totals for actual revenues and expenditures can be compared the 2012 forecasts presented below as a form of verification.
- Forecasts are expressed in nominal or "then-year" dollars, unless otherwise noted. Where dollars are either indexed using some recognized national index, such as the Consumer Price Index, or expressed in base year dollars, the tables, figures, and text will reflect that change.
- A fundamental assumption for much of this study is that ALDOT revenues from state and federal sources continue in a "status quo" fashion, 2012-2030—that is, no change in gasoline excise tax rate, no modification to include indexing, no changeover to tax on miles driven, no toll road income, etc. Many of these revenue-side alternatives are being studied by another University of Alabama research team.
- One set of questions to be answered by this study deals with the effect of status quo revenue sources on ALDOT expenditures:
    - How soon is the cross-over point where total expenditure forecasts exceed revenue forecasts? This turns out to be very soon (2012).
    - What is the extent of the annual shortfall in revenues (in total dollars or percentage shortfall) if ALDOT desires to continue current operational levels?
    - If expenditures are forced to fit within forecasts, how are the various categories of expenditures affected, assuming relative proportions of expenditures are held (pro rata cuts in each expenditure category)? Assuming one or at most two categories absorb the shortfall?
- Another set of questions to be answered by this study originate in the CAFÉ standards for passenger cars and light trucks:
    - What is the forecasted impact on gasoline consumption in Alabama?
    - What in turn will be the forecasted impact on ALDOT revenues and shortfalls?

The study was broken into five tasks as follows:

Task 1: Analyze and Forecast State Revenues
Task 2: Analyze and Forecast Federal and Total Revenues
Task 3: Analyze and Forecast Statutory Diversions of ALDOT Revenues
Task 4: Analyze and Forecast Expenditures
Task 5. Draw Conclusions for Future ALDOT Revenues and Expenditures

and this chapter is organized accordingly. Note that Tasks 1 and 2 deal with ALDOT revenues, Tasks 3 and 4 deal with ALDOT expenditures (with some data from TXDOT and CALTRANS included for comparisons or insights), and Task 5 is where forecasts for revenues are used to draw conclusions about expenditures for the 19 year period 2012-2030 under baseline revenue sources and associated changes in factors affecting Alabama revenues, especially gasoline consumption in the State. Expenditure growth for System Enhancement (SE) is also a subject of sensitivity analysis in Task 5.

The study process itself can be visualized as a complex information flow as depicted in Figure 2-1. The task numbers have been omitted in this flowchart to emphasize the interconnectivity of the task activities which converge on Task 5 in the bottom right-hand corner of the figure. Since the Interim Report on October 31, 2012, two modeling efforts for future gasoline demand have been completed, the impact on state, federal, and total revenues has been determined, and a number of sensitivities (Task 5B in Figure 2.1) have been completed and will be reported.

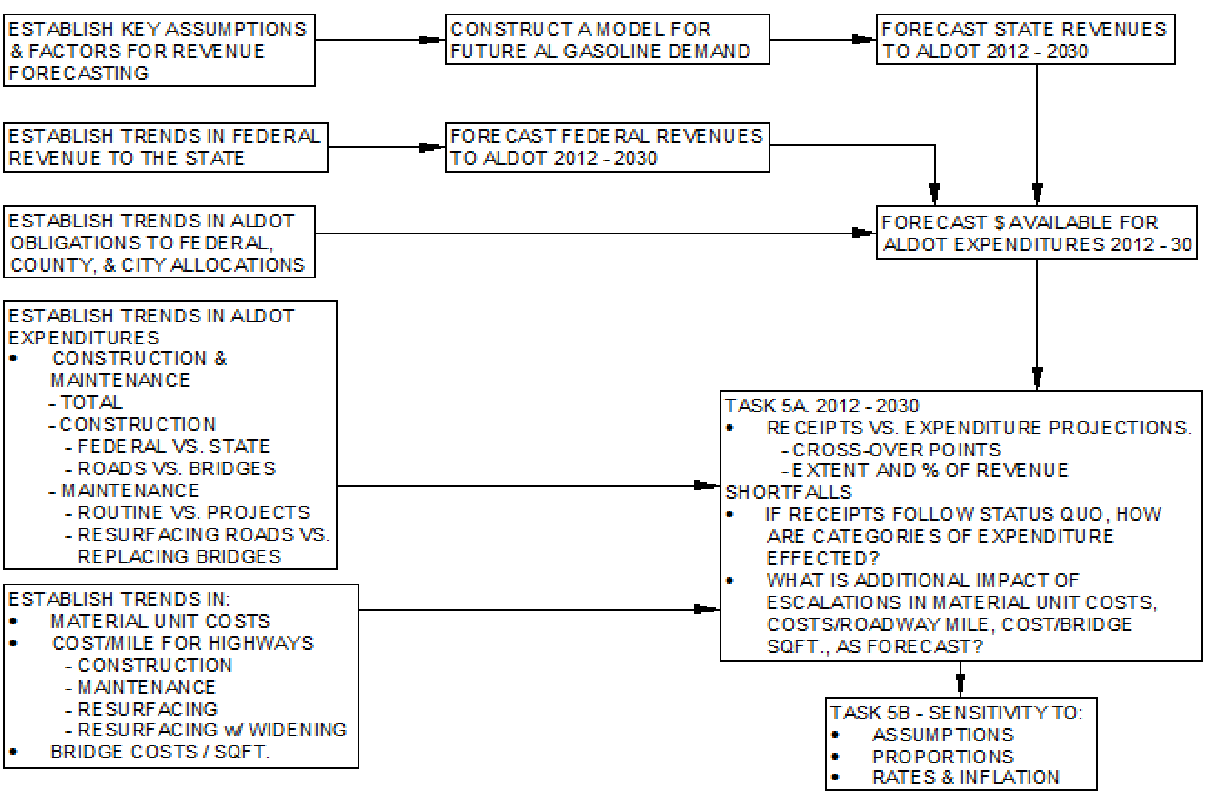

Figure 2-1. Study Process Flowchart

2.1 Analyze and Forecast State Revenues

2.1.A Key Assumptions and Factors for State Revenue Forecasts

This section presents a baseline projection using ALDOT's current sources of state revenues, and the following section (Task 2) forecasts the federal funds to ALDOT. A structural equations modeling system was developed with a set of regression equations for each source of revenue stream that determines the total funds to be received by ALDOT during the time frame of this study, 2012-2030. The equations were based on following assumptions:

- U.S. and Alabama economic conditions that have an impact on such factors as transportation activity (trucking, shipping etc.);
- Gasoline prices;
- Consumer and business spending;
- Consumer spending on gasoline;
- Demand for alternative sources of energy and fuels.

Most of the variables used are susceptible to changes in economic conditions and have a direct impact on gasoline sales and other sources of revenue for ALDOT.

2.1.B Forecasts of Alabama Gasoline Demand

Table 2-1 contains a fifteen year record of gasoline sales in Alabama, from FHWA [2]:

Table 2-1. Alabama Gasoline Sales 1997-2011 (FHWA)

Year	Gasoline Sales (Gallons)
1997	2,327,588,000
1998	2,377,996,000
1999	2,430,644,000
2000	2,375,190,000
2001	2,390,242,000
2002	2,552,567,000
2003	2,477,986,000
2004	2,594,299,000
2005	2,591,830,000
2006	2,583,160,000
2007	2,612,364,000
2008	2,542,928,000
2009	2,513,306,000
2010	2,612,900,000
2011	2,618,000,000

2.1.B.1 Linear and Quadratic Extrapolation of 1997-2011 Trends

Referring to the Figures 2-2 and 2-3, the following rates of change were computed:
Years 1-15 (1997-2011): 19,171,307 gallons increase per year
Years 1-8 (1997-2004): 32,711,286 gallons increase per year
Years 8-15 (2004-2011): 0 gallons increase per year, constant at 2,583,598,375 gallons.
These declining slopes over the past 15 years seem to indicate that the rate of increase in gasoline consumption has declined, and is now essentially flat at 2.584B gallons per year. A quadratic model for the past 15 years, Figure 2-4, also supports this conclusion.

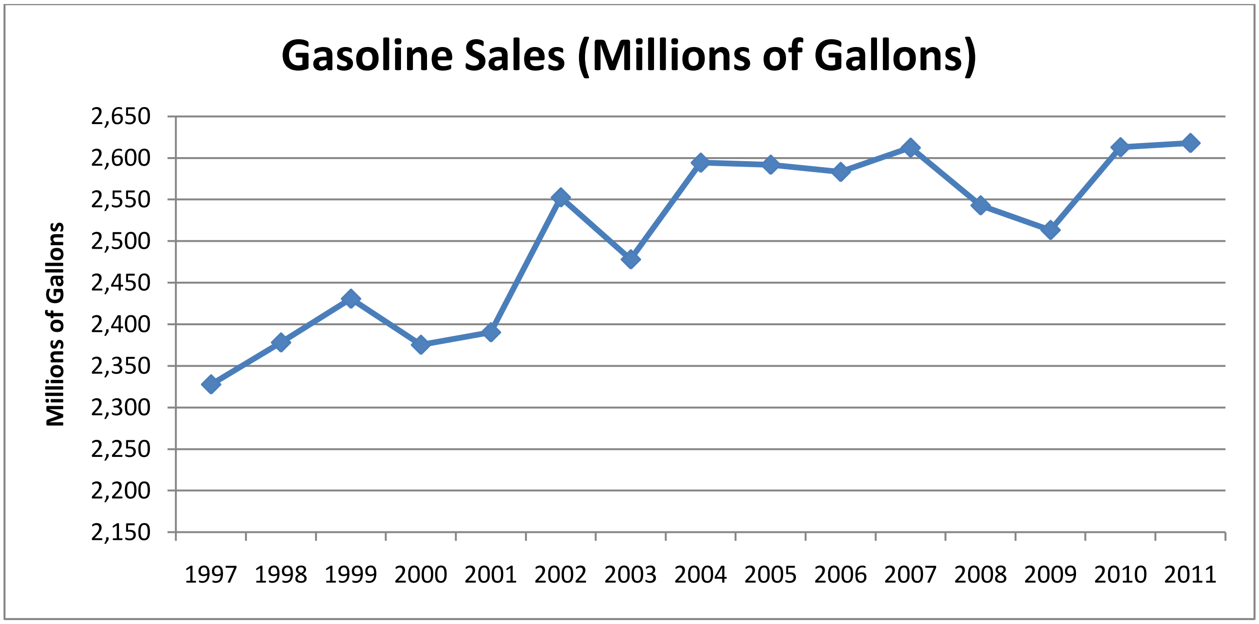

Figure 2-2. Alabama Gasoline Sales 1997-2011 (FHWA)

Based strictly on trends the past fifteen years, the forecast for future gasoline consumption in Alabama is therefore flat, where the underlying assumption is that increases in the number of vehicles traveling Alabama highways have been offset by reduced annual fuel use per vehicle, which depends on average vehicle miles driven and fuel economy. The 2.584B gallons is a forecast mean for future years, with 95% prediction intervals centered at 2.584B as follows:

2012 (2.459B, 2.708B)
2020 (2.367B, 2.798B)
2030 (2.239B, 2.924B).

However, if the two "recession years" 2008-09 are deleted from the last eight years (2004-2011) data, and the trend line refit, it shows that Alabama gasoline consumption will continue to increase by 4.824M gallons per year, which is encouraging. Using this model, the 95% prediction intervals are respectively: 2012 (2.580B, 2.668B), 2020 (2.579B, 2.746B), 2030 (2.569B, 2.853B) with the mean gradually increasing rather than constant.

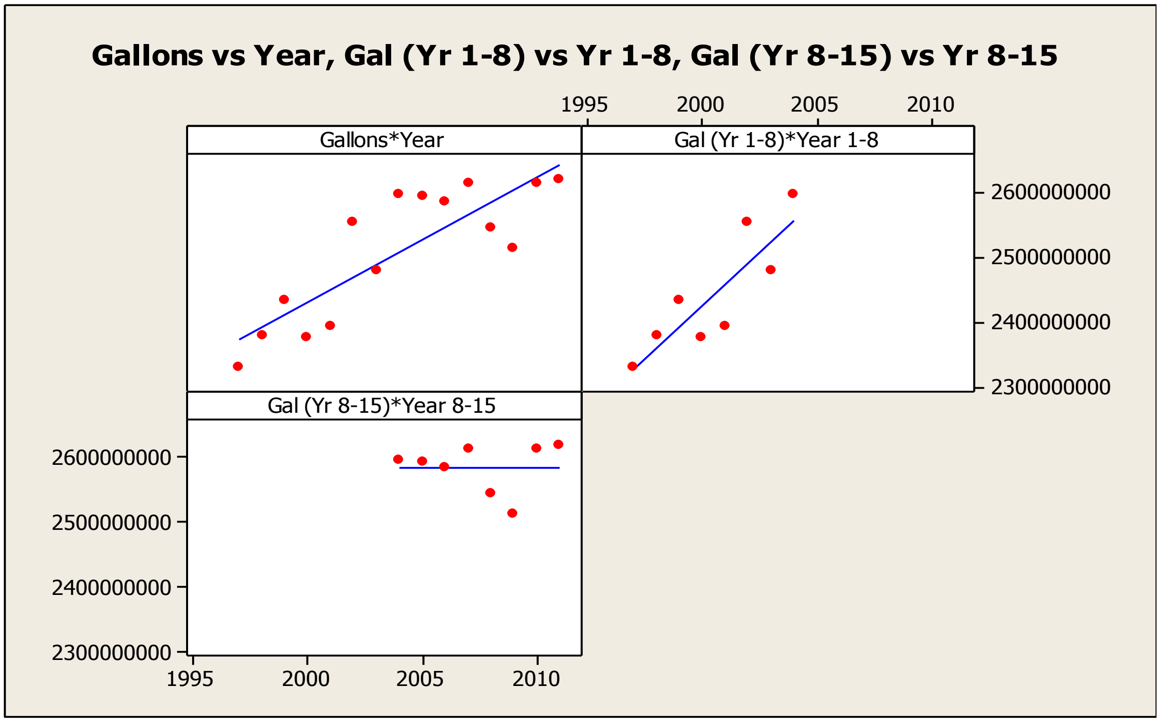

Figure 2-3. Scatterplots with Linear Trend Lines for Alabama Gasoline Consumption

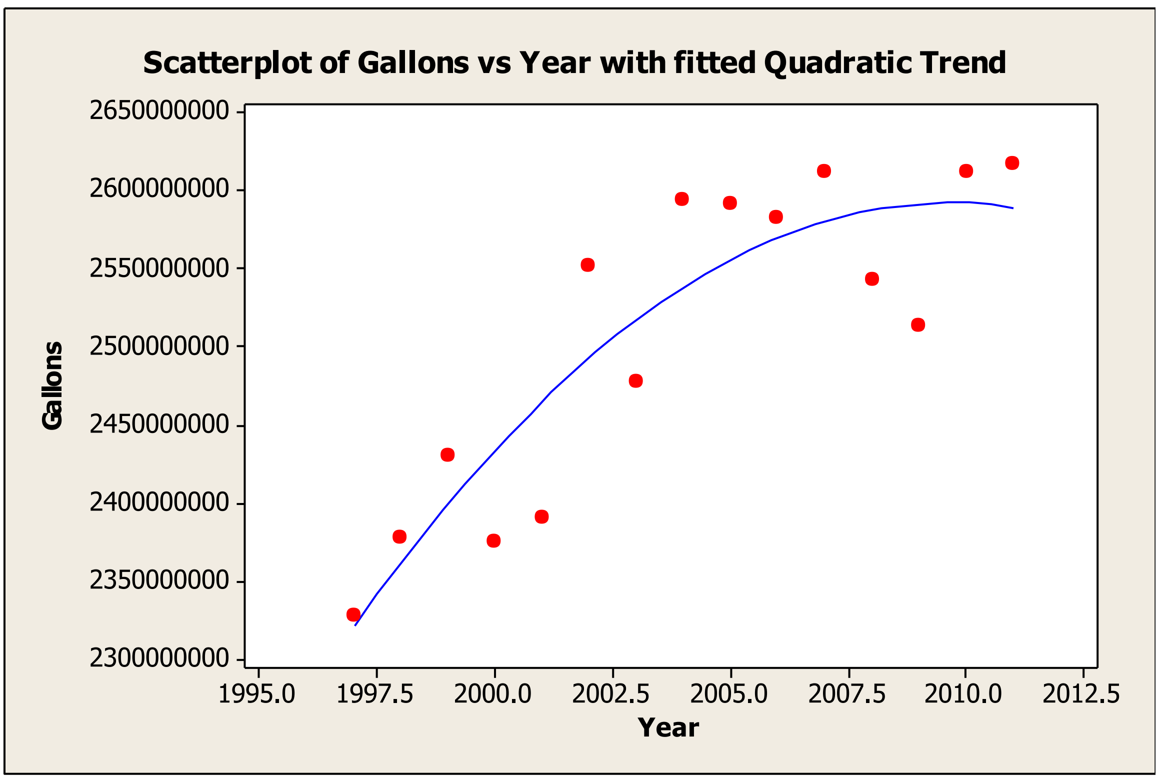

Figure 2-4. Scatterplot with Quadratic Trend in Alabama Gasoline Consumption

Normally, one should not extrapolate using the quadratic model depicted in Figure 2-4, because clearly any parabolic fit must turn downward at some point. However, it will be shown later in this section that the decreasing forecast of Alabama gasoline consumption in Figures 2-5 (using all fifteen year) or Figure 2-6 (omitting 2008-09) fits well with forecasts based on miles driven (linearly increasing) and gallons per mile (decreasing non-linearly due to CAFÉ standards being phased in), lending credence to those forecasts.

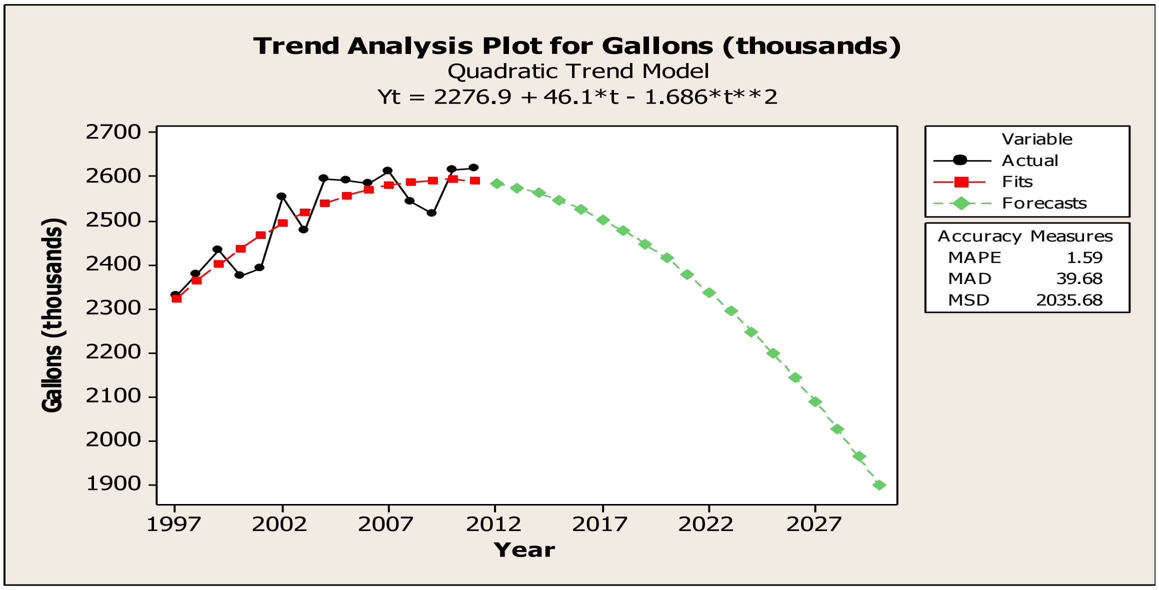

Figure 2-5. Forecast of AL Gasoline Consumption based on Quadratic Trend, 1997-2011

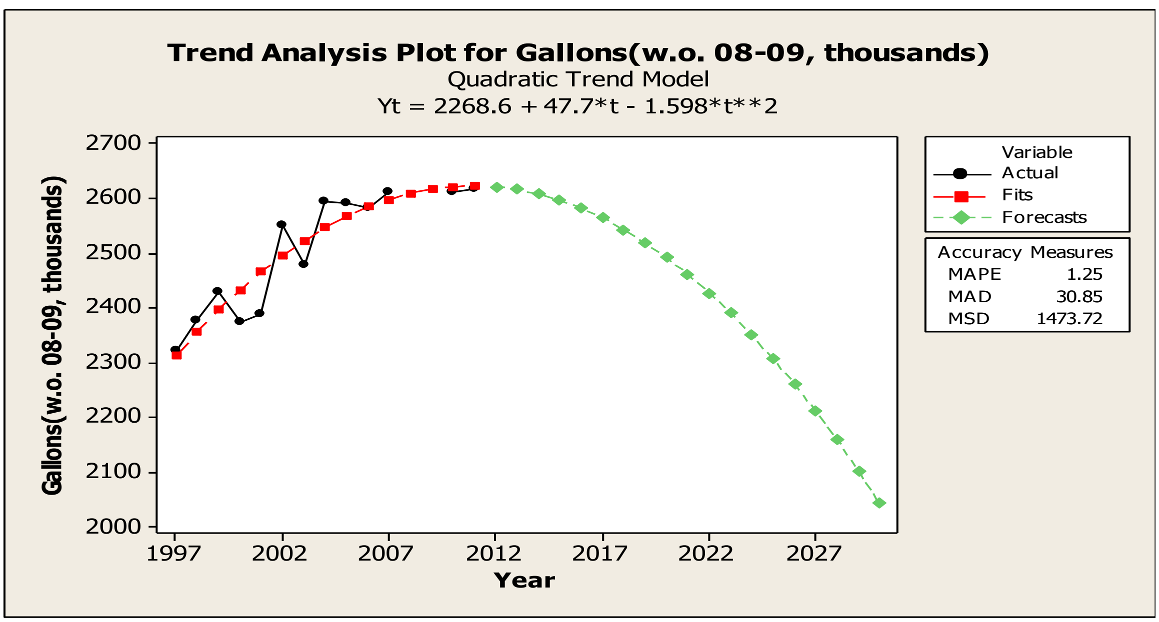

Figure 2-6. Forecast of AL Gasoline Consumption based on Quadratic Trend, 2008-09 omitted

The actual data and forecasts graphed in Figures 2-3 through 2-6 are shown in Table 2-2.

Table 2-2. Alabama Gasoline Consumption and Forecasts (Gallons, B)

Year	Gallons (billions)	Gallons (w.o. 08-09, billions)	Linear Extrapolation of Gallons	Linear Extrapolation of Gallons (w.o. 08-09)	Quadratic Extrapolation of Gallons	Quadratic Extrapolation of Gallons (w.o. 08-09)
1997	2.3276	2.3236				
1998	2.3780	2.3780				
1999	2.4306	2.4306				
2000	2.3752	2.3752				
2001	2.3902	2.3902				
2002	2.5526	2.5526				
2003	2.4780	2.4780				
2004	2.5943	2.5943				
2005	2.5918	2.5918				
2006	2.5832	2.5832				
2007	2.6124	2.6124				
2008	2.5429					
2009	2.5133					
2010	2.6129	2.6129				
2011	2.6180	2.6180				
2012			2.659052	2.6940	2.5837	2.6225
2013			2.678223	2.7162	2.5742	2.6175
2014			2.697394	2.7384	2.5613	2.6092
2015			2.716565	2.7606	2.5451	2.5978
2016			2.735736	2.7827	2.5255	2.5832
2017			2.754907	2.8049	2.5025	2.5654
2018			2.774078	2.8271	2.4762	2.5443
2019			2.793249	2.8492	2.4465	2.5201
2020			2.81242	2.8714	2.4134	2.4927
2021			2.831591	2.8936	2.3769	2.4621
2022			2.850762	2.9157	2.3371	2.4283
2023			2.869933	2.9379	2.2939	2.3913
2024			2.889104	2.9601	2.2473	2.3511
2025			2.908275	2.9823	2.1974	2.3078
2026			2.927446	3.0044	2.1440	2.2612
2027			2.946617	3.0266	2.0874	2.2114
2028			2.965788	3.0488	2.0273	2.1584
2029			2.984959	3.0709	1.9639	2.1023
2030			3.00413	3.0931	1.8971	2.0429

To contrast the linear forecasts with quadratic forecasts of Alabama gasoline consumption based on trends 1997-2011, and 1997-2011 with 2008-09 omitted, consider Figures 2-7 and 2-8. Linear trends certainly are more favorable to the future revenues of ALDOT, whereas the quadratic trends are discouraging and would suggest return to consumption levels of the late 90s by 2020.

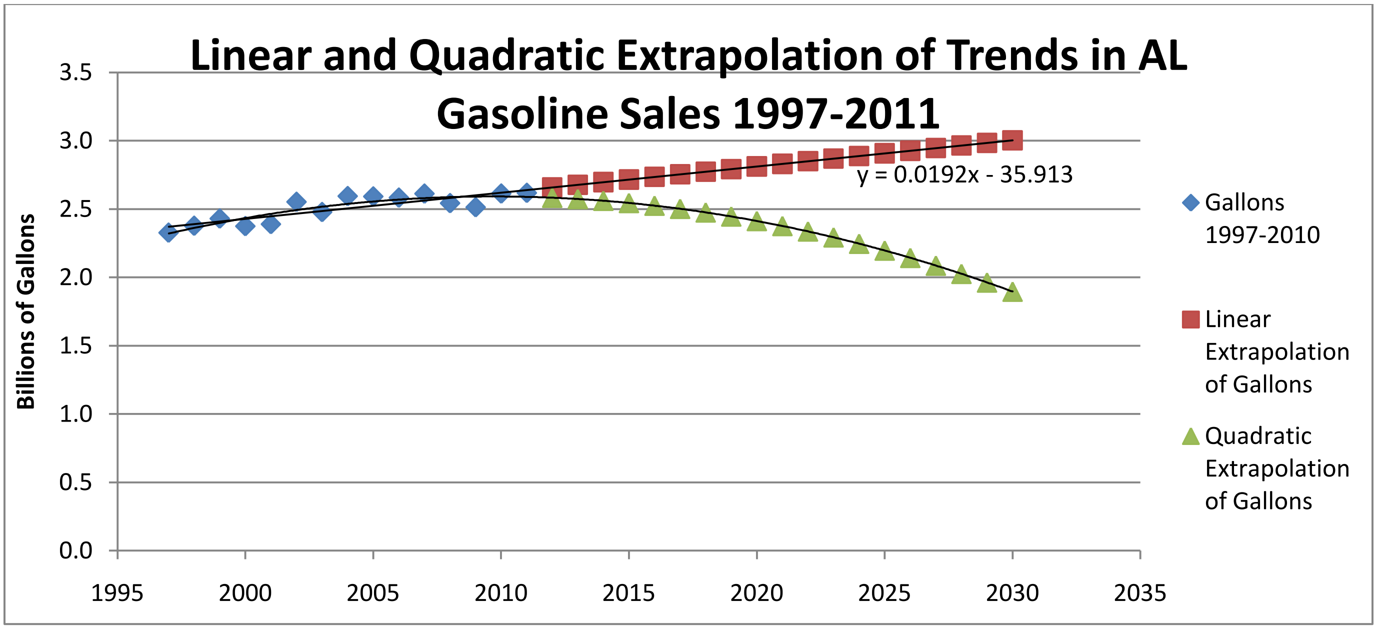

Figure 2-7. Linear and Quadratic Forecasts of AL Gasoline Consumption, using 1997-2011

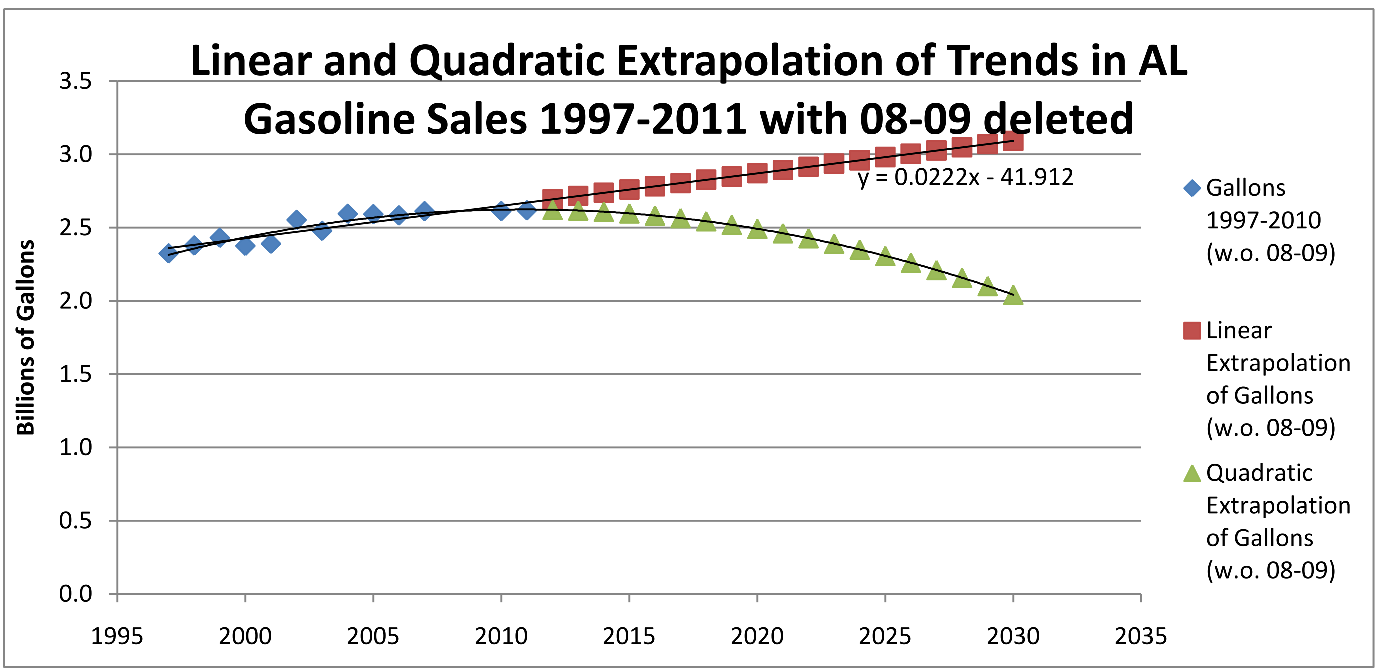

Figure 2-8. Linear and Quadratic Forecasts of AL Gasoline Consumption, 2008-09 omitted

2.1.B.2 Forecasts based on CAFÉ Standards and Alabama Annual Mileage

The Corporate Average Fuel Economy (CAFÉ) standards for light-duty vehicles from 1997-2025 are depicted in Table 2-3 under passenger cars and light trucks. If one assumes a 20-80 mix of large to small passenger cars and a 40-60 mix of large to small light trucks, the average CAFÉ for each year is shown. Finally, if one assumes a 50-50 mix of cars and light trucks in each year's new models purchased, a grand average new vehicle mpg is calculated (final column).

Table 2-3. CAFÉ Standards and resulting Average Fuel Economy (mpg), 1997-2025

CAFÉ mpg	Passenger Cars			Light Trucks			Combined Cars and Trucks
Year	Large	Small	20-80 mix	Large	Small	40-60 mix	50-50 mix in new vehicles
1997	27.5	27.5	27.5	20.7	20.7	20.7	24.1
1998	27.5	27.5	27.5	20.7	20.7	20.7	24.1
1999	27.5	27.5	27.5	20.7	20.7	20.7	24.1
2000	27.5	27.5	27.5	20.7	20.7	20.7	24.1
2001	27.5	27.5	27.5	20.7	20.7	20.7	24.1
2002	27.5	27.5	27.5	20.7	20.7	20.7	24.1
2003	27.5	27.5	27.5	20.7	20.7	20.7	24.1
2004	27.5	27.5	27.5	20.7	20.7	20.7	24.1
2005	27.5	27.5	27.5	20.7	20.7	20.7	24.1
2006	27.5	27.5	27.5	20.7	20.7	20.7	24.1
2007	27.5	27.5	27.5	20.7	20.7	20.7	24.1
2008	27.5	27.5	27.5	20.7	20.7	20.7	24.1
2009	27.5	27.5	27.5	20.7	20.7	20.7	24.1
2010	27.5	27.5	27.5	20.7	20.7	20.7	24.1
2011	30.2	30.2	30.2	24.1	24.1	24.1	27.15
2012	28	36	34.4	22	30	26.8	30.6
2013	28.5	37	35.3	22.5	31	27.6	31.45
2014	29	38	36.2	23	32	28.4	32.3
2015	30	39	37.2	23.5	33	29.2	33.2
2016	31	41	39	24.5	34	30.2	34.6
2017	33	44	41.8	25	36	31.6	36.7
2018	34	45	42.8	25	37	32.2	37.5
2019	35	47	44.6	25	38	32.8	38.7
2020	36	49	46.4	25	39	33.4	39.9
2021	37	51	48.2	25	42	35.2	41.7
2022	38	53	50	26	44	36.8	43.4
2023	40	56	52.8	27	46	38.4	45.6
2024	41	58	54.6	28.5	48	40.2	47.4
2025	43	61	57.4	30	50	42	49.7

The CAFÉ standards are actually presented by the EPA and NHTSA as a set of graphs, with large-medium-small vehicles assigned a mpg for each year. The medium-sized vehicles are assigned a mpg based on a sliding scale according to their size. So, the numbers in Table 2-3 are working with only the two extremes of vehicle size, and using reasonable averaging across sizes and types of vehicles to come up with average fuel economy for all new vehicles entering the U.S. fleet each year. The averages we compute have been checked against articles in the press and statements by federal government officials and found to be accurate. In order to make gasoline consumption forecasts out to 2030, we needed average mpg for 2026-2030, so we fit a quadratic to the mpg forecasts shown and continued the trend out to 2030, as will be seen in later tables. In order to convert the numbers in the last column of Table 2-3 into forecasts of the combined mpg of all vehicles on the road in any one year, the method of moving averages was used. For instance, to forecast the U.S. fleet mpg in 2020 based on an assumptions of 10 year average vehicle life (125,000 average vehicle mileage at retirement using the known average 12,500 miles per vehicle per year), one would need to reach back to obtain the average mpg for the 10 years 2010-2019. Similarly, we will use 12-year, 14-year, and 16-year moving averages to calculate the U.S. fleet mpg if vehicles are assumed to last, on average, 150,000, 175,000, and 200,000 miles respectively. Once we know the fleet mpg, it is a simple matter to invert that average to obtain the average gallons per mile for all vehicles on the road in a given year. Multiplying gallons per mile times a forecast of total mileage driven in Alabama will yield gasoline consumption forecasts as shown in Table 2-4 and Figure 2-9 for the case of 10-year (125,000 mile) average vehicle life, with total Alabama miles driven predicted as described next.

We created Alabama gasoline consumption forecasts based on forecasting vehicle miles traveled (vmt) in three different ways: using the official vmt data from 1967-2010 as the basis in two cases, and the vmt data from 1997-2010 (but with 2008-09 omitted) as the basis in a third model.

The regression models fit for Alabama vehicle miles traveled (vmt), in billions (B), are:

Model 1 (Uses 1997-2010 mileage but with 2008, 2009 omitted as odd years in the trend):

vmt (B) = -1431.12+0.744*year, R^2 = 98.1%, so mileage increases 744M miles per year.

Model 2 (Uses 1967-2010 mileage, which gives a steeper annual increase than Model 1):

vmt(B) = -2262.05 +1.158*year, R^2 = 97.6%, so mileage increases 1158 M miles per year.

Model 3 (Uses 1967-2010 mileage, but with 2008-09 omitted, yielding the steepest slope):

vmt (B) = -2341.18 + 1.198*year, R^2 = 98.5%, so mileage increases 1198 M miles per year.

The problem ALDOT faces is this sort of increase in vmt is not enough to offset the annual increase in mpg of vehicles on the road, whether you assume the average age is as low as 10 years (125,000 mi) or as high as 16 years (200,000 mi). Also note the magnitude of the slopes of these liner models. Model 1 gives the slowest growth in mileage, hence to biggest drop in gasoline consumption; Model 3 has highest mileage growth and least drop in consumption.

Table 2-4. Predictions of Vehicle Miles Traveled and Gasoline Consumed, 10-yr Vehicle Life

year	CAFÉ mpg	10-yr MA mpg	vmt(B) using Model 1	gal (B) forecast Model 1	vmt(B) using Model 2	gal (B) forecast Model 2	vmt(B) using Model3	gal (B) forecast Model 3
1997	24.10	24.10	54.648	2.268	50.476	2.094	51.226	2.126
1998	24.10	24.10	55.392	2.298	51.634	2.142	52.424	2.175
1999	24.10	24.10	56.136	2.329	52.792	2.191	53.622	2.225
2000	24.10	24.10	56.880	2.360	53.950	2.239	54.820	2.275
2001	24.10	24.10	57.624	2.391	55.108	2.287	56.018	2.324
2002	24.10	24.10	58.368	2.422	56.266	2.335	57.216	2.374
2003	24.10	24.10	59.112	2.453	57.424	2.383	58.414	2.424
2004	24.10	24.10	59.856	2.484	58.582	2.431	59.612	2.474
2005	24.10	24.10	60.600	2.515	59.740	2.479	60.810	2.523
2006	24.10	24.10	61.344	2.545	60.898	2.527	62.008	2.573
2007	24.10	24.10	62.088	2.576	62.056	2.575	63.206	2.623
2008	24.10	24.10	62.832	2.607	63.214	2.623	64.404	2.672
2009	24.10	24.10	63.576	2.638	64.372	2.671	65.602	2.722
2010	24.10	24.10	64.320	2.669	65.530	2.719	66.800	2.772
2011	27.15	24.41	65.064	2.666	66.487	2.724	67.998	2.786
2012	30.60	25.06	65.808	2.627	67.645	2.700	69.196	2.762
2013	31.45	25.79	66.552	2.581	68.803	2.668	70.394	2.730
2014	32.30	26.61	67.296	2.529	69.961	2.629	71.592	2.690
2015	33.20	27.52	68.040	2.472	71.118	2.584	72.790	2.645
2016	34.60	28.57	68.784	2.408	72.276	2.530	73.988	2.590
2017	36.70	29.83	69.528	2.331	73.434	2.462	75.186	2.520
2018	37.50	31.17	70.272	2.254	74.592	2.393	76.384	2.451
2019	38.70	32.63	71.016	2.176	75.750	2.321	77.582	2.378
2020	39.90	34.21	71.760	2.098	76.908	2.248	78.780	2.303
2021	41.70	35.67	72.504	2.033	78.066	2.189	79.978	2.242
2022	43.40	36.95	73.248	1.983	79.224	2.144	81.176	2.197
2023	45.60	38.36	73.992	1.929	80.382	2.095	82.374	2.147
2024	47.40	39.87	74.736	1.874	81.540	2.045	83.572	2.096
2025	49.70	41.52	75.480	1.818	82.697	1.992	84.770	2.042
2026		43.31	76.224	1.760	83.855	1.936	85.968	1.985
2027		45.20	76.968	1.703	85.013	1.881	87.166	1.928
2028		47.17	77.712	1.647	86.171	1.827	88.364	1.873
2029		49.23	78.456	1.594	87.329	1.774	89.562	1.819
2030		51.37	79.200	1.542	88.487	1.723	90.760	1.767

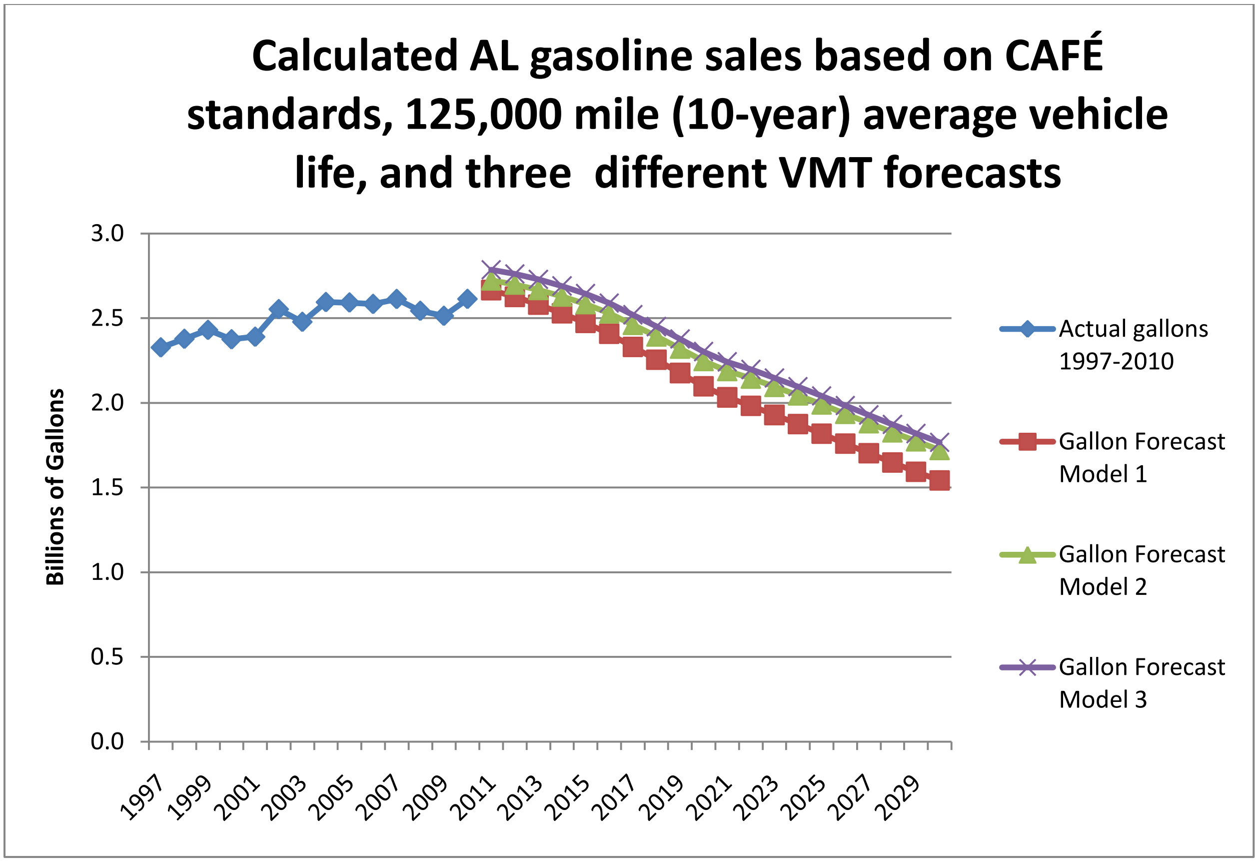

Figure 2-9. Forecasts of Alabama Gasoline Consumption, 10-yr Vehicle Life

Graphs of forecasts for Alabama gasoline consumption using the same three vmt models but increasing the average automobile life from 10 years to 16 years in 2 year increments (25,000 mile increments) are depicted in Figures 2-9 through 2-12. All these graphs show significant declines in Alabama gasoline consumption over the forecasting period 2012-2030. Mileage Model 1 gives the lowest increase in annual vehicle miles traveled, hence is least advantageous in terms of gasoline consumption taxes; Mileage Model 3 gives the highest increase in annual vehicle miles traveled, hence is the most advantageous in terms of gasoline consumption taxes. Also, working across all four graphs, it is clear that as the average lifetime of vehicles increases, less fuel efficient vehicles remain on the road longer, and hence the decline in gasoline consumption (hence tax receipts) is lessened. The current (2012) lifetime of U.S. vehicles is approximately 140,000 miles, so with 200,000 miles expected as an average by 2030, the graphs in Figure 2-11 are considered representative for the period 2012-2030, and will be used as such later in this report. The quadratic extrapolation in Figure 2-6 takes on the general appearance of the gasoline consumption forecasts in Figures 2-9 through 2-12; it actually predicts a somewhat smaller decline out to 2030 than in Figure 2-9. In fact, the quadratic extrapolation is very strongly correlated with the 12-year and 14-year moving average forecasts (Figures 2-10 & 2-11) using Model 3. Using two quite different forecasting methods have led to the same conclusion: *gasoline consumption in Alabama will decline significantly during the next two decades.*

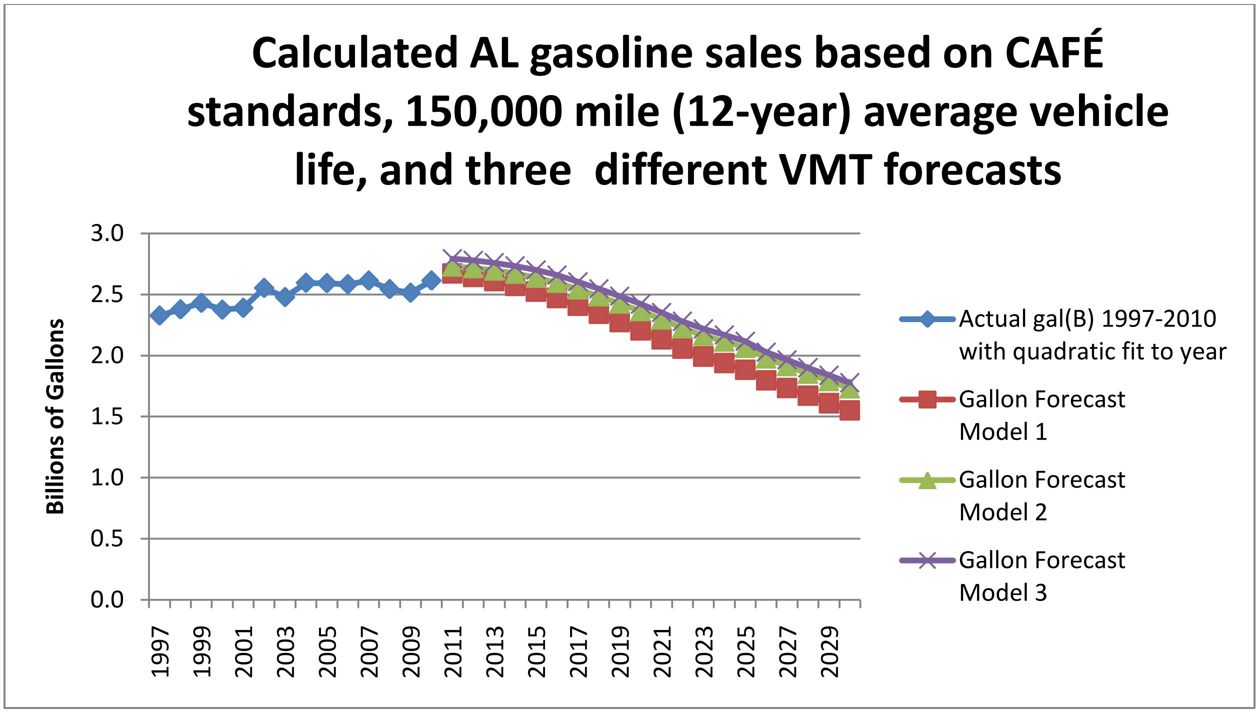

Figure 2-10. Forecasts of Alabama Gasoline Consumption, 12-yr Vehicle Life

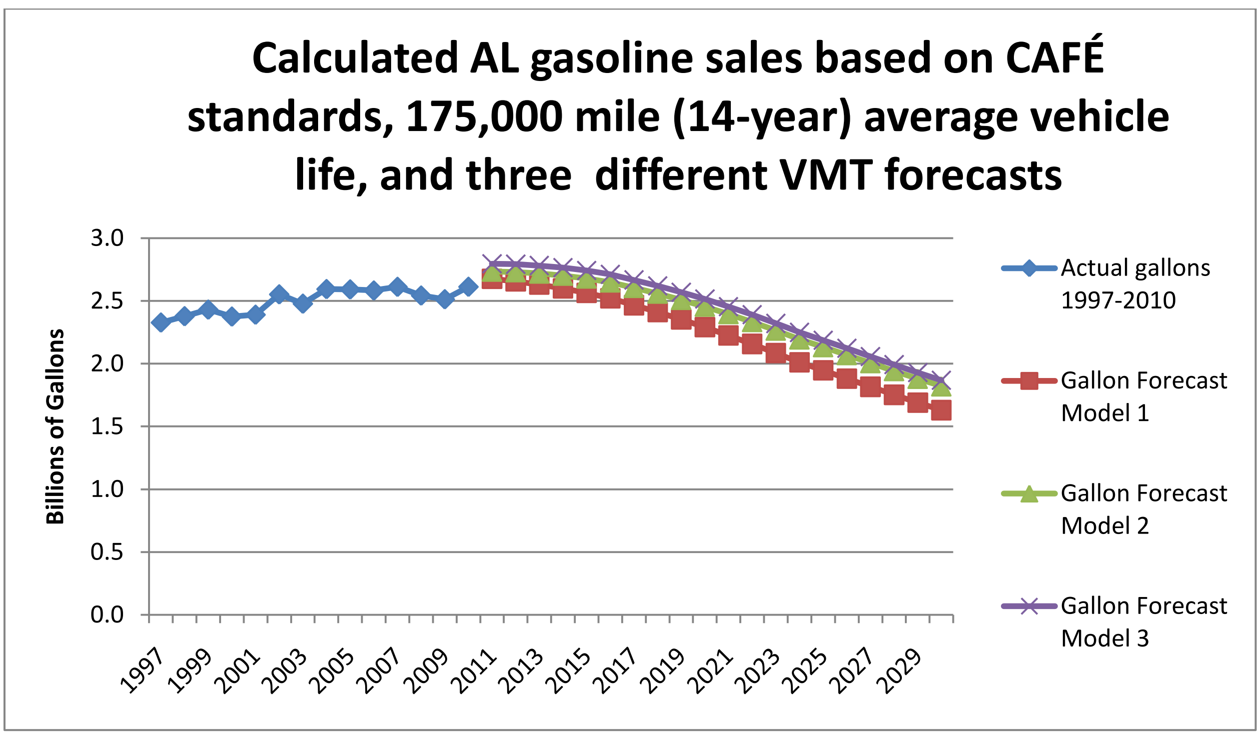

Figure 2-11. Forecasts of Alabama Gasoline Consumption, 14-yr Vehicle Life

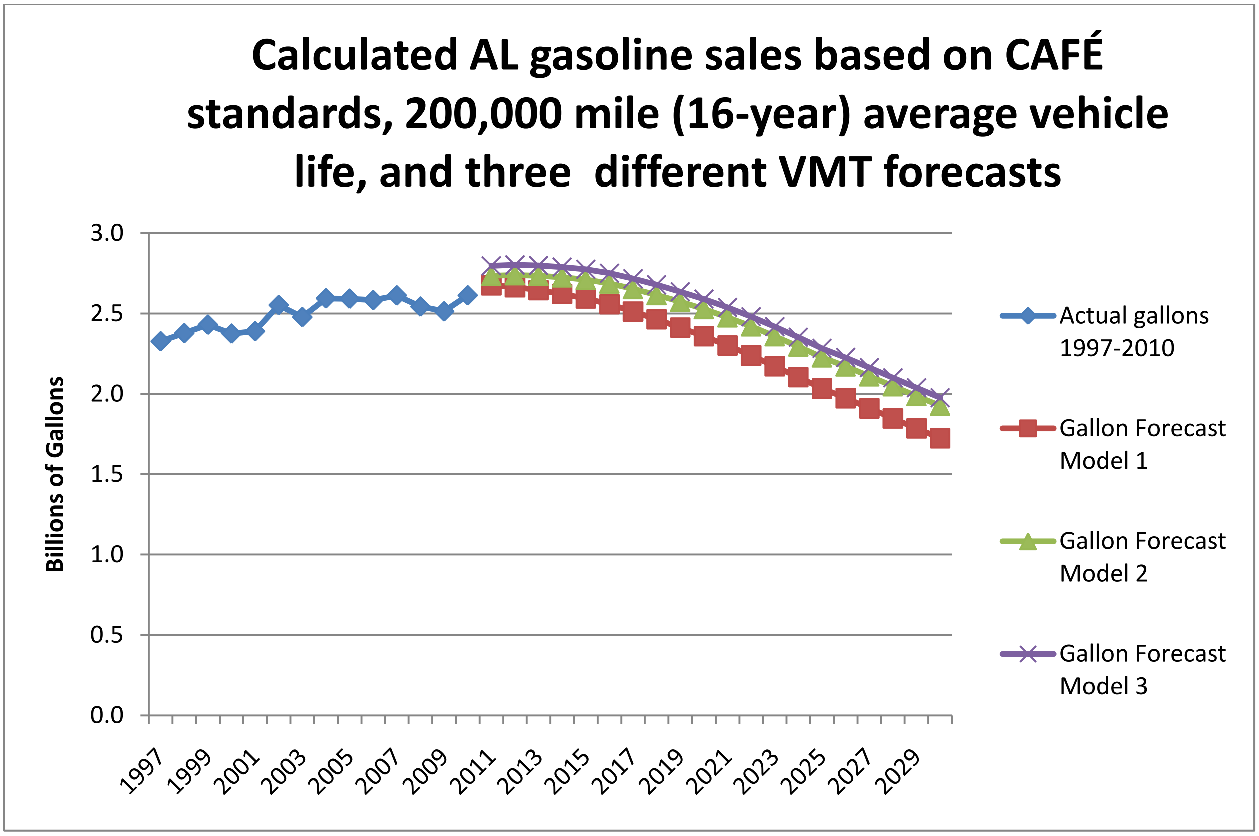

Figure 2-12. Forecasts of Alabama Gasoline Consumption, 16-yr Vehicle Life

Table 2-5 is a summary of the Alabama gasoline consumption forecasts, in billions of gallons, for the years 2020 and 2030, using the four assumed values for average vehicle life and the three models for Alabama vehicle miles traveled (vmt). Recall the *known* gasoline consumption in Alabama for 2011 was 2.618B gallons. Our models all show the 2012 consumption peaking at between 2.6 and 2.7 B gallons, then declining 2012-2030. If one assumes the 14-year vehicle life (175,000 miles) is representative, then in 2020, we predict the gasoline consumption to be in the range 2.29-2.52 B gallons—an 8% decline, and in 2030 to be in the range 1.63-1.83 B gallons—a 33% decline, relative to the known 2011 consumption.

Table 2-5. Forecasts of Alabama Gasoline Consumption in 2020 and 2030

Alabama Gasoline Consumption (Gal, B)								
Forecast Year-->	2020				2030			
Average Vehicle Life Assumed-->	10 yr	12 yr	14 yr	16 yr	10 yr	12 yr	14 yr	16 yr
based on Model 1 forecast vmt*	2.098	2.206	2.291	2.359	1.542	1.551	1.630	1.725
based on Model 2 forecast vmt	2.248	2.365	2.455	2.528	1.723	1.733	1.821	1.927
based on Model 3 forecast vmt	2.303	2.422	2.515	2.590	1.767	1.778	1.826	1.976

* Vehicle Miles Traveled (total, Alabama)

2.1.B.3 Diesel Fuel Consumption Trends and Forecasts

The consumption of diesel fuel in Alabama has essentially been flat the past 14 years. From 1997-2010, the average annual consumption was 737.5M gallons, with no statistically significant trend. Taking the seven years 2004-2010, the average was slightly higher, 768.1M gallons, but the trend line of these data actually shows consumption declining by 12.9 million gallons per year, on average. Because the years 2008-09 are included, it is fair to say the trend continued essentially flat during the past 7-8 years. Diesel engines do offer a fuel economy benefit of 30-35% over gasoline engines with same horsepower, but today only 3% of U.S. light vehicles use diesel, versus Europe's 50% [4]. There is speculation that CAFÉ Standards will drive this percentage to increase to the range of 4-10% by 2015, and if so diesel fuel sales would increase; this increase would be off-set by a decrease in gasoline sales. Net revenue effect would be small.

2.1.C Forecast of State Revenues to ALDOT 2012-30

This subsection first presents baseline forecasts of ALDOT state receipts in more detail that presented in the Introduction, and secondly provides alternative state receipt forecasts using the CAFÉ-related gasoline consumption declines forecast in subsection 1.B.

2.1.C.1
Historical ALDOT Receipts 1997-2011 are shown in Table 2.6, and the State Receipts are graphed in Figure 2-13.

Table 2-6. Record of State, Federal, Other and Total ALDOT Receipts ($M), 1997-2011

Year	State Receipts	Federal Receipts	Other Receipts	Total Receipts
1997	428.95	329.11	55.41	817.95
1998	444.42	303.09	23.79	773.88
1999	455.79	405.54	17.86	881.48
2000	464.03	537.77	15.68	1019.61
2001	454.25	688.35	25.99	1168.70
2002	460.11	761.25	54.86	1276.61
2003	460.13	587.75	40.61	1088.49
2004	470.64	526.86	108.18	1105.68
2005	496.91	630.38	98.52	1225.82
2006	531.42	755.45	86.64	1373.51
2007	523.35	724.72	81.87	1324.56
2008	496.85	813.59	54.40	1364.84
2009	484.07	740.78	27.54	1252.39
2010	498.94	763.07	28.32	1290.33
2011	514.33	786.15	29.13	1329.61

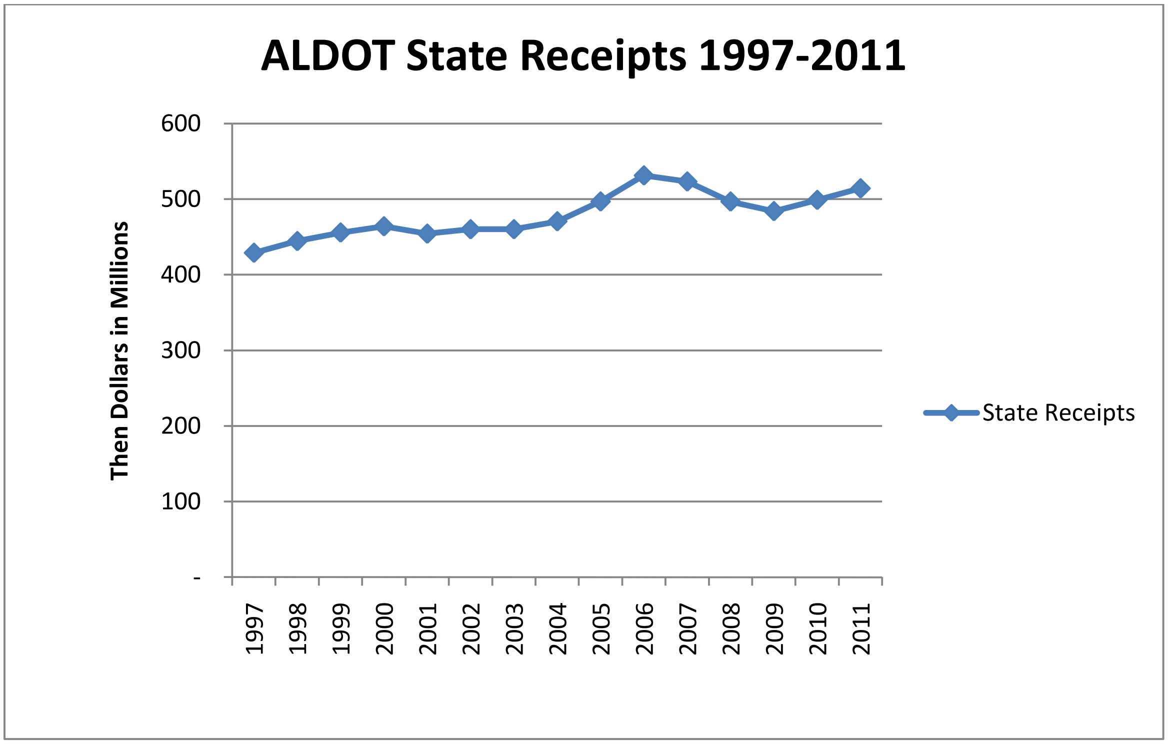

Figure 2-13. ALDOT State Receipts 1997-2011

State Receipts were increasing 1997-2006, but experienced a dip with recovery 2007-2011. State Receipts increased at a compound rate of only 1.22 % per year, 1997-2011. Table 2-7 includes actual data 1997-2011 and our baseline forecast of ALDOT revenues for 2012-2030.

Figure 2-14 depicts actual State Receipts 1997-2011 and our baseline forecast of State Receipts 2012-2030. We forecast State Receipts to increase at a compound rate of 3.19% per year, 2012-2030, which may be optimistic given (a) the 1.22% rate of increase the previous 15 years, and (b) the previous concerns over the declining rate of increase of gasoline consumption in the State. Of course, increase in state revenue would come from other sources besides gasoline consumption. We fully investigate the impact of declining gasoline consumption on State Receipts in the next subsection.

Table 2-7. Baseline Forecast of State, Federal, and Total Revenues ($M) to ALDOT 2012-30

Year	State Receipts	Federal Receipts	Other Receipts	Total Receipts
1997	428.95	329.11	55.41	817.95
1998	444.42	303.09	23.79	773.88
1999	455.79	405.54	17.86	881.48
2000	464.03	537.77	15.68	1019.61
2001	454.25	688.35	25.99	1168.70
2002	460.11	761.25	54.86	1276.61
2003	460.13	587.75	40.61	1088.49
2004	470.64	526.86	108.18	1105.68
2005	496.91	630.38	98.52	1225.82
2006	531.42	755.45	86.64	1373.51
2007	523.35	724.72	81.87	1324.56
2008	496.85	813.59	54.40	1364.84
2009	484.07	740.78	27.54	1252.39
2010	498.94	763.07	28.32	1290.33
2011	514.33	786.15	29.13	1329.61
2012	530.47	810.24	29.96	1370.66
2013	547.20	834.52	30.80	1412.52
2014	564.55	859.60	31.68	1455.84
2015	582.57	885.49	32.59	1500.65
2016	601.45	912.57	33.52	1547.54
2017	620.97	939.95	34.46	1595.38
2018	641.40	968.54	35.45	1645.38
2019	662.69	997.62	36.46	1696.78
2020	684.81	1027.70	37.50	1750.01
2021	707.79	1058.49	38.57	1804.85
2022	731.81	1090.57	39.68	1862.06
2023	756.92	1123.65	40.83	1921.40
2024	782.87	1158.24	41.99	1983.09
2025	810.05	1193.12	43.19	2046.37
2026	838.23	1228.90	44.42	2111.56
2027	867.58	1265.99	45.69	2179.26
2028	898.33	1304.07	47.00	2249.40
2029	930.15	1343.65	48.34	2322.14
2030	963.37	1384.24	49.73	2397.34

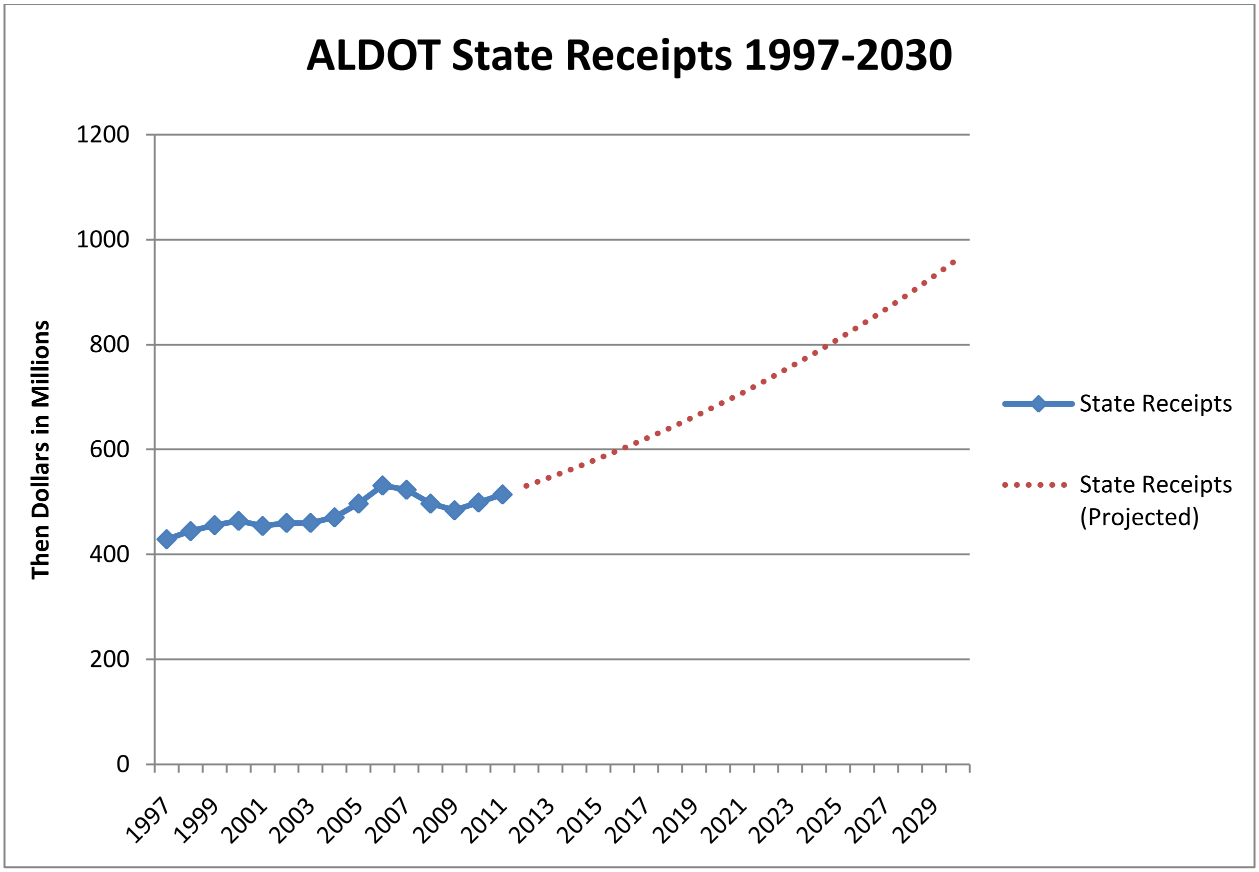

Figure 2-14. Baseline Forecast of State Receipts to ALDOT, 2012-2030

2.1.C.2 State Revenue Forecasts that adjust for CAFÉ Standards

Recall near the end of subsection 1.B.2, we mentioned the 14-year (175,000 mile) vehicle life as a representative life for vehicles on the road in the time period 2012-2030, reasoning that 175,000 miles is longer than the current average of 140,000 but not so long as the 200,000 miles expected in 2030. We also used the Model 1 mileage forecast as a "Worst Case" scenario in Table 2-5 and the discussion of gasoline consumption that followed, and used the Model 3 mileage forecast as "Best Case" scenario. Continuing that line of discussion here, in Table 2-8 CBER has generated ALDOT state, federal, and total revenue forecasts for these two scenarios, where the first set of forecasts is for "Best Case Gasoline Consumption Decline" meaning the smallest decline relative to Baseline, and the second set of forecasts is for "Worst Case Gasoline Consumption Decline" meaning the largest decline relative to baseline. Figure 2-15 depicts the baseline forecast of ALDOT's state receipts in comparison to the state receipt forecasts under best case and worst case gasoline consumption declines, brought on by the CAFÉ standards. The cycles represent economic conditions other than gasoline consumption that affect state receipts. "Other Receipts" are not shown, but over this 34 year period, they average 5% of total receipts (varying from 1-11%) and are included in all total receipts columns.

Table 2-8. Forecasts of State, Federal, and Total Receipts to ALDOT under CAFÉ Standards

	Best Case Gasoline Consumption Decline 2011-2030 ($M, then year)			Worst Case Gasoline Consumption Decline 2011-2030 ($M, then year)		
Year	State Receipts	Federal Receipts	Total Receipts	State Receipts	Federal Receipts	Total Receipts
1997	428.95	329.11	817.95	428.95	329.11	817.95
1998	444.42	303.09	773.88	444.42	303.09	773.88
1999	455.79	405.54	881.48	455.79	405.54	881.48
2000	464.03	537.77	1019.61	464.03	537.77	1019.61
2001	454.25	688.35	1168.70	454.25	688.35	1168.70
2002	460.11	761.25	1276.61	460.11	761.25	1276.61
2003	460.13	587.75	1088.49	460.13	587.75	1088.49
2004	470.64	526.86	1105.68	470.64	526.86	1105.68
2005	496.91	630.38	1225.82	496.91	630.38	1225.82
2006	531.42	755.45	1373.51	531.42	755.45	1373.51
2007	523.35	724.72	1324.56	523.35	724.72	1324.56
2008	496.85	813.59	1364.84	496.85	813.59	1364.84
2009	484.07	740.78	1252.39	484.07	740.78	1252.39
2010	498.94	763.07	1290.33	498.94	763.07	1290.33
2011	535.00	847.00	1400.00	533.00	839.00	1390.00
2012	560.00	844.00	1450.00	553.00	816.00	1420.00
2013	552.00	838.00	1430.00	541.00	788.00	1380.00
2014	517.00	826.00	1390.00	502.00	755.00	1310.00
2015	487.00	811.00	1360.00	467.00	715.00	1250.00
2016	487.00	790.00	1340.00	462.00	668.00	1210.00
2017	513.00	760.00	1320.00	482.00	610.00	1160.00
2018	536.00	728.00	1290.00	498.00	550.00	1100.00
2019	526.00	694.00	1250.00	482.00	485.00	1030.00
2020	486.00	657.00	1210.00	436.00	419.00	957.00
2021	446.00	616.00	1160.00	391.00	406.43	881.00
2022	438.00	573.00	1120.00	377.00	390.17	807.55
2023	461.00	526.00	1070.00	393.00	374.57	807.96
2024	483.00	477.00	1020.00	407.00	361.46	808.90
2025	475.00	435.00	976.00	393.00	348.81	780.85
2026	434.00	391.00	929.00	347.00	333.11	715.90
2027	391.00	347.00	882.00	300.00	318.12	650.65
2028	379.00	331.39	836.00	283.00	302.21	616.01
2029	402.00	318.13	791.00	300.00	287.10	618.00
2030	429.00	308.59	747.00	320.00	272.75	623.94

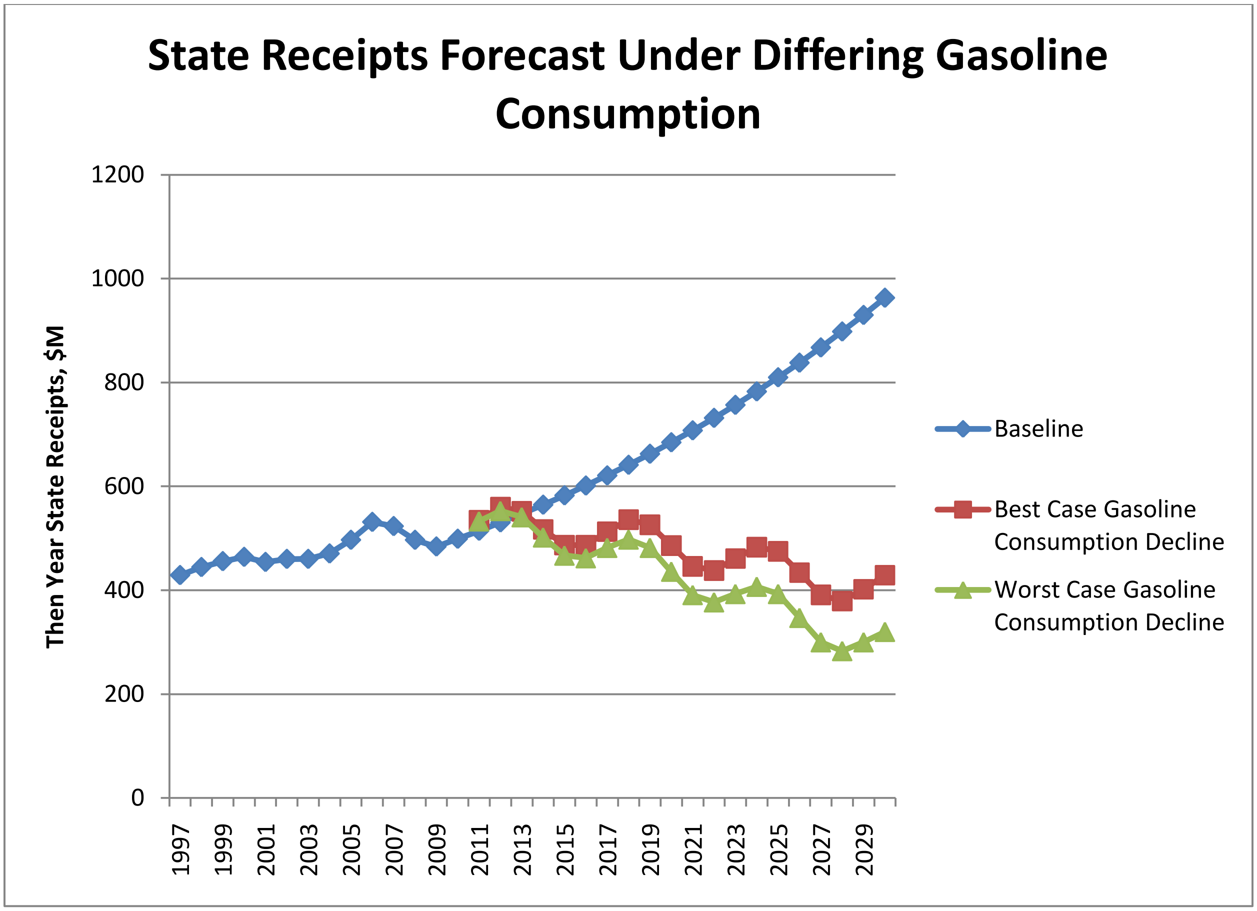

Figure 2-15. Forecast of State Receipts to ALDOT under Differing Gasoline Consumption

State receipts under two gasoline consumption decline models are forecast to decrease 2012-2030, in stark contrast to the baseline forecast which increasing from $514M in 2011 to $810M by 2025. Specifically, the two gasoline consumption decline models forecast State receipts in 2025 to decline to the range of $393-475M.

2.2 Analyze and Forecast Federal Revenues

2.2.A Key Assumptions and Factors for Federal Revenue Forecasts

A structural equations modeling system was developed with a set of regression equations for each source of revenue stream that determines the total funds to be received by ALDOT during the time frame of this study 2012-2030, including funds provided by the federal government. The equations were based on following assumptions:

- U.S. and Alabama economic conditions that have an impact on such factors as transportation activity (trucking, shipping etc.)
- Gasoline prices

- Consumer and business spending
- Consumer spending on gasoline
- Demand for alternative sources of energy and fuels.

Most of the variables used are susceptible to changes in economic conditions and have a direct impact on gasoline sales and other sources of revenue for ALDOT.

2.2.B Forecast of Federal Revenues to ALDOT 2012-2030

This subsection first presents baseline forecasts of ALDOT federal receipts in more detail that presented in the Introduction, and secondly provides alternative federal receipt forecasts using the CAFÉ-related gasoline consumption declines forecast in subsection 1.B.

2.2.B.1 Baseline Federal Revenue Forecast

Table 2-6 and Figure 2-16 show Federal Receipts increased at a compound rate of 5.98% per year 1997-2011, with some reduction in the rate of increase the last six years. Table 2-8 and Figure 2-17 contain our forecast for Federal Receipts 2012-2030 which follow a 2.86% per year compound rate of increase, a reduction in annual rate of about one-half compared to 1997-2011.

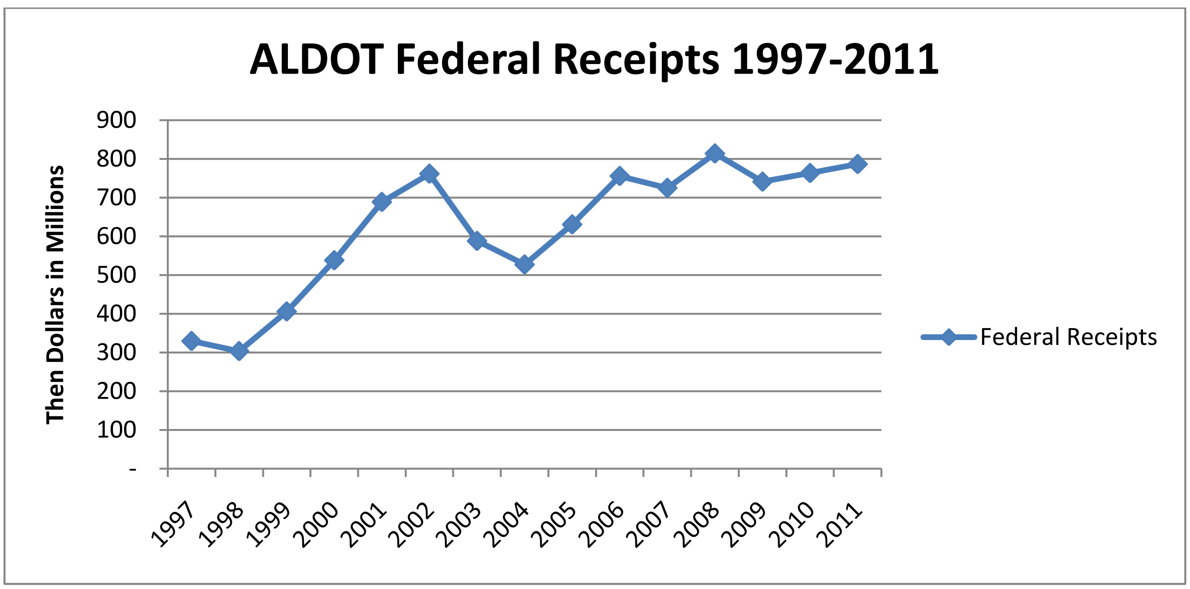

Figure 2-16. ALDOT Federal Receipts 1997-2011

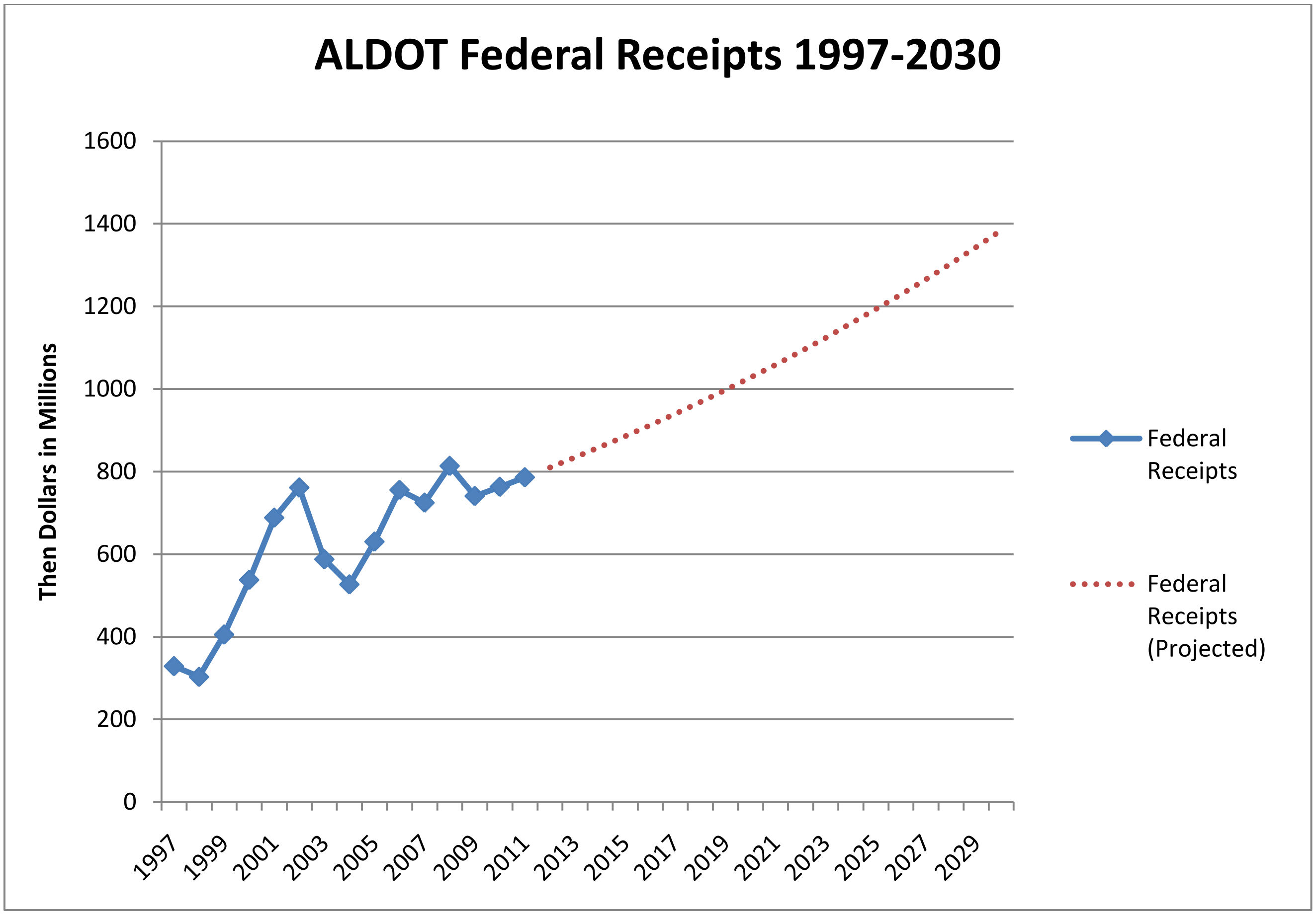

Figure 2-17. Baseline Forecast of Federal Receipts to ALDOT, 2012-2030

2.2.B.2 Federal Revenue Forecasts that adjust for CAFÉ Standards

Recall near the end of subsection 1.B.2, we mentioned the 14-year (175,000 mile) vehicle life as a representative life for vehicles on the road in the time period 2012-2030, reasoning that 175,000 miles is longer than the current average of 140,000 but not so long as the 200,000 miles expected in 2030. We also used the Model 1 mileage forecast as a "Worst Case" scenario in Table 2-5 and the discussion of gasoline consumption that followed, and used the Model 3 mileage forecast as "Best Case" scenario. Continuing that line of discussion here, in Table 2-8 CBER has generated ALDOT state, federal, and total revenue forecasts for these two scenarios, where the first set of forecasts is for "Best Case Gasoline Consumption Decline" meaning the smallest decline relative to Baseline, and the second set of forecasts is for "Worst Case Gasoline Consumption Decline" meaning the largest decline relative to baseline. Figure 2-18 depicts the baseline forecast of ALDOT's federal receipts in comparison to the federal receipt forecasts under best case and worst case gasoline consumption declines, brought on by the CAFÉ standards. Like the state receipt forecasts, the two forecasts based on reduced gasoline consumption return the revenue levels in the late 2020s to the same level as the late 1990s.

Specifically, Federal receipts under two gasoline consumption decline models are forecast to decrease 2012-2030. In fact, the baseline model has Federal receipts increasing by 50% by 2025, whereas the two gasoline consumption decline models have Federal receipts decreasing by at least 50% by 2025.

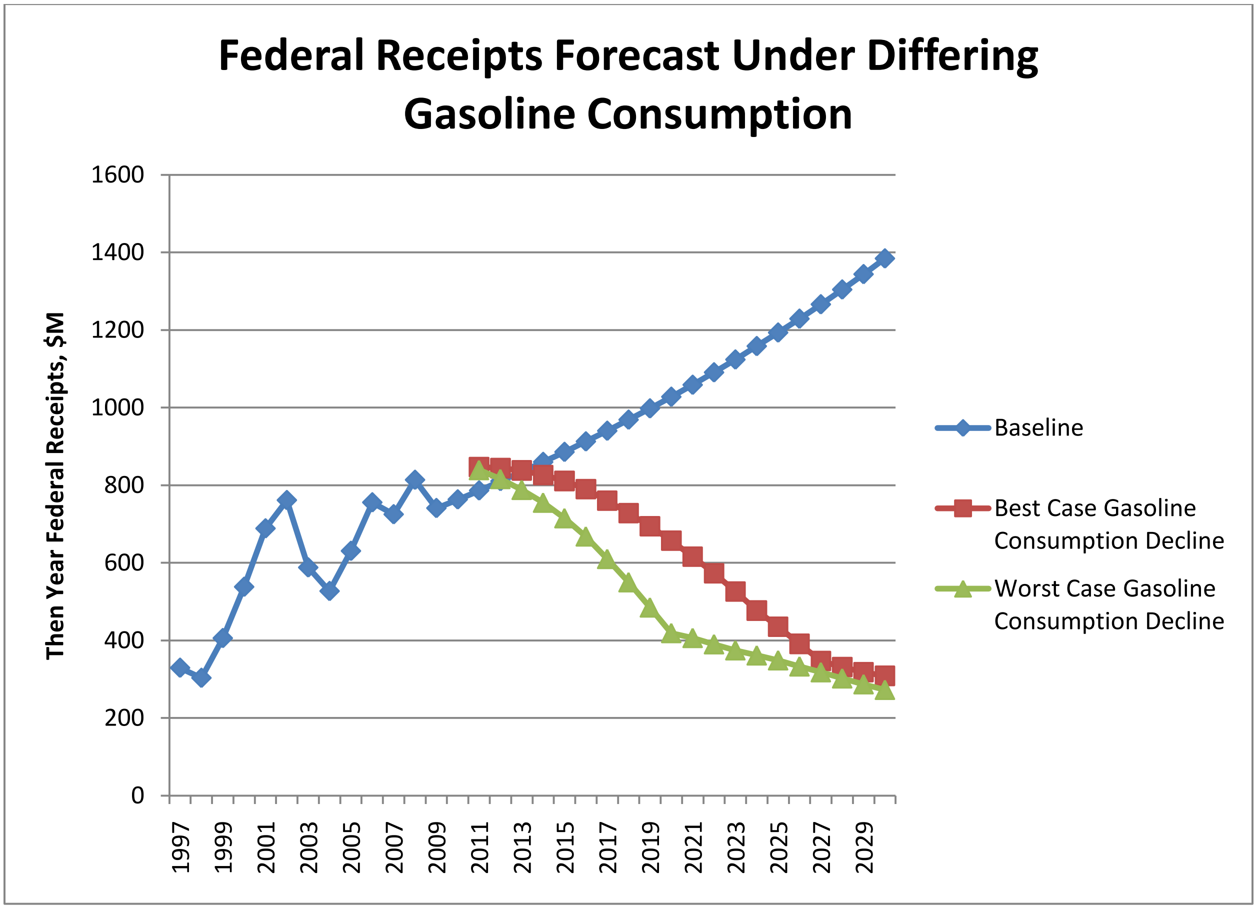

Figure 2-18. Forecast of Federal Receipts to ALDOT under Differing Gasoline Consumption

2.2.C Forecast of ALDOT Total Revenues 2012-2030

2.2.C.1 Baseline Total Revenue Forecast

Figures 2-19 and 2-20 are two different depictions of the ALDOT receipts, total and components, from Annual Reports FY 1997-2011, as listed in Table 2-6 and the first 15 rows of Table 2-7. As can be seen, the majority of the growth in Total Receipts is due to Federal Receipts, with State Receipts slowly increasing and Other Receipts a small proportion of Total that actually declined substantially in 2009-2011. Figures 2-21 and 2-22 are two different depictions of ALDOT receipts, total and components, with actual data for 1997-2011 and our forecasts for 2012-2030. The Baseline forecast of ALDOT Total Receipts for the next 19 years, includes the following:

2012 $1370.66M 3.08% annual growth from 2011
2020 $1750.01M 2.47% annual growth from 2011
2030 $2397.34M 2.99% annual growth from 2011,
taking into account all economic factors that affect such receipts.

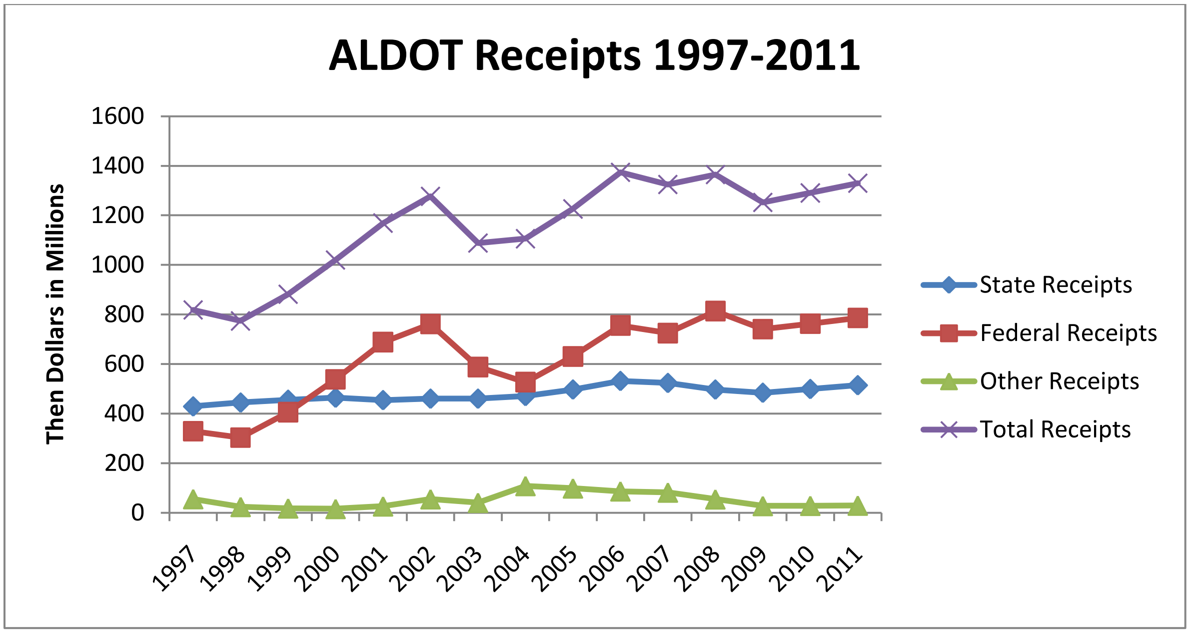

Figure 2-19. Graph of ALDOT State, Federal, Other, and Total Receipts, 1997-2011

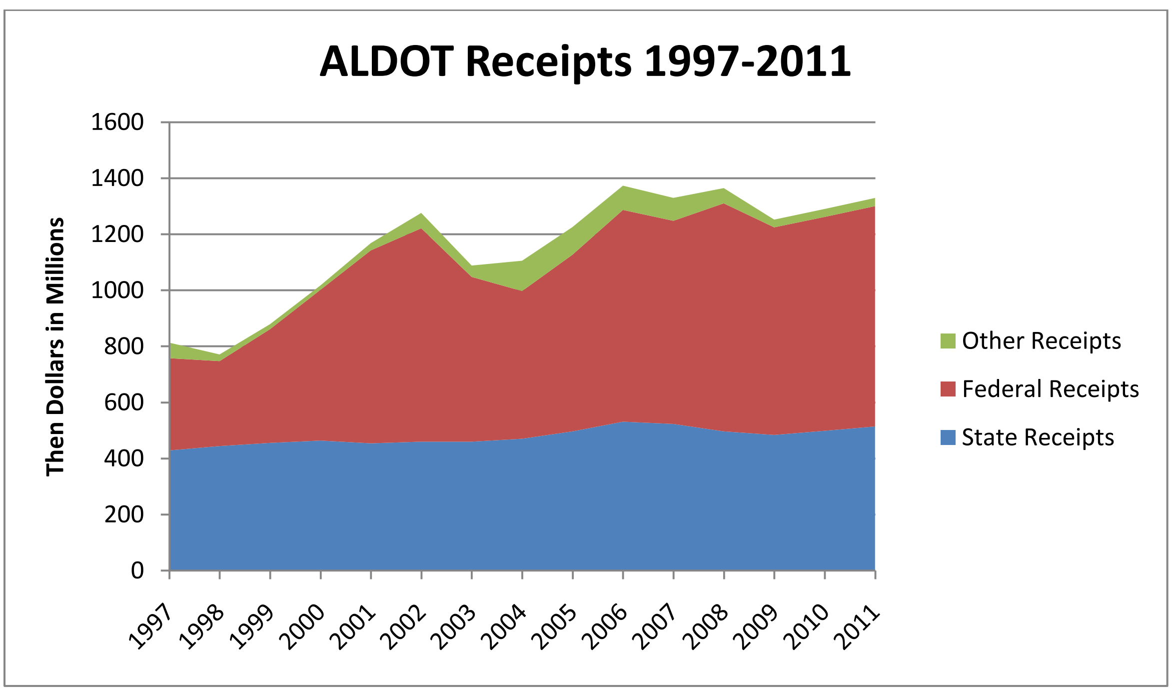

Figure 2-20. Layer-Cake Graph of ALDOT Receipts 1997-2011 by Source

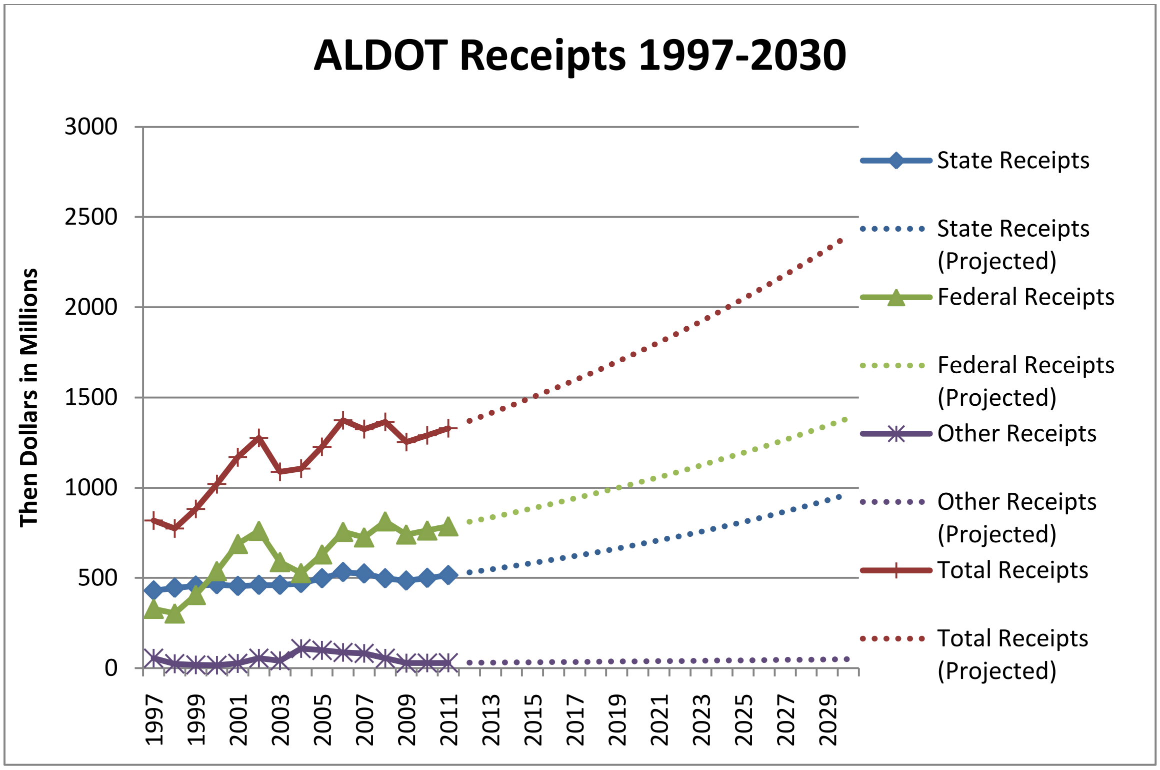

Figure 2-21. Baseline Forecast of Total Receipts to ALDOT, 1997-2030

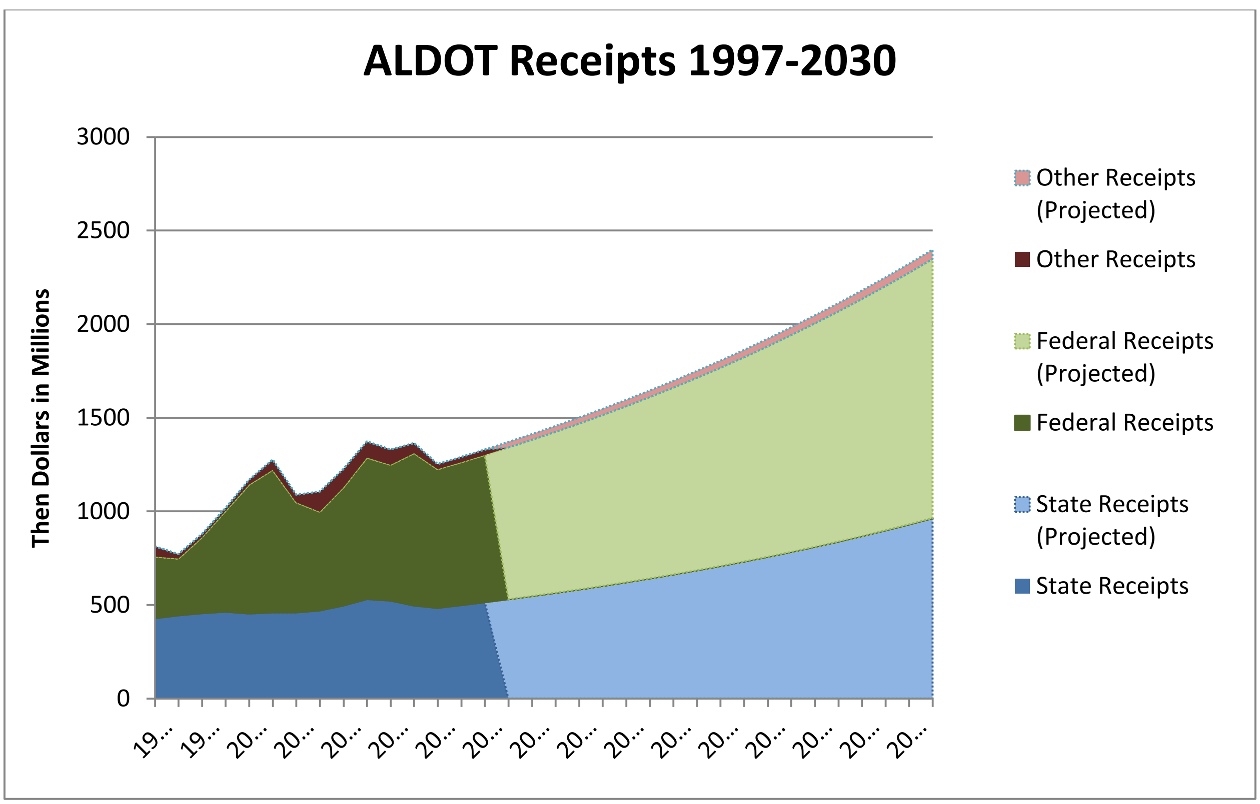

Figure 2-22. Layer-Cake Graph of ALDOT Actual and Baseline Forecast of Total Receipts

2.2.C.2 Total Revenue Forecasts that adjust for CAFÉ Standards

Recall near the end of subsection 1.B.2, we mentioned the 14-year (175,000 mile) vehicle life as a representative life for vehicles on the road in the time period 2012-2030, reasoning that 175,000 miles is longer than the current average of 140,000 but not so long as the 200,000 miles expected in 2030. We also used the Model 1 mileage forecast as a "Worst Case" scenario in Table 2-5 and the discussion of gasoline consumption that followed, and used the Model 3 mileage forecast as "Best Case" scenario. Continuing that line of discussion here, in Table 2-8 CBER has generated ALDOT state, federal, and total revenue forecasts for these two scenarios, where the first set of forecasts is for "Best Case Gasoline Consumption Decline" meaning the smallest decline relative to Baseline, and the second set of forecasts is for "Worst Case Gasoline Consumption Decline" meaning the largest decline relative to baseline. Figure 2-23 depicts the baseline forecast of ALDOT's total receipts in comparison to the total receipt forecasts under best case and worst case gasoline consumption declines, brought on by the CAFÉ standards. Like the state and federal receipt forecasts, the two forecasts based on reduced gasoline consumption both return the total revenue levels in the late 2020s to the same level as the late 1990s.

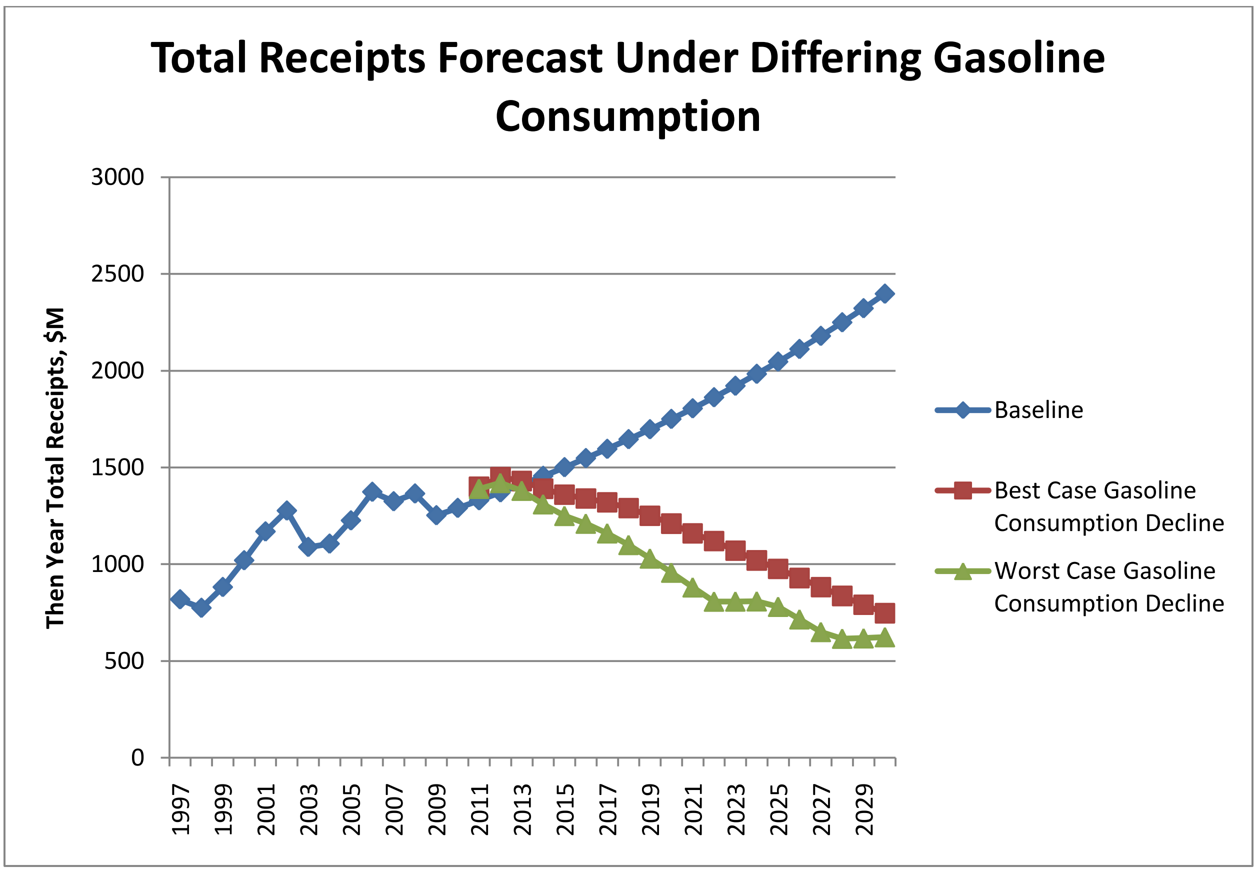

Figure 2-23. Forecast of Total Receipts to ALDOT under Differing Gasoline Consumption

The Baseline forecast of ALDOT Total Receipts has them increasing from $1330M in 2011, to $1750M in 2020, $2046M in 2025, and $2379M in 2030. However, using the gasoline consumption decline models, Total Receipts will decline to a range of $957-1210M in 2020, $780-976M in 2025, and $624-747M in 2030. Again focusing on 2025, total receipts were forecast to be up 54% assuming gasoline consumption continues to increase as in the past, but are forecast to be down 33% if one takes average (not extreme) impacts of the CAFÉ Standards.

2.3 Analyze and Forecast Statutory Diversions of ALDOT Revenues

Each year, as documented for FY 2010 in *Alabama's Transportation Infrastructure Needs and Fiscal Reality: A Report to Governor Bentley* (ALDOT, 2011), the revenue received from state and federal sources is reduced by two categories of statutory obligations:

- Allocation of State Funds to Others;
- Allocation of Federal Funds to Cities/Counties (also known as Federal Aid Apportionments).

In FY 2010, Allocation of State Funds to Others was 6.7% of revenues and Allocation of Federal Funds to Cities/Counties was 9.9% of revenues, for a total diversion of 16.6% of revenues. So, one way to think of these combined allocations as currently constituted is a 40-60 split of one-sixth of ALDOT's annual revenues.

2.3.A Trends and Forecasts for Federal Obligations to Cities/Counties

Table 2-9 describes the variety of allocations within each of the two categories. The researchers received from ALDOT a nearly complete record of FY 1997-2011 Allocations of Federal Funds to Cities/Counties, as shown in the lower half of Table 2-9. Garvee Bond payments began in FY 2002 and were scheduled to end in FY 2017, as will be carefully noted in the forecasts below. County rural roadway safety funds started in FY 2006 and have remained essentially constant since, as can be seen in Figure 2-24.

Table 2-9 Statutory Diversions of ALDOT Revenues 1997-2011

Allocation of State Funds to Others ($M*)	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006	FY2007	FY2008	FY2009	FY2010	FY2011
Administrative Office of the Courts														$35.00	
Department of Public Safety									$3.50	$21.64	$21.58	$13.35	$22.50	$28.50	$49.50
Revenue Department									$1.38					$4.90	
State Personnel Expense									$0.68					$1.38	
State Park Maintenance														$0.50	
Industrial Access Appropriation									$10.16					$11.00	
County Engineer Salary Support									$1.54					$6.10	
Captive County Insurance									$0.09	$0.08	$0.09	$0.08	$0.08	$0.13	$0.06
Total														$87.50	
* Dollars are FY, then year															
Allocation of Federal Funds to Cities/Counties($M*)															
Large Urban Areas	$18.81	$11.96	$19.07	$20.06	$19.99	$21.23	$17.90	$21.07	$24.20	$22.24	$26.01	$26.59	$24.45	$26.44	$27.27
Small Urban Areas	$12.05	$8.67	$11.02	$12.12	$12.40	$13.16	$10.28	$11.79	$13.54	$12.45	$14.56	$14.88	$13.66	$14.77	$15.24
Counties	$13.13	$13.19	$13.19	$13.19	$13.19	$13.03	$13.19	$12.43	$13.19	$13.19	$13.19	$13.19	$13.19	$13.19	$13.19
Counties HRRR Safety Funds										$2.02	$2.02	$2.02	$2.06	$2.04	$2.00
CMAQ Birmingham Area	$4.17	$6.78	$7.62	$8.30	$5.97	$9.10	$7.22	$9.28	$10.80	$10.06	$6.00	$11.76	$10.09	$11.78	$12.12
Transportation Enhancement	$11.51	$11.24	$12.77	$13.91	$14.71	$15.25	$12.80	$15.07	$17.31	$17.31	$10.33	$16.65	$17.31	$17.31	$17.31
Garvee Bond Payment						$3.97	$18.90	$18.95	$18.98	$19.03	$19.08	$19.06	$18.98	$18.90	$18.86
Total	$59.67	$51.84	$63.67	$67.57	$66.26	$75.72	$80.28	$88.59	$98.02	$96.30	$91.19	$104.14	$99.74	$104.43	$106.00
* Dollars are FY, then year															
Allocation of Federal Funds to Cities/Counties - Proportions															
Large Urban Areas	0.315	0.231	0.300	0.297	0.302	0.280	0.223	0.238	0.247	0.231	0.285	0.255	0.245	0.253	0.257
Small Urban Areas	0.202	0.167	0.173	0.179	0.187	0.174	0.128	0.133	0.138	0.129	0.160	0.143	0.137	0.141	0.144
Counties	0.220	0.254	0.207	0.195	0.199	0.172	0.164	0.140	0.135	0.137	0.145	0.127	0.132	0.126	0.124
Counties HRRR Safety Funds										0.021	0.022	0.019	0.021	0.020	0.019
CMAQ Birmingham Area	0.070	0.131	0.120	0.123	0.090	0.120	0.090	0.105	0.110	0.104	0.066	0.113	0.101	0.113	0.114
Transportation Enhancement	0.193	0.217	0.201	0.206	0.222	0.201	0.159	0.170	0.177	0.180	0.113	0.160	0.174	0.166	0.163
Garvee Bond Payment						0.052	0.235	0.214	0.194	0.198	0.209	0.183	0.190	0.181	0.178

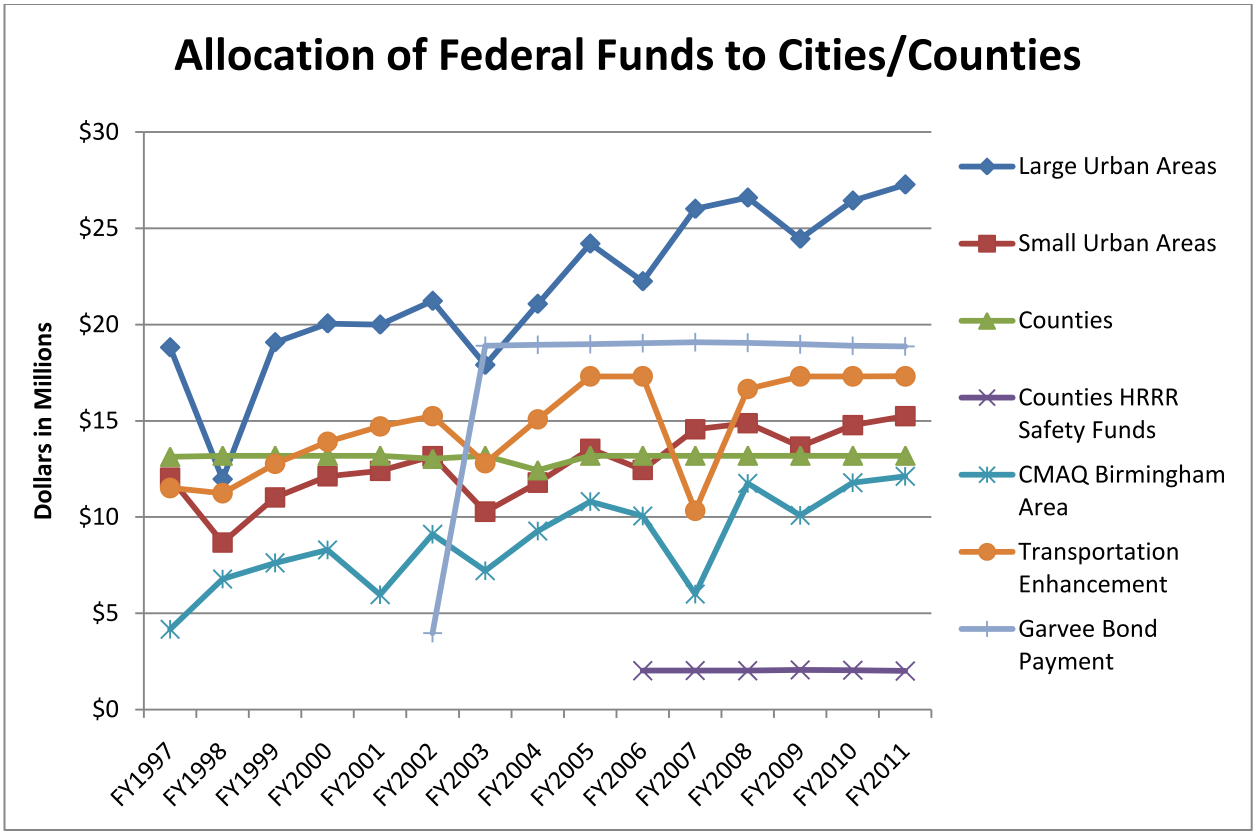

Figure 2-24. Individual Allocations of Federal Funds to Cities/Counties, FY1997-2011

For the three allocations that are *not* essentially flat, a regression fitted line will be used to forecast these allocations (all are trending up) into the future:

Large Urban Areas Allocation (SM) = -1592 + 0.8053*Year, R^2 = 76%

Small Urban Areas Allocation ($M) = -642 + 0.327*Year, R^2 = 63%

CMAQ Birmingham Area Allocation ($M) = -926 + 0.467*Year, R^2 = 80%.

Figure 2-25 presents these same data in layer-cake fashion, with the top (cumulative) broken line in this figure representing the total Allocation to Federal Funds to Cities/Counties. This total has a very strong linear trend up (increasing by an average of about $4M per year) as can be seen in the fitted model:

Total Federal Funds Allocated ($M) = -7790 + 3.93*Year, R^2 = 92%.

The coefficient of determination, R^2, reported with these regression models indicates the proportion of the variation in the dependent variable explained by the fitted linear relationship with time.

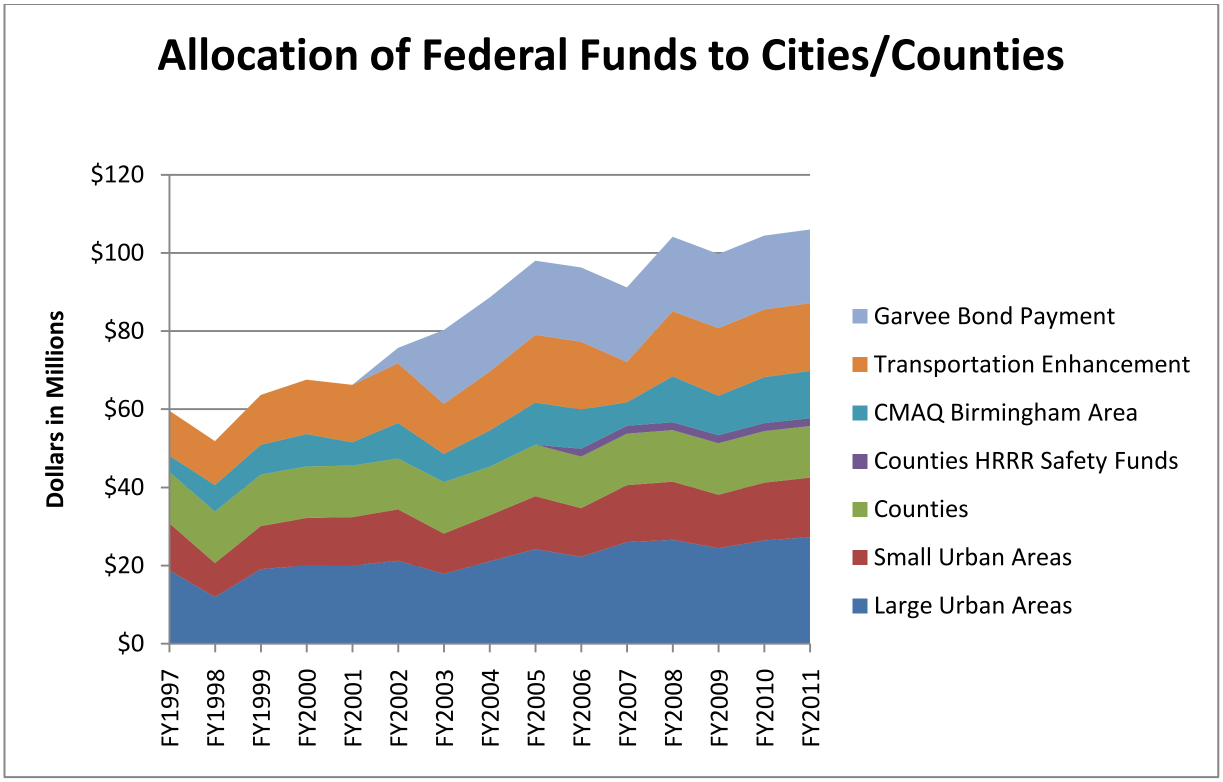

Figure 2-25. Layer-cake Version of Allocation of Federal Funds to Cities/Counties

2.3.B Trends and Forecasts for Obligations of State Funds to Others

As for the Allocation of State Funds to Others, the researchers have a complete record for FY 2010, a partial record for FY 2005, and very limited data for FY 2006-2009 and FY 2011. Comparing the growth from FY 2005 to FY 2010 is interesting. Let us assume $0.5M for State Park Maintenance in FY 2005, just like FY 2010. If one ignores the allocation to Administrative Office of the Courts of $35M in FY 2010, then Allocation of State Funds to Others increased from $17.841M in FY 2005 to $52.5M in FY 2010, a 192% increase or compound growth rate of 19.7% per year! We cannot say for sure if the rate of increase was larger or smaller, not knowing the allocation to Administrative Office of Courts in FY 2005. Because we have very good forecasting model for Total Federal Funds Allocated, and because we know Allocation of State Funds to Others was 83.78% of Total Federal Funds Allocated in FY 2010, we will use this simple ratio to predict the growth in Allocation of State Funds to Others for FY 2012-2030—at least until more data is made available to us.

The FY 2012-2030 forecasts for each allocation within Allocation of State Funds to Others, Total Allocation of State Funds to Others, and the above mentioned forecast for Total Federal Funds Allocated are shown in Table 2-10. At the bottom of each column is a note on what sort of forecasting method was used to produce the time series in the column.

Table 2-10 Forecasts for Statutory Diversions of ALDOT Revenues, 2012-2030

Year	Large Urban Areas	Small Urban Areas	Counties	Counties HRRR Safety Funds	CMAQ B'ham	Transportation Enhancement	Garvee Bond Payment	Total Alloc. Fed. Funds	Total Alloc. Of State Funds-Others	
1997	18.81	12.046	13.131		4.172	11.512		59.671		
1998	11.962	8.672	13.189		6.78	11.241		51.844		
1999	19.074	11.018	13.189		7.618	12.767		63.666		
2000	20.055	12.123	13.189		8.296	13.908		67.571		
2001	19.994	12.395	13.189		5.97	14.707		66.255		
2002	21.225	13.156	13.026		9.103	15.247	3.965	75.722		
2003	17.899	10.278	13.189		7.217	12.803	18.897	80.283		
2004	21.07	11.791	12.428		9.275	15.071	18.953	88.588		
2005	24.2	13.543	13.189		10.799	17.31	18.98	98.021	42.841	*
2006	22.244	12.449	13.189	2.016	10.055	17.31	19.033	96.296		
2007	26.009	14.558	13.189	2.023	5.999	10.329	19.084	91.191		
2008	26.591	14.878	13.189	2.017	11.756	16.653	19.056	104.14		
2009	24.452	13.66	13.189	2.062	10.089	17.31	18.977	99.739		
2010	26.436	14.773	13.189	2.042	11.782	17.31	18.9	104.432	87.500	*
2011	27.271	15.24	13.189	2.002	12.116	17.31	18.864	105.995	88.803	*
2012	28.2636	15.924	13.189	2.002	13.604	17.31	18.833	117.16	98.157	*
2013	29.0689	16.251	13.189	2.002	14.071	17.31	18.761	121.09	101.449	*
2014	29.8742	16.578	13.189	2.002	14.538	17.31	18.688	125.02	104.742	*
2015	30.6795	16.905	13.189	2.002	15.005	17.31	18.64	128.95	108.034	*
2016	31.4848	17.232	13.189	2.002	15.472	17.31	18.627	132.88	111.327	*
2017	32.2901	17.559	13.189	2.002	15.939	17.31	18.645	136.81	114.619	*
2018	33.0954	17.886	13.189	2.002	16.406	17.31	0	122.095	102.291	*
2019	33.9007	18.213	13.189	2.002	16.873	17.31	0	126.025	105.584	*
2020	34.706	18.54	13.189	2.002	17.34	17.31	0	129.955	108.876	*
2021	35.5113	18.867	13.189	2.002	17.807	17.31	0	133.885	112.169	*
2022	36.3166	19.194	13.189	2.002	18.274	17.31	0	137.815	115.461	*
2023	37.1219	19.521	13.189	2.002	18.741	17.31	0	141.745	118.754	*
2024	37.9272	19.848	13.189	2.002	19.208	17.31	0	145.675	122.047	*
2025	38.7325	20.175	13.189	2.002	19.675	17.31	0	149.605	125.339	*
2026	39.5378	20.502	13.189	2.002	20.142	17.31	0	153.535	128.632	*
2027	40.3431	20.829	13.189	2.002	20.609	17.31	0	157.465	131.924	*
2028	41.1484	21.156	13.189	2.002	21.076	17.31	0	161.395	135.217	*
2029	41.9537	21.483	13.189	2.002	21.543	17.31	0	165.325	138.509	*
2030	42.759	21.81	13.189	2.002	22.01	17.31	0	169.255	141.802	*
	regression	regression	constant	constant	regression	constant	ALDOT Annual	regression	83.78% of Alloc. of Federal Funds	
							Reports	w/Garvee	*$35M to Admin. Office of the	
								out after '17	Courts is assumed	

2.4 Analyze and Forecast Expenditures

2.4.A Trends and Forecasts for ALDOT Expenditure Categories

Using ALDOT Annual Reports, FY 1997-2011, UA researchers constructed Table 2-11. Expenditures are expressed in two different "category breakouts" in the annual reports: Construction and Maintenance Expenditures, and State Highway Funds Expenditures (also called Disbursements) where:

Disbursements = Expenditures + Adjustments to Cash, each year.

Construction and Maintenance Expenditures are expressed in Table 2-11 as the sum of seven categories, with Federal Construction and State Construction contributing to the largest proportions: Federal Construction was 52.7% of Total Expenditures in 1997, and has risen to the level of 73% in 2010 and 74% in 2011. In contrast, State Construction has dropped from 8% in 1997 to 3.2% in 2011. Total Expenditures have increased over the 15 year span at a compound interest rate of $i = 3.76\%$, or at an absolute rate of $46.1M per year.

State Highway Funds Expenditures are expressed as the sum of six categories, with Construction and Maintenance composing the largest proportions. A small table appended at the bottom of the cost table section of Table 2-11 shows the changing proportions of Construction and Maintenance Expenditures over the 15 year period, 1997-2011. Construction Expenditures over the past five years dominated Maintenance Expenditures by a 5-to-1 ratio, essentially 75% vs. 15% of Total Expenditures. Early in the data (1997-99), this ratio was essentially 3-to-1.

Figure 2-26 illustrates the behavior of Construction, Maintenance, and Total Expenditures over the past 15 years. While the best forecasting model for Maintenance Expenditures was double exponential smoothing, the following regression models were good fits for Construction Expenditures and Total Expenditures, and will be used in the forecasts to come:

Construction Expenditures ($M) = -79276 + 39.99*Year, $R^2 = 78\%$

Total Expenditures ($M) = -91238 + 46.1*Year, $R^2 = 91\%$.

Double exponential smoothing is a forecasting technique that enables the forecast to react to an abrupt shift in average response, in addition to gradual trends both up and down in the data. Therefore, it is more sophisticated than regression-based forecasts based on overall trend in the data. It is most often applied to predict "one-step-ahead data, such as sales or funding based on historical data to that point" but can be used to establish a mechanism to predict multiple periods into the future. The technique used here automatically chooses the optimal weight to forecast future values based on shifts in mean and gradual trends in the historical data, so that on a historical basis, the forecasts minimize total sum of squared errors (actual-forecast).

Table 2-11 ALDOT Expenditures, FY1997-2011

Construction and Maintenance Expenditures ($M*)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Federal Construction	$ 421.3	$ 436.7	$ 498.8	$ 669.4	$ 806.1	$ 935.8	$ 851.7	$ 811.2	$ 864.0	$ 925.2	$ 905.2	$ 928.3	$ 1,000.4	$ 1,020.2	$ 998.0
State Constuction	$ 63.6	$ 58.4	$ 53.3	$ 60.8	$ 59.1	$ 61.9	$ 56.7	$ 57.0	$ 75.1	$ 75.5	$ 58.7	$ 67.3	$ 56.5	$ 38.5	$ 43.5
Special Work Authorizations	$ 1.1	$ 0.9	$ 1.0	$ 2.7	$ 3.5	$ 1.5	$ 1.5	$ 0.8	$ 1.1	$ 1.0	$ 1.1	$ 1.0	$ 0.9	$ 0.9	$ 1.6
Routine Maintenance										$ 98.3	$ 106.8	$ 117.6	$ 117.1	$ 117.2	$ 118.0
Maintenance Projects										$ 58.3	$ 123.2	$ 78.3	$ 105.8	$ 70.9	$ 76.0
Adminstration										$ 123.8	$ 137.8	$ 131.8	$ 122.5	$ 116.5	$ 117.3
Debt Service	$ 44.7	$ 4.8	$ 4.4	$ 4.4	$ 4.4	$ 4.4	$ 14.0	$ 12.6	$ 11.8	$ 10.9	$ 11.4	$ 11.9	$ 12.5	$ 13.0	$ 13.6
Total Expenditures	$ 799.8	$ 776.3	$ 829.4	$ 1,001.6	$ 1,093.9	$ 1,167.0	$ 1,148.2	$ 1,149.8	$ 1,201.8	$ 1,293.0	$ 1,344.2	$ 1,336.2	$ 1,415.7	$ 1,377.2	$ 1,368.0
State Highway Funds Expenidtures ($M*)															
Construction	$ 486.1	$ 495.2	$ 552.1	$ 732.9	$ 866.0	$ 997.8	$ 908.5	$ 888.2	$ 956.4	$ 1,001.8	$ 965.0	$ 996.6	$ 1,057.8	$ 1,055.6	$ 1,043.1
Maintenance	$ 172.8	$ 173.3	$ 155.5	$ 140.1	$ 130.1	$ 126.5	$ 134.5	$ 144.7	$ 125.5	$ 156.5	$ 230.0	$ 195.9	$ 222.8	$ 188.1	$ 194.0
Equipment Purchases	$ 4.7	$ 5.2	$ 3.9	$ 5.5	$ 5.8	$ 7.6	$ 5.7	$ 6.7	$ 10.4	$ 8.2	$ 9.4	$ 7.7	$ 10.1	$ 7.2	$ 7.0
Administration	$ 26.2	$ 31.2	$ 42.2	$ 45.5	$ 37.1	$ 26.8	$ 38.2	$ 36.1	$ 24.5	$ 65.8	$ 88.6	$ 101.9	$ 89.8	$ 82.7	$ 60.8
Debt Service	$ 44.7	$ 4.8	$ 4.4	$ 4.4	$ 4.4	$ 4.4	$ 14.0	$ 12.6	$ 11.8	$ 10.9	$ 11.4	$ 11.9	$ 12.5	$ 13.0	$ 13.6
Other Expenditures	$ 51.8	$ 119.9	$ 74.3	$ 72.6	$ 56.5	$ 46.6	$ 57.2	$ 63.9	$ 102.4	$ 53.4	$ 51.4	$ 53.6	$ 23.9	$ 59.6	$ 49.2
Total Disbursements^	$ 786.3	$ 829.6	$ 832.4	$ 1,001.0	$ 1,099.9	$ 1,209.7	$ 1,158.1	$ 1,152.2	$ 1,231.0	$ 1,296.6	$ 1,355.8	$ 1,367.6	$ 1,416.9	$ 1,406.2	$ 1,367.7
*Dollars are FY "then year"															
^Disbursements = Expenditures + Adjustments to Cash															
Construction/Total Expenditure Ratio	0.61	0.64	0.67	0.73	0.79	0.86	0.79	0.77	0.80	0.77	0.72	0.75	0.75	0.77	0.76
Maintenance/Total Expenditure Ratio	0.22	0.22	0.19	0.14	0.12	0.11	0.12	0.13	0.10	0.12	0.17	0.15	0.16	0.14	0.14

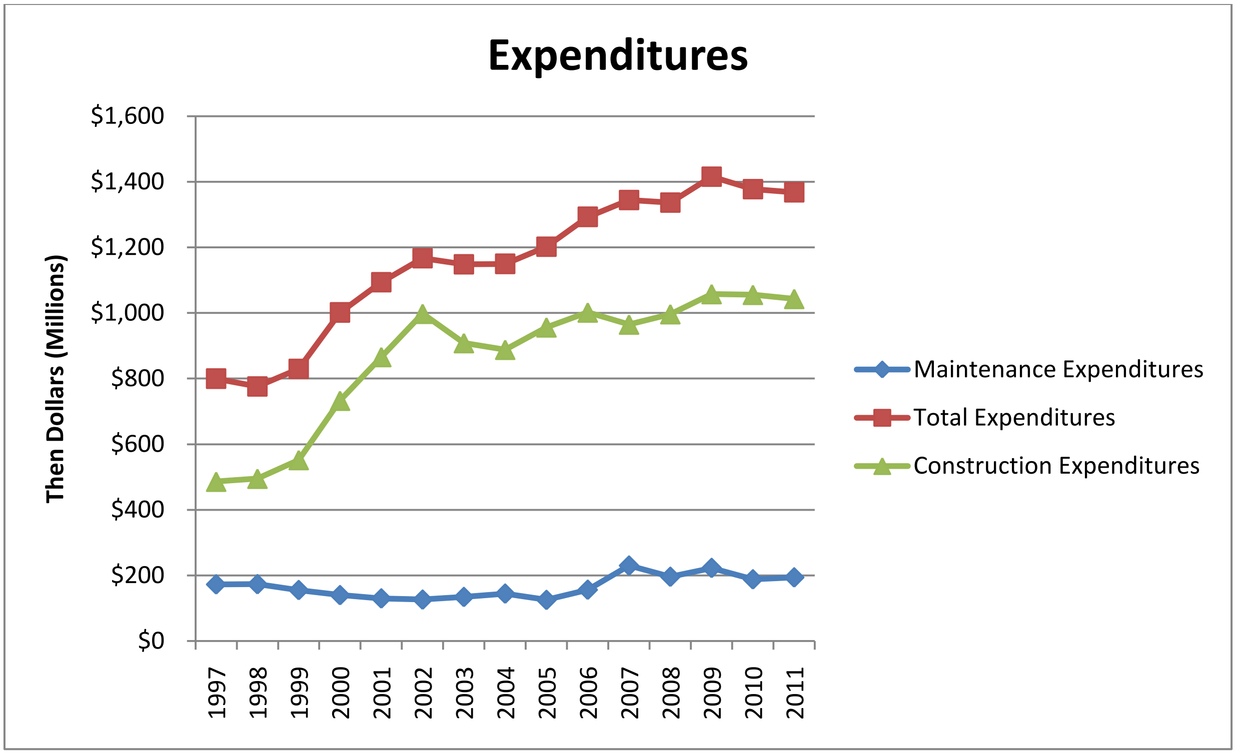

Figure 2-26. Construction, Maintenance, and Total Expenditures, FY1997-2011

Table 2-12 converts all nominal (then-year) expenditures in Table 2-11 to constant, base-year 1997 dollars. The graphs in Figure 2-27 illustrate that in constant dollars, Total Expenditures have been essentially flat since 2004, whereas Construction Expenditures have declined slightly and Maintenance Expenditures have increased slightly, 2004-2011. In fact, Total Expenditures in 1997 dollars have increased at an average annual rate of 1.5%, which combined with average annual inflation of 2.3% over these years, explains the overall growth in expenditures of 3.8% per year. An interesting question is whether the total roads and bridges that ALDOT is responsible for has increased faster or slower than 1.5% over this same period. Referring to the final two rows in Table 2-12, of course the ratios of Construction and Maintenance Expenditures to Total Expenditures remain the same under this conversion to FY 1997 base dollars.

Table 2-12 ALDOT Expenditures in Base Year 1997 Dollars, FY1997-2012

Construction and Maintenance Expenditures ($M)**	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Federal Construction	$421.3	$427.0	$476.9	$625.8	$736.9	$836.5	$744.4	$693.3	$722.0	$756.0	$723.2	$725.2	$764.2	$762.0	$728.9
State Constuction	$63.6	$57.1	$51.0	$56.8	$54.0	$55.3	$49.6	$48.7	$62.8	$61.7	$46.9	$52.6	$43.2	$28.8	$31.8
Special Work Authorizations	$1.1	$0.9	$1.0	$2.5	$3.2	$1.3	$1.3	$0.7	$0.9	$0.8	$0.9	$0.8	$0.7	$0.7	$1.2
Routine Maintenance										$80.3	$85.3	$91.9	$89.4	$87.5	$86.2
Maintenance Projects										$47.6	$98.4	$61.2	$80.8	$53.0	$55.5
Adminstration										$101.2	$110.1	$103.0	$93.6	$87.0	$85.7
Debt Service	$44.7	$4.7	$4.2	$4.1	$4.0	$3.9	$12.2	$10.8	$9.9	$8.9	$9.1	$9.3	$9.5	$9.7	$9.9
Total Expenditures	$799.8	$759.1	$793.0	$936.4	$1,000.0	$1,043.1	$1,003.5	$982.6	$1,004.3	$1,056.5	$1,073.9	$1,043.9	$1,081.4	$1,028.7	$999.1
State Highway Funds Expenidtures ($M)**															
Construction	$486.1	$484.2	$527.9	$685.2	$791.6	$891.9	$794.0	$759.1	$799.2	$818.6	$771.0	$778.6	$808.0	$788.4	$761.8
Maintenance	$172.8	$169.5	$148.7	$131.0	$118.9	$113.1	$117.6	$123.7	$104.9	$127.9	$183.8	$153.0	$170.2	$140.5	$141.7
Equipment Purchases	$4.7	$5.1	$3.7	$5.1	$5.3	$6.8	$5.0	$5.7	$8.7	$6.7	$7.5	$6.0	$7.7	$5.4	$5.1
Administration	$26.2	$30.5	$40.3	$42.5	$33.9	$24.0	$33.4	$30.9	$20.5	$53.8	$70.8	$79.6	$68.6	$61.8	$44.4
Debt Service	$44.7	$4.7	$4.2	$4.1	$4.0	$3.9	$12.2	$10.8	$9.9	$8.9	$9.1	$9.3	$9.5	$9.7	$9.9
Other Expenditures	$51.8	$117.2	$71.0	$67.9	$51.6	$41.7	$50.0	$54.6	$85.6	$43.6	$41.1	$41.9	$18.3	$44.5	$35.9
Total Disbursements^	$786.3	$811.2	$795.9	$935.8	$1,005.4	$1,081.3	$1,012.2	$984.7	$1,028.7	$1,059.4	$1,083.2	$1,068.4	$1,082.3	$1,050.3	$998.9
**Dollars are adjusted to FY 1997 base using US inflation rate															
^Disbursements = Expenditures + Adjustments to Cash															
Construction/Total Expenditure Ratio	0.61	0.64	0.67	0.73	0.79	0.86	0.79	0.77	0.80	0.77	0.72	0.75	0.75	0.77	0.76
Maintenance/Total Expenditure Ratio	0.22	0.22	0.19	0.14	0.12	0.11	0.12	0.13	0.10	0.12	0.17	0.15	0.16	0.14	0.14

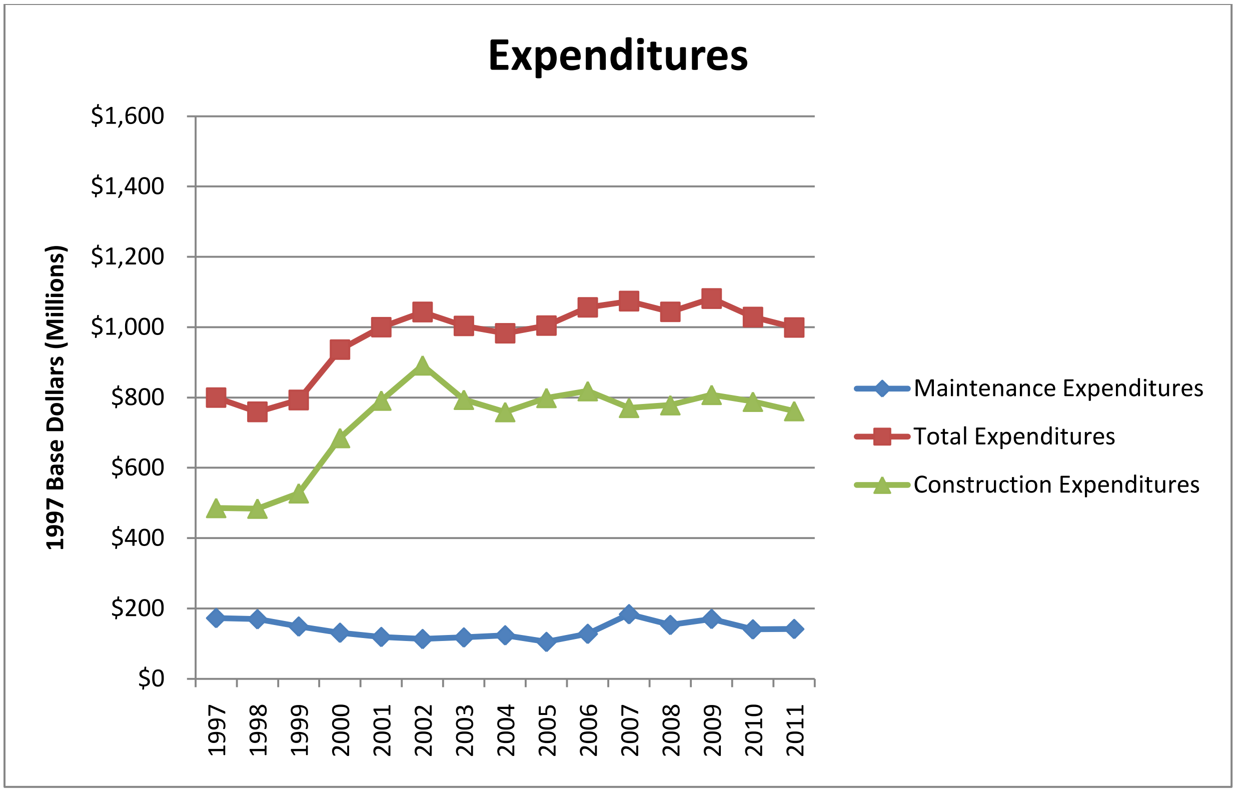

Figure 2-27. Construction, Maintenance, and Total Expenditures in 1997 Dollars

Table 2-13 contains our forecasts for fiscal years 2012-2030 for the following time series:

- Total Expenditures
- Federal Construction
- State Construction
- Construction
- Maintenance.

At the bottom of each column in Table 2-13 is a note about what sort of forecasting model produced the time series above it. For instance, we used double exponential smoothing to forecast State Construction and the following regression model for Federal Construction:

Federal Construction ($M) = -80571 + 40.6*Year, R^2 = 80%.

Table 2-13. Forecasts for ALDOT Expenditures, FY 2012-2030

Year	Total Expenditures($M)	Federal Construction($M)	State Construction($M)	Construction($M)	Maintenance($M)
1997	$799.80	$421.30	$63.60	$486.10	$172.80
1998	$776.30	$436.70	$58.40	$495.20	$173.30
1999	$829.40	$498.80	$53.30	$552.10	$155.50
2000	$1,001.60	$669.40	$60.80	$732.90	$140.10
2001	$1,093.90	$806.10	$59.10	$866.00	$130.10
2002	$1,167.00	$935.80	$61.90	$997.80	$126.50
2003	$1,148.20	$851.70	$56.70	$908.50	$134.50
2004	$1,149.80	$811.20	$57.00	$888.20	$144.70
2005	$1,201.80	$864.00	$75.10	$956.40	$125.50
2006	$1,293.00	$925.20	$75.50	$1,001.80	$156.50
2007	$1,344.20	$905.20	$58.70	$965.00	$230.00
2008	$1,336.20	$928.30	$67.30	$996.60	$195.90
2009	$1,415.65	$1,000.40	$56.50	$1,057.80	$222.80
2010	$1,377.20	$1,020.20	$38.50	$1,055.60	$188.10
2011	$1,368.00	$998.00	$43.50	$1,043.10	$194.00
2012	$1,515.20	$1,116.20	$40.34	$1,183.88	$198.75
2013	$1,561.30	$1,156.80	$37.81	$1,223.87	$202.09
2014	$1,607.40	$1,197.40	$35.27	$1,263.86	$205.42
2015	$1,653.50	$1,238.00	$32.73	$1,303.85	$208.75
2016	$1,699.60	$1,278.60	$30.19	$1,343.84	$212.09
2017	$1,745.70	$1,319.20	$27.66	$1,383.83	$215.42
2018	$1,791.80	$1,359.80	$25.12	$1,423.82	$218.76
2019	$1,837.90	$1,400.40	$22.58	$1,463.81	$222.09
2020	$1,884.00	$1,441.00	$20.04	$1,503.80	$225.42
2021	$1,930.10	$1,481.60	$17.51	$1,543.79	$228.76
2022	$1,976.20	$1,522.20	$14.97	$1,583.78	$232.09
2023	$2,022.30	$1,562.80	$12.43	$1,623.77	$235.42
2024	$2,068.40	$1,603.40	$9.89	$1,663.76	$238.76
2025	$2,114.50	$1,644.00	$7.35	$1,703.75	$242.09
2026	$2,160.60	$1,684.60	$4.82	$1,743.74	$245.42
2027	$2,206.70	$1,725.20	$2.28	$1,783.73	$248.76
2028	$2,252.80	$1,765.80	$0.00	$1,823.72	$252.09
2029	$2,298.90	$1,806.40	$0.00	$1,863.71	$255.42
2030	$2,345.00	$1,847.00	$0.00	$1,903.70	$258.76
	regression	regression	dbl expon sm	regression	dbl expon sm

Table 2-14 contains our forecasts for proportion of Total Expenditures that would be allocated to each of the four major expenditure categories *if* the current trends were to continue over the 19 year period, 2012-2030. Note in that table that State Construction declines to zero in FY 2028, which is probably unrealistic. Also, Construction is projected to grow from 76.25% of Total Expenditures in 2011 to 81.18% in 2030, while Maintenance is projected to decline from 14.18% in 2011 to 11.03% in 2030.

Table 2-14. Forecasted Percent of Expenditures Allocated to Major Categories

Year	Fed as % Construction	State as % Construction	Construction as % Total	Maintenance as % Total
1997	86.67%	13.08%	60.78%	21.61%
1998	88.19%	11.79%	63.79%	22.32%
1999	90.35%	9.65%	66.57%	18.75%
2000	91.34%	8.30%	73.17%	13.99%
2001	93.08%	6.82%	79.17%	11.89%
2002	93.79%	6.20%	85.50%	10.84%
2003	93.75%	6.24%	79.12%	11.71%
2004	91.33%	6.42%	77.25%	12.58%
2005	90.34%	7.85%	79.58%	10.44%
2006	92.35%	7.54%	77.48%	12.10%
2007	93.80%	6.08%	71.79%	17.11%
2008	93.15%	6.75%	74.58%	14.66%
2009	94.57%	5.34%	74.72%	15.74%
2010	96.65%	3.65%	76.65%	13.66%
2011	95.68%	4.17%	76.25%	14.18%
2012	94.28%	3.41%	78.13%	13.12%
2013	94.52%	3.09%	78.39%	12.94%
2014	94.74%	2.79%	78.63%	12.78%
2015	94.95%	2.51%	78.85%	12.63%
2016	95.15%	2.25%	79.07%	12.48%
2017	95.33%	2.00%	79.27%	12.34%
2018	95.50%	1.76%	79.46%	12.21%
2019	95.67%	1.54%	79.65%	12.08%
2020	95.82%	1.33%	79.82%	11.97%
2021	95.97%	1.13%	79.98%	11.85%
2022	96.11%	0.95%	80.14%	11.74%
2023	96.25%	0.77%	80.29%	11.64%
2024	96.37%	0.59%	80.44%	11.54%
2025	96.49%	0.43%	80.57%	11.45%
2026	96.61%	0.28%	80.71%	11.36%
2027	96.72%	0.13%	80.83%	11.27%
2028	96.82%	0.00%	80.95%	11.19%
2029	96.92%	0.00%	81.07%	11.11%
2030	97.02%	0.00%	81.18%	11.03%

2.4.B Trends and Forecasts for Material Unit Costs

California and Texas have such extensive highway construction and maintenance activities that they track their average unit costs for six primary materials from their respective databases of "projects let", and have been doing so since at least 1997. The materials whose annual unit cost profiles are publically available from CALTRANS and TXDOT are:

- Roadway Excavation (actually, a task in road-building)
- Aggregate Base

- Asphalt Concrete Pavement
- Portland Cement Concrete (PCC) Pavement
- Bar Reinforced Steel (Rebar)
- Structural Steel.

These data should be informative for Alabama current and future unit costs as well. First, in Table 2-15, we present the California average unit cost data in nominal (or then-year) dollars, along with a calculated average inflation rate for each respective material. As can be seen, the first five materials have experienced an average cost escalation of between 2.1% and 6.1% over the 15 year span 1997 to 2011. By comparison, the Consumer Price Index (CPI) and US Inflation Rate over that same period was 2.28%. Four of the six materials experienced cost escalations above inflation, while structural steel unit cost fluctuated wildly—probably due to variation in source (US vs. Asian steel plants) used by their contractors. The corresponding average unit costs for TXDOT materials are presented in Table 2-16. As can be seen, half the TXDOT materials had cost escalations below inflation, and half had cost escalations above inflation—and all escalations were positive. We provide comparative graphs (California vs. Texas) of average annual unit costs for these six materials in Figures 2-28 through 2-33. The patterns are similar, though unit material costs in California tend to be higher than corresponding costs in Texas, year-by-year. Note also that Alabama average unit costs 2006-2011 have been included in Figures 2-29,30,32, and 33, whose trends will be discussed later in this section. Unit costs for Alabama Bridge Concrete Type A were also captured and are graphed in Figure 2-34.

Table 2-15. CALTRANS Material Unit Costs, 1997-2011

California - Then Dollars						
Year	Roadway Excavation Per cuyd	Aggregate Base Per ton	Asphalt Concrete Pavement Per Ton	PCC Pavement Per cuyd	Bar Reinf. Steel Per lb	Structural Steel Per lb
1997	5.25	10.29	36.07	78.48	0.496	2.37
1998	4.95	11.55	38.78	75.91	0.553	2.60
1999	6.55	12.86	40.14	77.95	0.521	3.22
2000	6.21	11.14	45.12	78.14	0.507	2.75
2001	5.83	14.58	43.89	75.74	0.612	3.91
2002	4.84	12.42	49.00	74.15	0.508	3.25
2003	5.05	15.05	48.35	109.96	0.600	1.71
2004	13.11	16.97	53.55	135.94	0.947	5.39
2005	14.13	20.61	75.72	171.22	0.968	2.67
2006	12.80	20.26	86.04	179.67	1.039	3.73
2007	10.84	20.54	85.48	204.69	0.935	6.97
2008	11.39	17.90	78.50	177.91	0.938	5.18
2009	9.37	14.91	80.38	125.41	0.593	4.49
2010	7.94	14.20	80.25	122.82	0.716	2.15
2011	11.82	14.12	87.11	135.40	0.830	2.10
Avg. Inflation	5.6%	2.1%	6.1%	3.7%	3.5%	NA

Table 2-16. TXDOT Material Unit Costs, 1997-2011

Texas - Then Dollars						
Year	Roadway Excavation Per cuyd	Aggregate Base Per ton	Asphalt Concrete Pavement Per Ton	PCC Pavement Per cuyd	Bar Reinf. Steel Per lb	Structural Steel Per lb
1997	5.25	10.29	30.43	72.08	0.496	2.37
1998	5.99	11.14	32.25	76.40	0.56	2.66
1999	6.29	11.45	34.47	76.35	0.58	2.75
2000	5.84	11.77	36.41	81.85	0.57	2.72
2001	5.92	11.50	37.61	95.66	0.58	2.75
2002	6.23	11.96	38.15	88.56	0.59	2.82
2003	6.19	11.68	36.91	86.06	0.57	2.74
2004	6.38	12.34	37.52	93.57	0.63	3.00
2005	7.47	14.40	45.26	107.16	0.74	3.54
2006	8.93	18.52	60.14	129.01	0.81	3.86
2007	9.72	19.72	67.36	126.67	0.80	3.84
2008	9.46	19.62	67.45	150.31	0.81	3.87
2009	8.02	16.72	64.45	143.11	0.78	3.73
2010	6.81	15.91	58.89	111.34	0.67	3.22
2011	6.51	16.23	59.30	109.26	0.71	3.38
Avg. Inflation	1.4%	3.1%	4.5%	2.8%	2.4%	2.4%

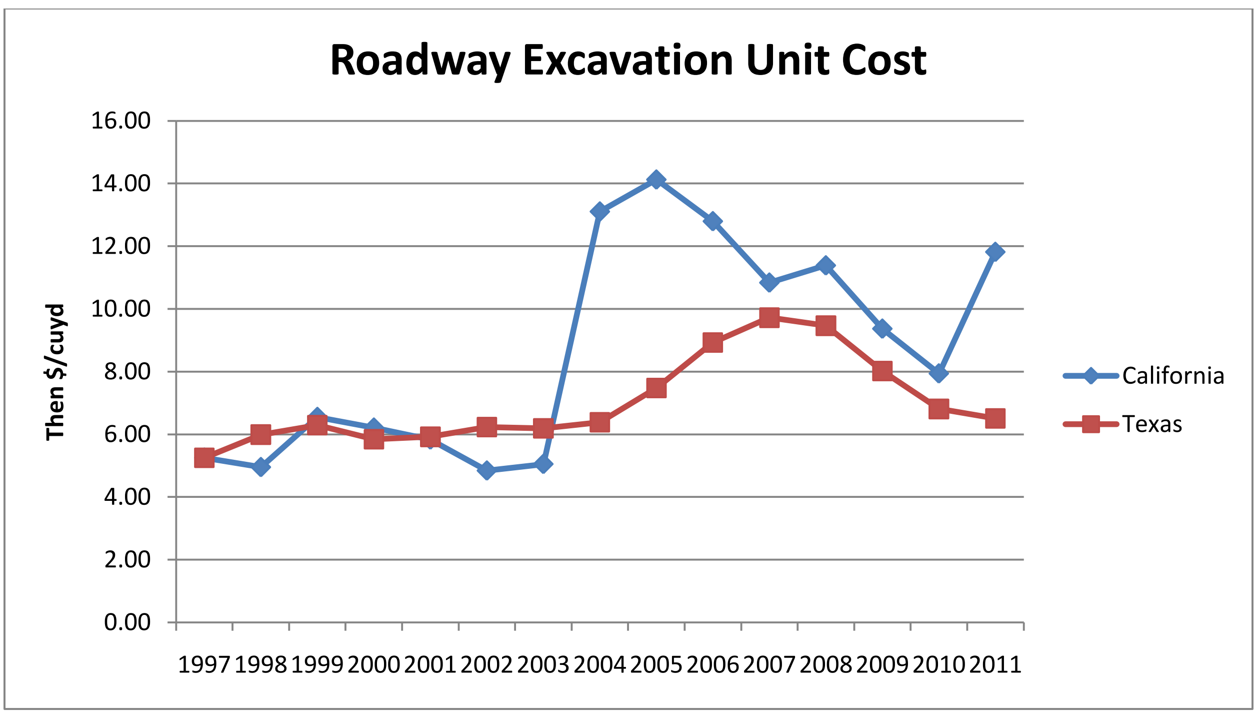

Figure 2-28. Average Excavation Unit Costs, California vs. Texas, 1997-2011

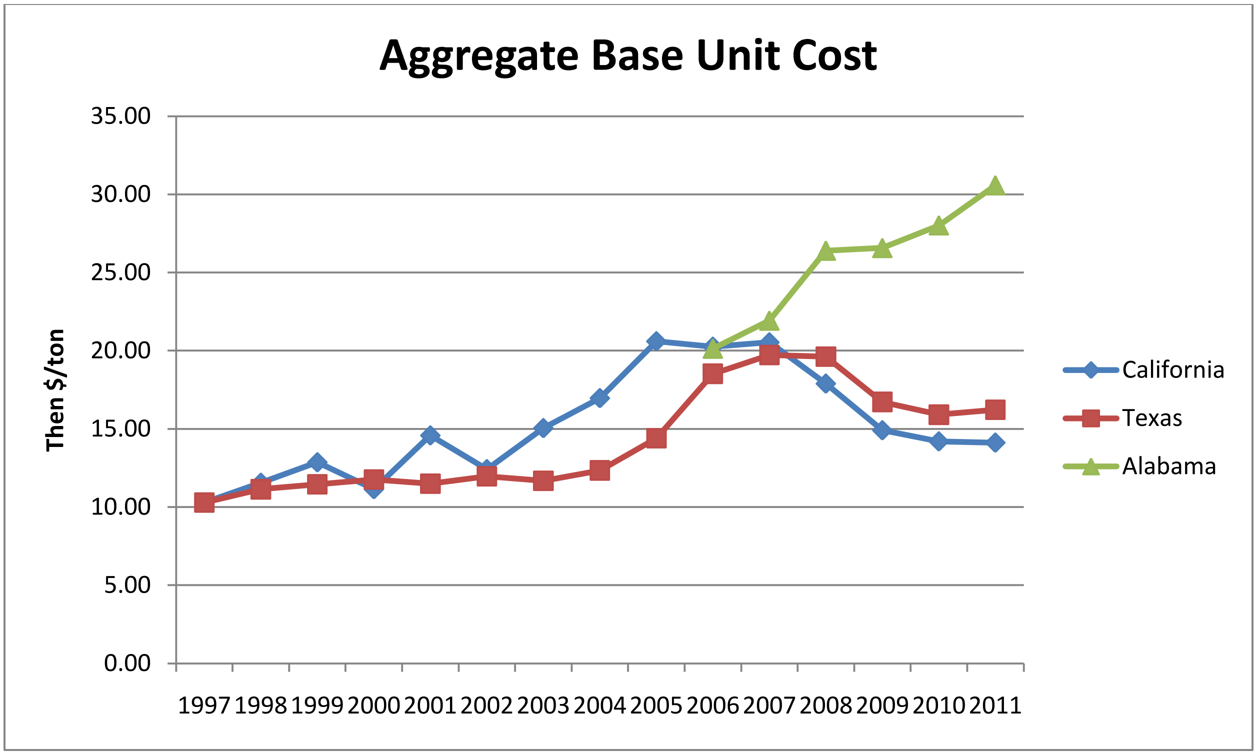

Figure 2-29. Average Aggregate Base Unit Costs, California-Texas-Alabama

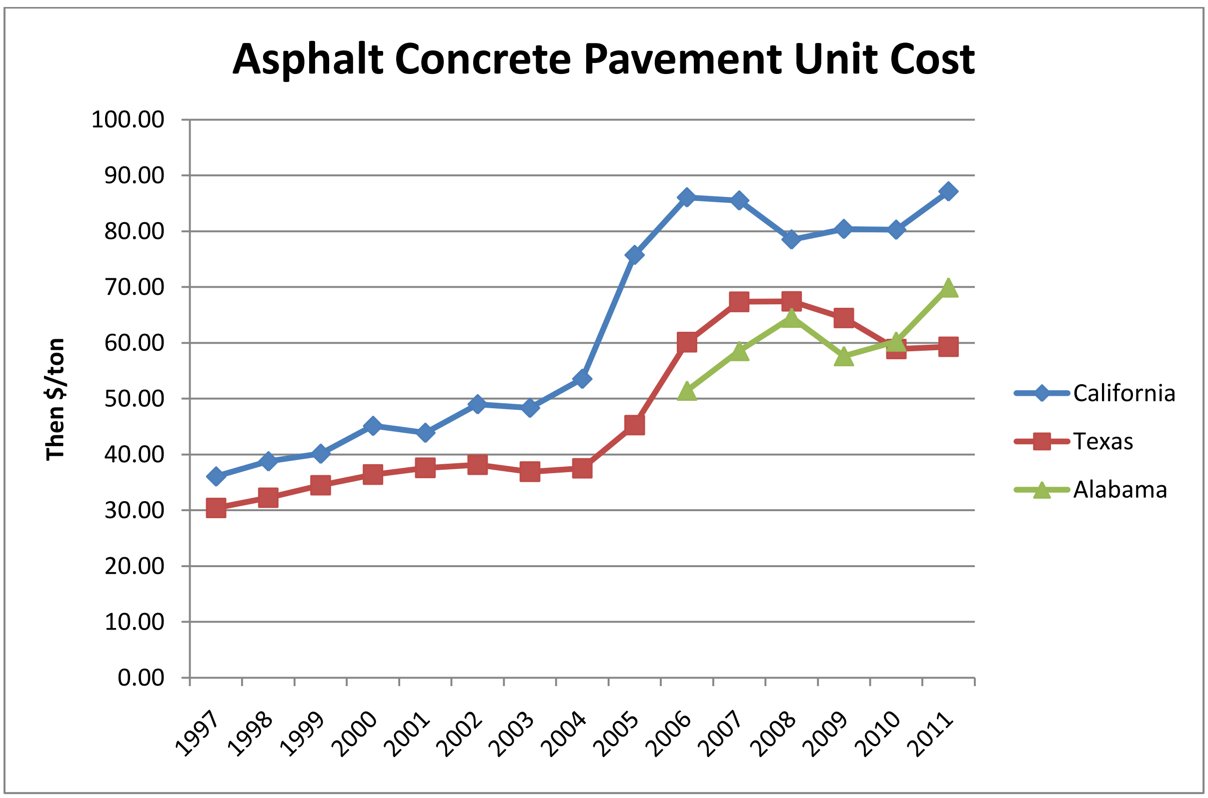

Figure 2-30. Average Asphalt Concrete Pavement Unit Costs, California-Texas-Alabama

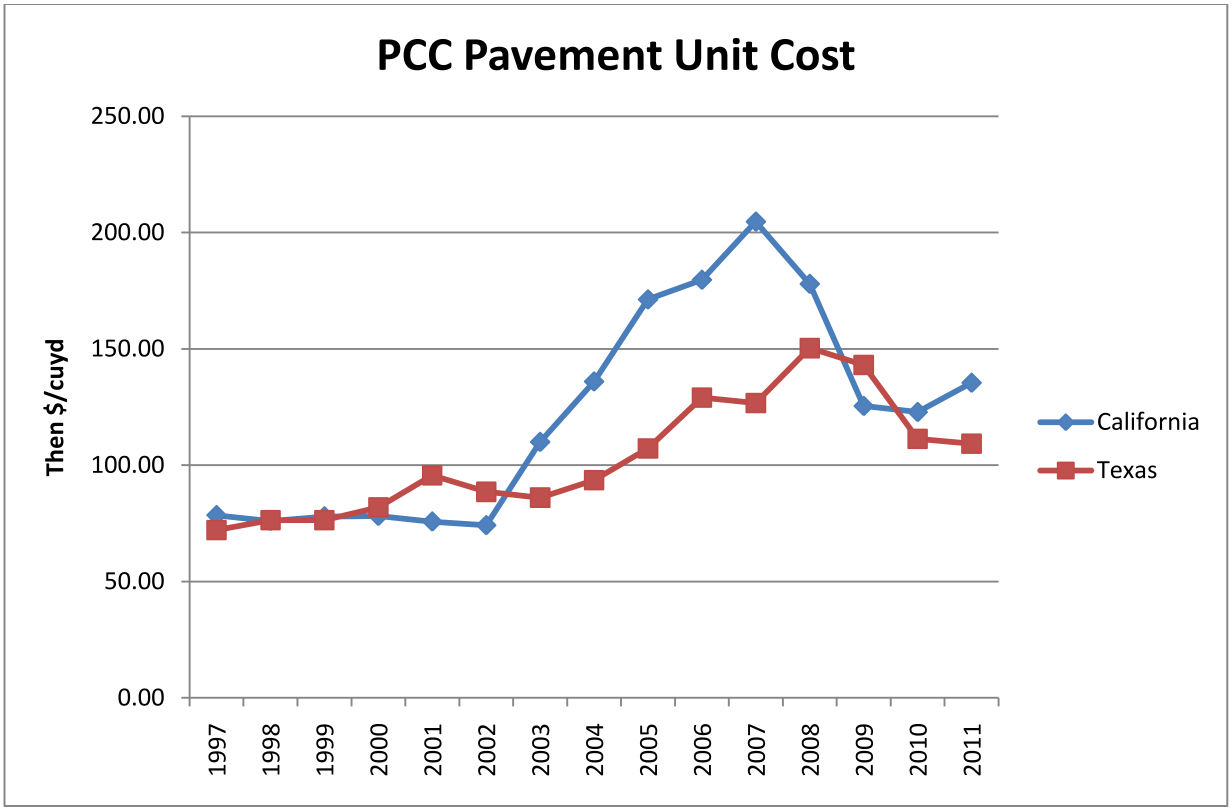

Figure 2-31. Average Portland Cement Concrete Unit Costs, California vs. Texas, 1997-2011

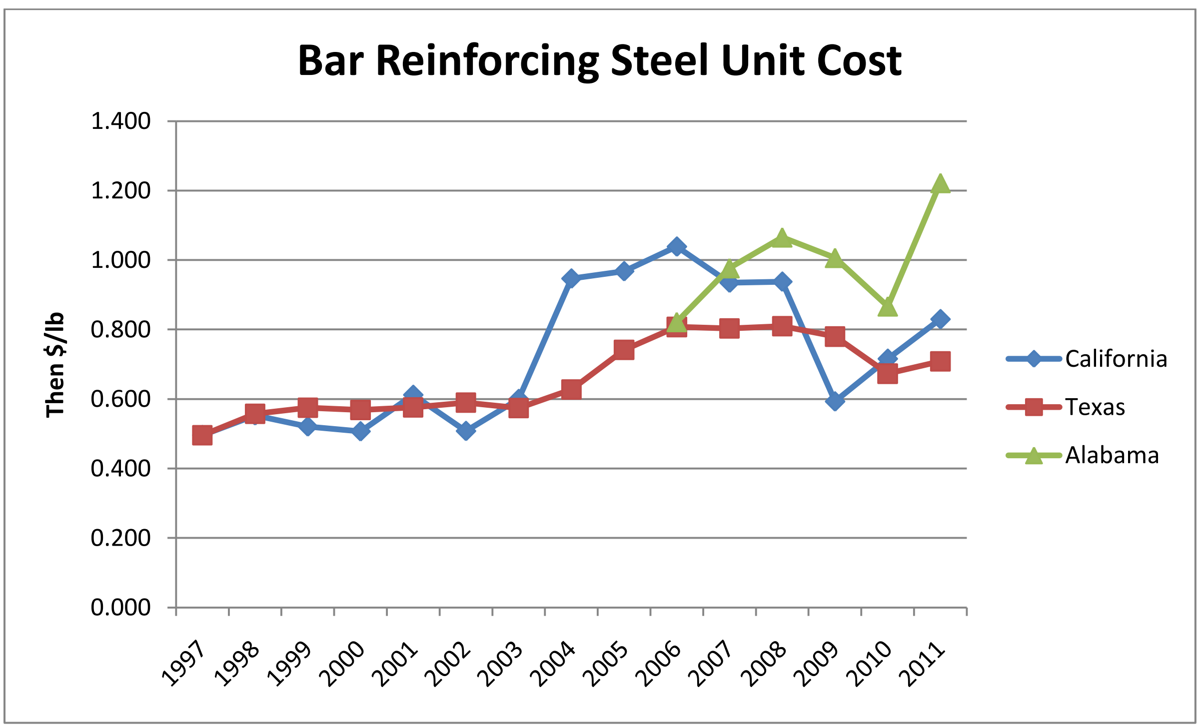

Figure 2-32. Average Rebar Unit Costs, California-Texas-Alabama

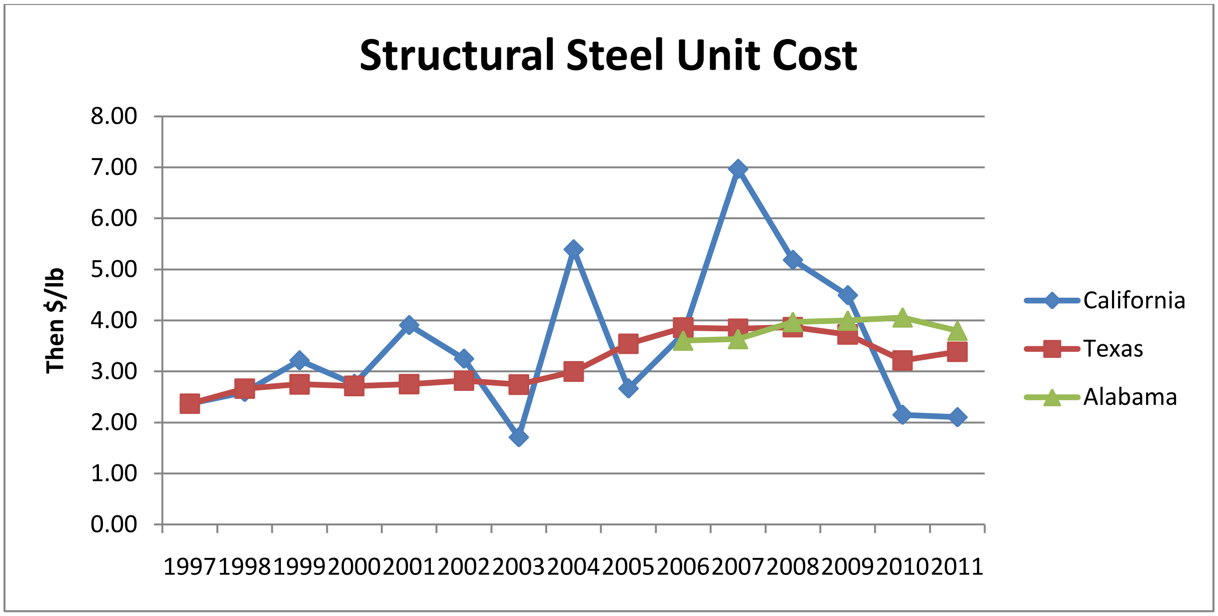

Figure 2-33. Average Structural Steel Unit Costs, California-Texas-Alabama

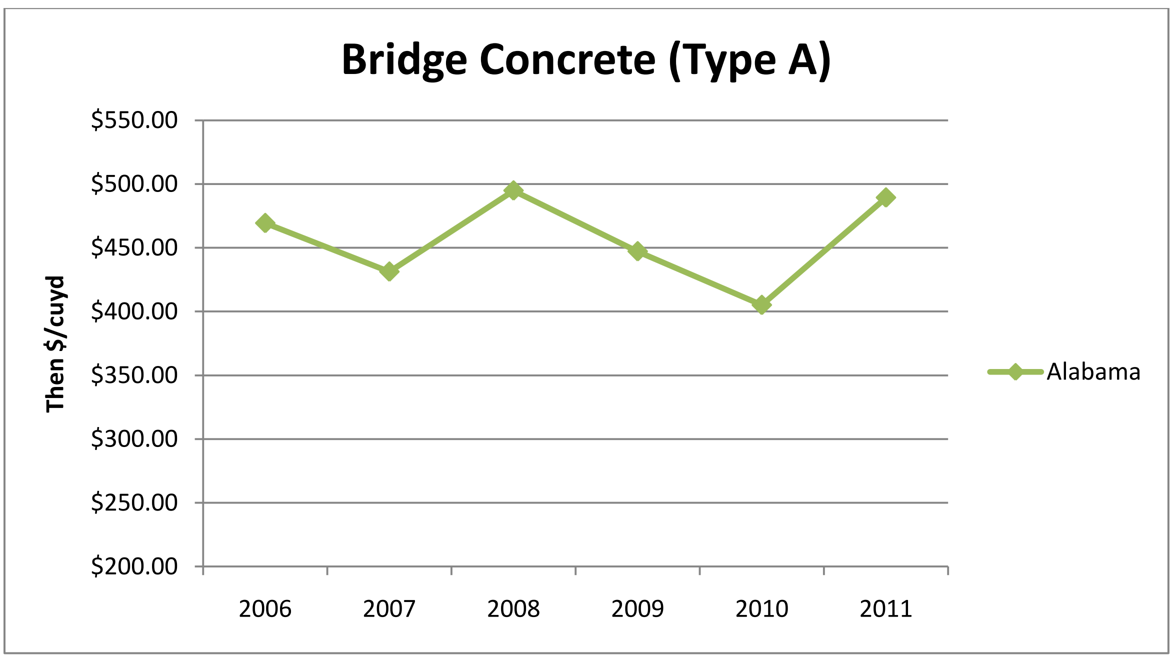

Figure 2-34. Average Unit Cost for Bridge Concrete Type A, Alabama, 2006-2011

In Base 1997 dollars, we present these same unit cost data from Tables 2-15 and 2-16 in Table 2-17 (California) and Table 2-18 (Texas), respectively. Studying these cost trends in 1997 base-year dollars shows that in both states, costs grew during 2003-2008 but have fallen back in 2009-2011 to near 1997-2002 levels.

Table 2-17. CALTRANS Material Unit Costs in 1997 Dollars, 1997-2011

California - 1997 Base Dollars						
Year	Roadway Excavation Per cuyd	Aggregate Base Per ton	Asphalt Concrete Pavement Per Ton	PCC Pavement Per cuyd	Bar Reinf. Steel Per lb	Structural Steel Per lb
1997	5.25	10.29	36.07	78.48	0.50	2.37
1998	4.84	11.29	37.92	74.22	0.54	2.54
1999	6.26	12.29	38.37	74.51	0.50	3.07
2000	5.80	10.41	42.17	73.03	0.47	2.57
2001	5.33	13.32	40.11	69.21	0.56	3.57
2002	4.32	11.10	43.78	66.25	0.45	2.90
2003	4.41	13.15	42.23	96.05	0.52	1.49
2004	11.20	14.49	45.73	116.09	0.81	4.60
2005	11.80	17.21	63.22	142.96	0.81	2.23
2006	10.45	16.54	70.24	146.68	0.85	3.05
2007	8.65	16.39	68.23	163.38	0.75	5.56
2008	8.89	13.97	61.26	138.84	0.73	4.04
2009	7.15	11.38	61.33	95.68	0.45	3.43
2010	5.92	10.59	59.86	91.62	0.53	1.60
2011	8.62	10.30	63.53	98.75	0.61	1.53

Table 2-18. TXDOT Material Unit Costs in 1997 Dollars, 1997-2011

Texas - 1997 Base Dollars						
Year	Roadway Excavation Per cuyd	Aggregate Base Per ton	Asphalt Concrete Pavement Per Ton	PCC Pavement Per cuyd	Bar Reinf. Steel Per lb	Structural Steel Per lb
1997	5.25	10.29	30.43	72.08	0.50	2.37
1998	5.86	10.89	31.53	74.70	0.54	2.60
1999	6.02	10.94	32.95	72.99	0.55	2.63
2000	5.46	11.00	34.02	76.50	0.53	2.54
2001	5.41	10.51	34.36	87.41	0.53	2.51
2002	5.57	10.69	34.08	79.12	0.53	2.52
2003	5.41	10.20	32.24	75.17	0.50	2.39
2004	5.45	10.54	32.04	79.91	0.54	2.56
2005	6.24	12.03	37.79	89.48	0.62	2.96
2006	7.29	15.12	49.09	105.32	0.66	3.15
2007	7.76	15.74	53.76	101.10	0.64	3.06
2008	7.39	15.31	52.63	117.30	0.63	3.02
2009	6.12	12.76	49.17	109.19	0.59	2.84
2010	5.08	11.87	43.93	83.06	0.50	2.40
2011	4.75	11.84	43.25	79.69	0.52	2.47

Our perception was that Alabama unit costs, though not readily available from ALDOT, would better match TXDOT costs than CALTRANS costs. To compare ALDOT material unit costs with TXDOT material unit costs, we worked through the "projects let" records publically available within the ALDOT website. We chose to focus on four materials Texas and Alabama had in common —Aggregate Base, Asphalt Concrete Pavement, Bar Reinforcing Steel, and Structural Steel—and averaged the unit costs for all *winning* bids from ALDOT during the six year period 2006-2011, to create Table 2-19. Bridge Concrete Type A was also included. Note the exceptionally high average cost escalation rates in Alabama over these six years: 7.22% for Aggregate Base, 5.25% for Asphalt Concrete Pavement, and 6.84% for Rebar. The reader encountered graphical depictions of the data in Table 2-19 in Figures 2-29 through 2-34.

Table 2-19. ALDOT Winning Bid Average Unit Costs for Five Selected Materials, 2006-11

Alabama - Then Dollars					
Year	Aggregate Base	AC Pavement	Bar Reinf. Steel Per lb	Structural Steel Per lb	Bridge Concrete Type A Per cuyd
2006	$20.13	$51.47	$0.82	$3.61	$469.26
2007	$21.93	$58.58	$0.98	$3.64	$431.19
2008	$26.40	$64.55	$1.07	$3.97	$494.81
2009	$26.57	$57.66	$1.01	$4.00	$447.13
2010	$28.02	$60.27	$0.87	$4.06	$405.04
2011	$30.58	$69.97	$1.22	$3.80	$489.30
Avg. Inflation	7.22%	5.25%	6.84%	0.87%	0.70%

What we discovered upon graphing some of the Texas vs. Alabama comparative data is quite interesting. Figure 2-35 shows that while both Aggregate and Asphalt Concrete Pavement unit costs were trending down in Texas during 2006-2011, the unit cost for these materials was trending up in Alabama. Here are equations for the trend lines fitted to the data in Figure 2-35:

TX Asphalt Concrete Pavement ($/ton) = 1933 - .9309*Year

AL Asphalt Concrete Pavement ($/ton) = -5144 + 2.591*Year

TX Aggregate Base ($/ton) = 1500 - 0.7378*Year

AL Aggregate Base ($/ton) = -4031 + 2.020*Year.

Furthermore, in 2011 the unit cost of Aggregate Base in Alabama ($30.58/ton) was 83% higher than the unit cost of Aggregate Base in Texas ($16.72/ton). Asphalt Concrete Pavement unit cost was 18% higher in Alabama than Texas in 2011. While interesting, it must be noted that Texas separates the cost of asphalt into aggregate and liquid, so the asphalt cost comparisons may be invalid. For rebar, Figure 2-36 shows the same pattern of increasing costs to ALDOT (up

$.046/lb annually) and decreasing costs to TXDOT (down $.026/lb annually), with 2011 rebar unit costs 72% higher ($1.22 vs. $.71) to ALDOT than TXDOT.

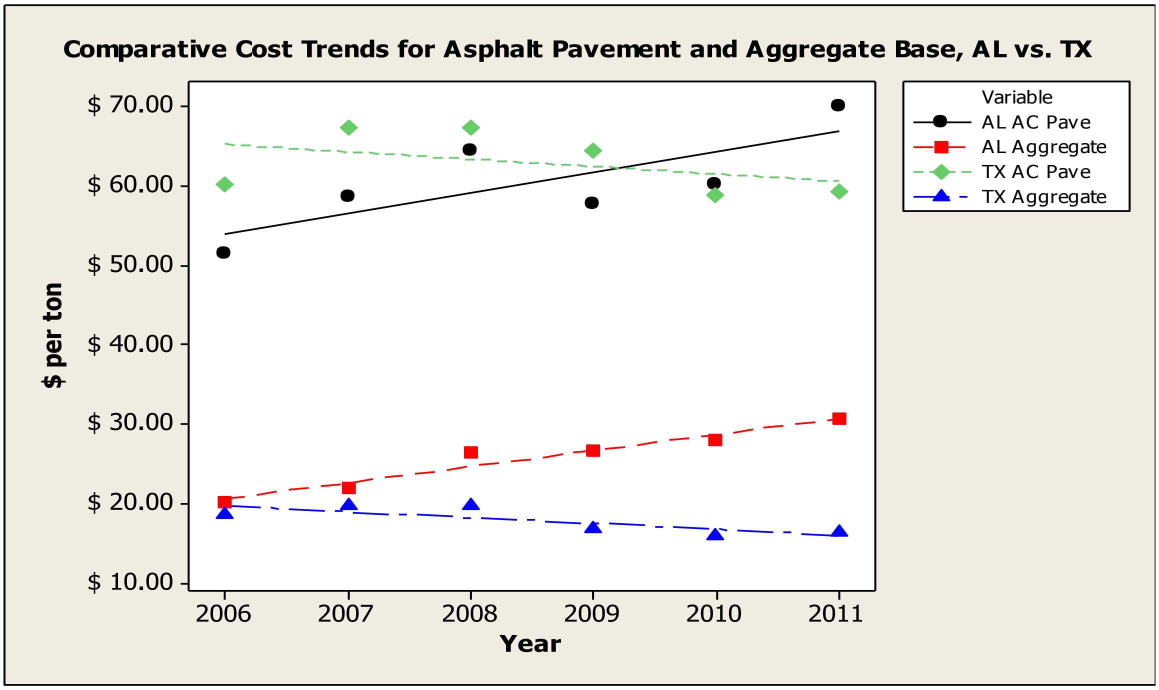

Figure 2-35. Trends in Aggregate Base and AC Pavement Unit Costs, ALDOT vs. TXDOT, 2006-11

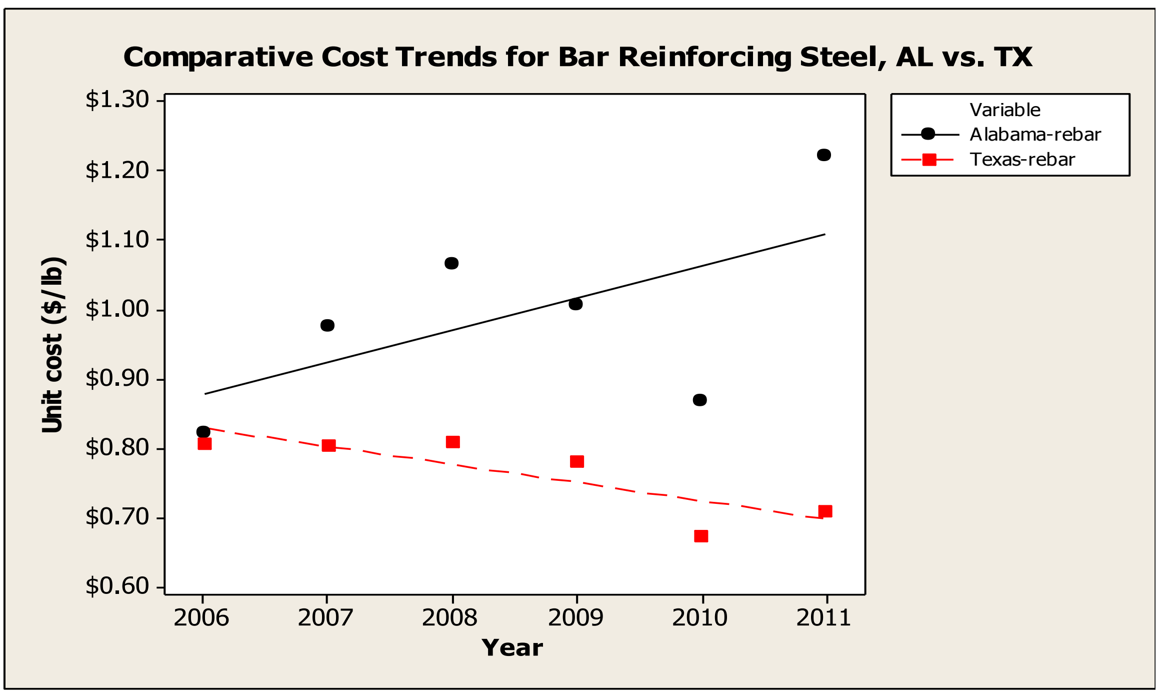

Figure 2-36. Trends in Bar Reinforcing Steel Unit Costs, ALDOT vs. TXDOT, 2006-11

To forecast Alabama rebar unit costs into the near future, the equation of the regression line shown in Figure 2-36 is

AL Bar Reinforcing Steel ($/lb) = -91.60 + 0.0461*Year.

Because of the fluctuations in unit cost for the other two materials in Table 2-19, we could not find suitable regression equations.

2.4.C Trends and Forecasts for Costs per Unit Constructed or Maintained

Table 2-20 is a compilation of FY 1997-2011 ALDOT construction and maintenance activities (miles authorized) with categorical breakouts into four types of road construction and three types of road maintenance. A “bridges authorized” column is included, but we shall analyze bridges later in this subsection based on “bridges let” each year, and their total square footage. Total Construction Miles and Total Maintenance Miles are cumulated in Table 2-20 and graphed in Figure 2-37. To forecast Construction Miles and Maintenance Miles, only the past five years FY2007-2011 were used due to the shapes of the graphs and the best models found were simply:

Construction Miles = 0.0615*Year

Maintenance Miles = 0.704*Year.

Table 2-20. Construction and Maintenance Activities by Miles Authorized

Construction and Maintenance Activities by Miles Authorized										
	Construction Activities				Maintenance Activities			Bridges	Totals	
Year	Grade & Drain	Base & Pave	Grade, Drain, Base Pave & Bridge	Added Roadway Lanes	Resurfacing With Pavement Widening	Rehabilitated	Resurfacing Projects Only	Number of Bridges Authorized	Total Construction Miles	Total Maintenance Miles
1997	18.5	45.2	18.3	55.0	396.6	31.4	942.8	64	157.0	1370.8
1998	26.6	27.2	4.4	35.6	253.7	18.8	864.8	35	93.8	1137.3
1999	11.7	30.1	32.5	37.5	231.7	15.0	653.9	34	111.8	900.6
2000	27.1	23.0	22.8	11.5	244.3	11.9	667.2	41	84.4	923.4
2001	30.5	33.6	23.0	25.5	119.7	0.0	666.1	49	112.6	785.8
2002	32.7	28.0	10.8	22.8	129.1	33.2	579.7	20	94.3	742.0
2003	58.9	42.8	50.8	38.1	50.1	64.2	510.0	90	190.6	624.3
2004	11.1	6.6	14.8	54.7	57.8	21.3	449.0	73	87.2	528.1
2005	4.8	16.4	22.3	8.4	122.5	4.8	348.0	72	51.9	475.3
2006	20.9	26.2	0.0	11.0	69.0	2.0	231.7	30	58.1	302.7
2007	0.3	27.5	41.1	34.8	228.7	93.7	873.9	58	103.7	1196.3
2008	73.5	31.9	19.8	20.1	616.1	18.1	705.6	82	145.3	1339.8
2009	5.1	14.9	72.5	33.1	748.3	138.6	868.7	88	125.6	1755.6
2010	12.2	10.4	70.5	28.1	450.3	119.8	862.6	106	121.2	1432.7
2011	23.4	35.9	27.6	35.0	491.0	98.9	762.1	98	121.9	1352.0

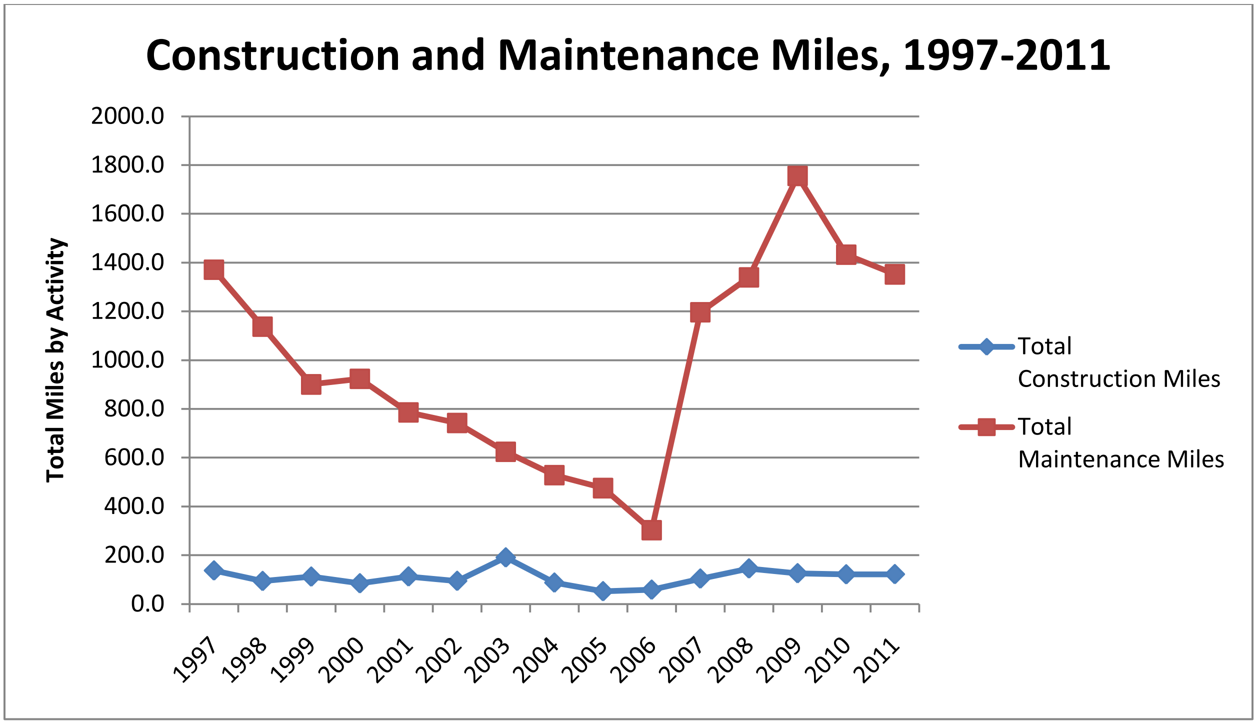

Figure 2-37. Comparison of Annual Construction and Maintenance Miles

Table 2-21 brings expenditure data in then-year dollars for FY 1997-2011 from Table 2-11 together with miles data from Table 2-20, to produce cost/mile annual metrics as shown in the final two columns of Table 2-21. The years 2002-2006 produced some very odd cost/mile results, evident in the time series graphed in Figure 2-38, which we cannot explain. To forecast Construction Cost/Mile, the best model was double exponential smoothing which predicts a gradual increase from $8.47M/mile in 2012 to $9.14M/mile in 2030. Maintenance Cost/mile based on this graph is predicted to be stable at $145,179/mile, averaged over all types of maintenance.

Table 2-21. Construction and Maintenance Expenditures per Mile

	Expenditures		Cost/Mile	
Year	Construction Expenditures ($M)	Maintenance Expenditures ($M)	Construction $M/Mile	Maintenance $/Mile
1997	$486.10	$172.80	$9.11	$126,058
1998	$495.20	$173.30	$52.79	$152,378
1999	$552.10	$155.50	$49.38	$172,663
2000	$732.90	$140.10	$86.84	$151,722
2001	$866.00	$130.10	$76.91	$165,564
2002	$997.80	$126.50	$105.81	$170,485
2003	$908.50	$134.50	$47.67	$215,441
2004	$888.20	$144.70	$101.86	$274,001
2005	$956.40	$125.50	$184.28	$264,044
2006	$1,001.80	$156.50	$172.43	$517,014
2007	$965.00	$230.00	$93.06	$192,259
2008	$996.60	$195.90	$68.59	$146,216
2009	$1,057.80	$222.80	$84.22	$126,908
2010	$1,055.60	$188.10	$87.10	$131,291
2011	$1,043.10	$194.00	$85.57	$143,491

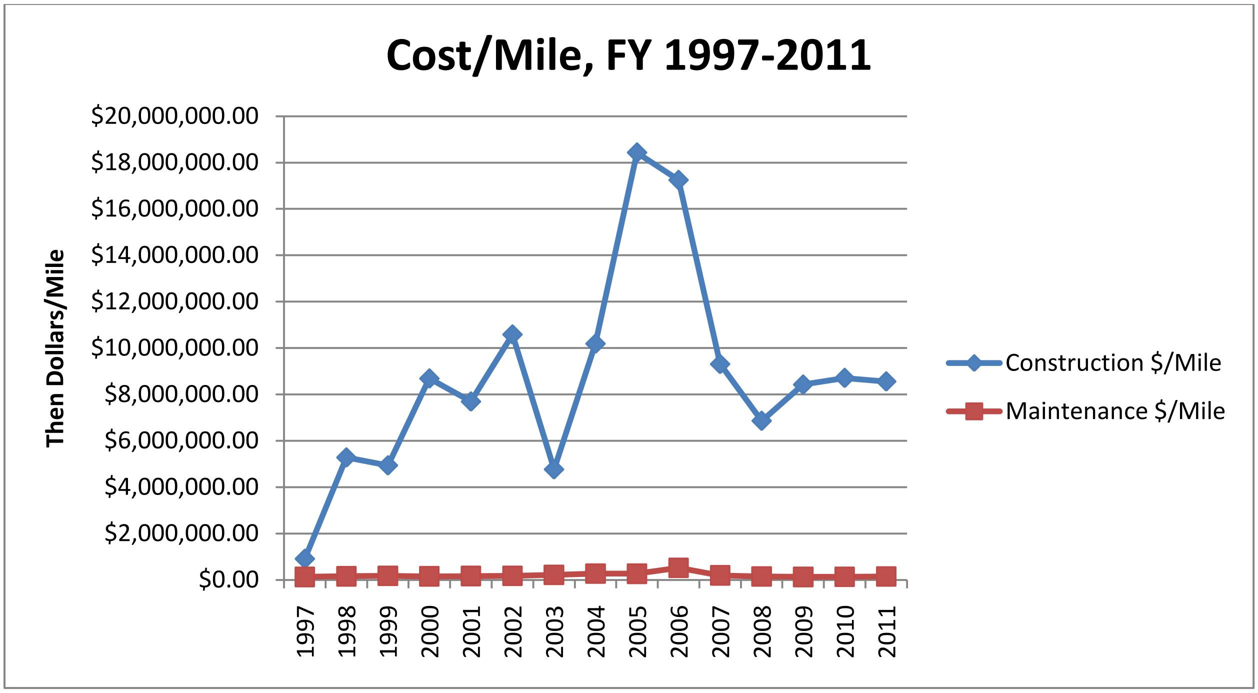

Figure 2-38. Comparison of Annual Construction Cost/Mile with Maintenance Cost/Mile

Because the data on Maintenance Cost/mile in Table 2-21 seems uninformative, we decided to study trends in such costs in terms of the following maintenance categories:

- Routine Maintenance (Not Interstate) Cost/Mile
- Routine Maintenance (Interstate) Cost/Mile
- Resurfacing Cost/Mile.

We constructed Table 2-22 from ALDOT Annual Reports. Note we could not locate data for the first two categories after 2005. The data is graphed in Figure 2-39, and shows linear trends for all three metrics. We were able to build good regression-based models for each of these three, as follows (units are $/mile):

Routine Maintenance (Not Interstate) Cost/Mile = -259563 + 132.56*Year, R^2 = 86%

Routine Maintenance (Interstate) Cost/Mile = -2830952 + 1425.4*Year, R^2 = 77%

Resurfacing Cost/Mile = -29341590 + 14745*Year, R^2 = 90%.

Table 2-22. Maintenance Category Costs per Mile

Year	Routine Maint. (Not Interstate)	Routine Maint. (Interstate Only)	Resurfacing
1997	$5,203.15	$16,103.44	$123,327.92
1998	$5,130.35	$16,429.03	$118,199.23
1999	$5,429.00	$16,461.00	$156,829.00
2000	$5,458.00	$17,502.00	$155,850.00
2001	$5,992.00	$24,009.00	$168,312.00
2002	$5,881.00	$26,513.00	$149,820.00
2003	$5,989.00	$24,535.00	$188,547.00
2004	$5,945.00	$24,527.00	$194,053.00
2005	$5,588.00	$25,121.00	$177,494.00
2006			$220,756.93
2007			$247,218.00
2008			$301,659.00
2009			$278,087.00
2010			$336,216.00
2011			$303,831.00

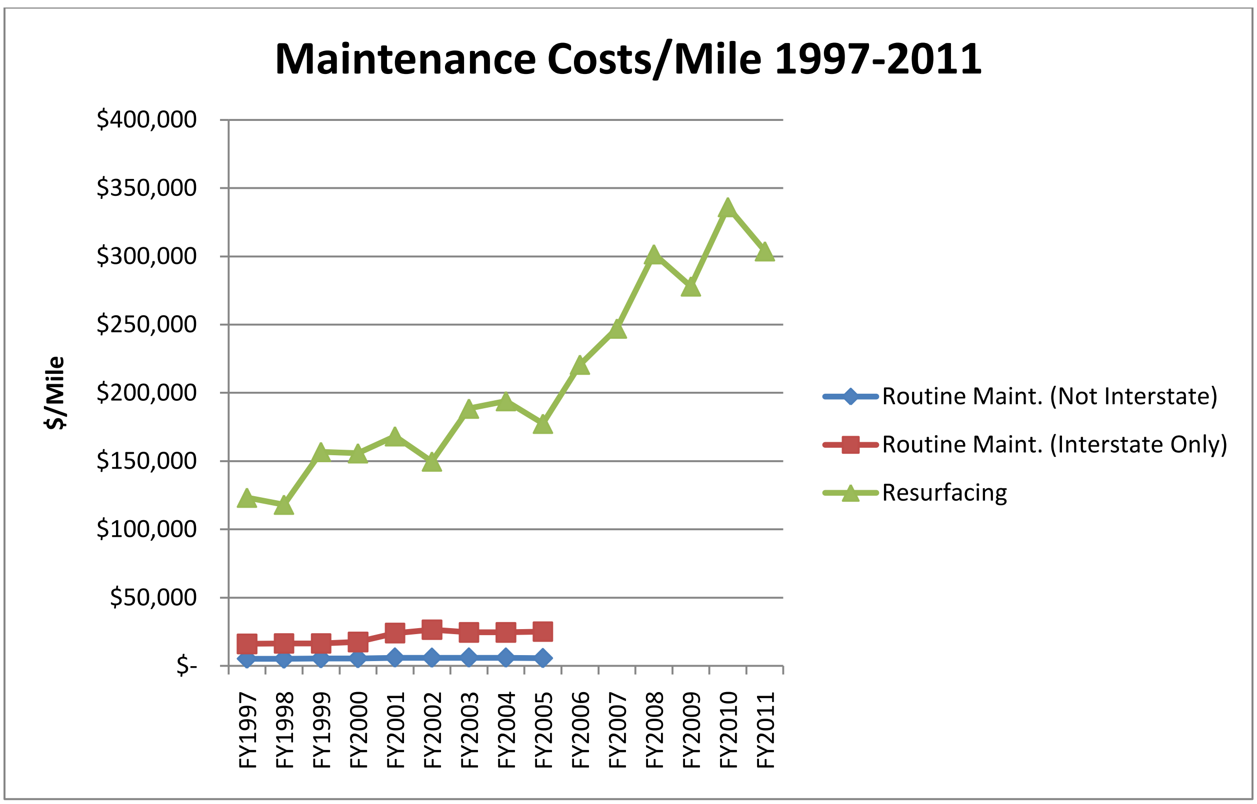

Figure 2-39. Trends in Maintenance Category Costs per Mile

In Table 2-23, we calculated the proportion of highway maintenance activities among the three categories shown. The following equations model the proportions found:

Resurfacing and Widening Proportion of Maintenance = -66.6 + 0.0333*Year

Resurfacing (only) Proportion = 72.3 – 0.0357*Year.

These equations indicate (see Figure 2-40) that the general historical pattern has been:

Resurfacing with Widening has been increasing as a proportion of maintenance by 3.5% per year, and stood at 36% in 2011
Resurfacing (only) has been decreasing as a proportion of maintenance by 3.5% per year, and stood at 56% in 2011.

These trends are important because Resurfacing with Widening is approximately ten times as expensive per mile as Resurfacing. Another interesting relationship between the two resurfacing measures is evident in Figure 2-41: Plotting the actual proportions for these two categories of maintenance over the past 15 years shows they are strongly negatively correlated, with correlation coefficient r = -0.952.

Table 2-23. Maintenance Category Proportions

	Maintenance Activities Proportions		
Year	Resurfacing With Widening	Rehabilitated	Resurfacing Projects Only
1997	0.29	0.02	0.69
1998	0.22	0.02	0.76
1999	0.26	0.02	0.73
2000	0.26	0.01	0.72
2001	0.15	0.00	0.85
2002	0.17	0.04	0.78
2003	0.08	0.10	0.82
2004	0.11	0.04	0.85
2005	0.26	0.01	0.73
2006	0.23	0.01	0.77
2007	0.19	0.08	0.73
2008	0.46	0.01	0.53
2009	0.43	0.08	0.49
2010	0.31	0.08	0.60
2011	0.36	0.07	0.56

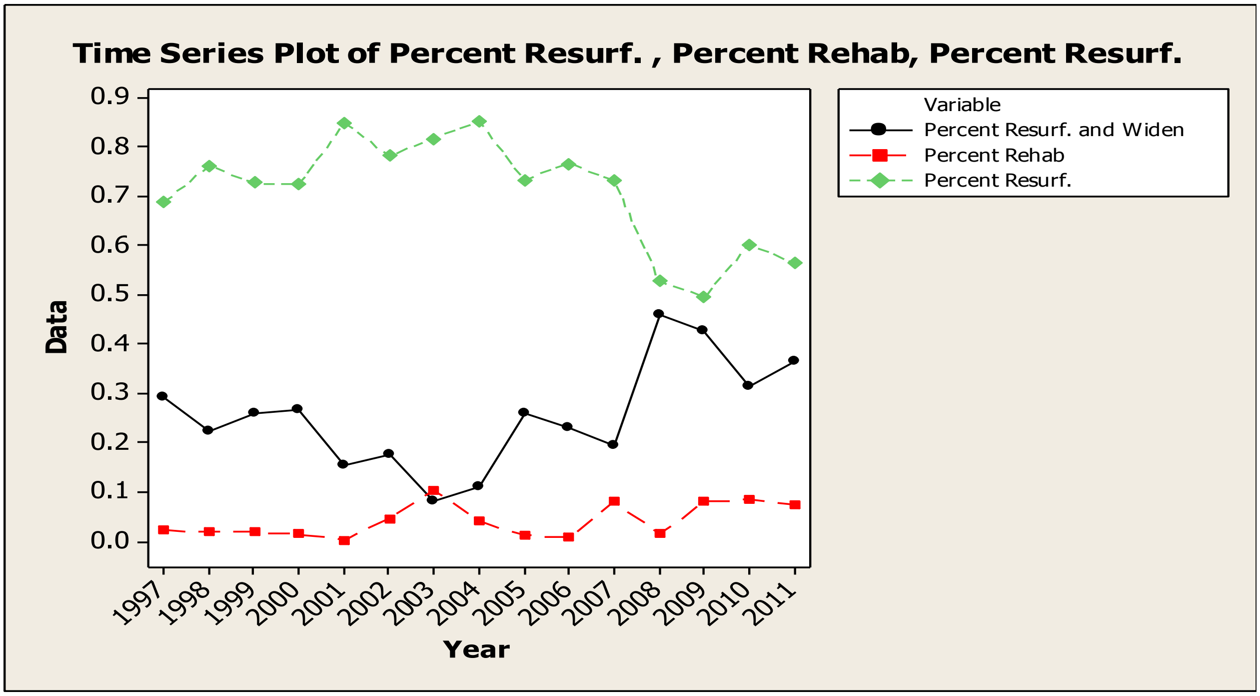

Figure 2-40. Trends in Maintenance Category Proportions

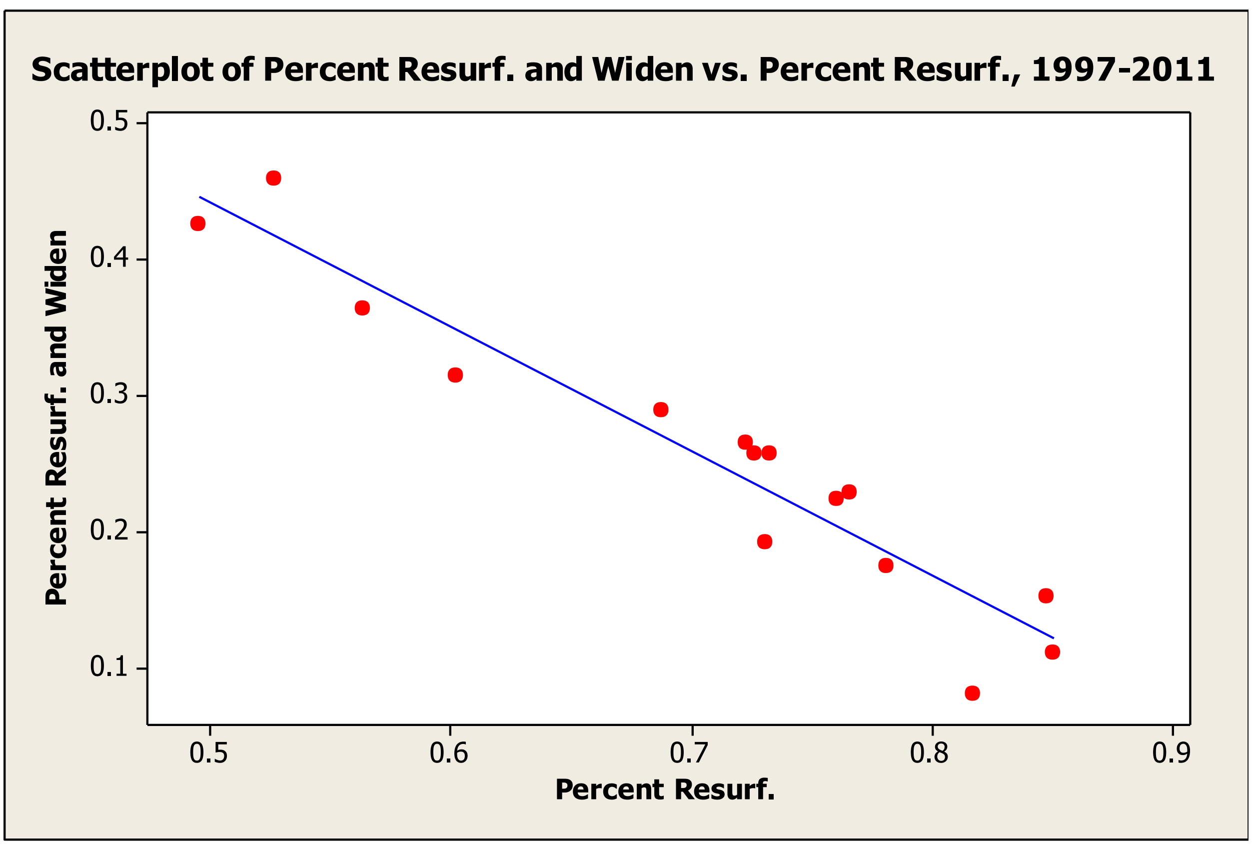

Figure 2-41. Scatterplot of Proportions, Resurfacing with Widening vs. Resurfacing (only)

Table 2-24 contains historical data on cost/mile from Table 2-22 with forecasts (2007-2030) for the two subcategories of Routine Maintenance, and forecasts (2012-2030) for Resurfacing, based on the regression equations preceding Table 2-22.

Table 2-24. Forecasts for Cost/Mile for three Maintenance Subcategories

Year	Routine Maint. (Not Interstate)	Routine Maint. (Interstate Only)	Resurfacing
1997	$5,203.15	$16,103.44	$123,327.92
1998	$5,130.35	$16,429.03	$118,199.23
1999	$5,429.00	$16,461.00	$156,829.00
2000	$5,458.00	$17,502.00	$155,850.00
2001	$5,992.00	$24,009.00	$168,312.00
2002	$5,881.00	$26,513.00	$149,820.00
2003	$5,989.00	$24,535.00	$188,547.00
2004	$5,945.00	$24,527.00	$194,053.00
2005	$5,588.00	$25,121.00	$177,494.00
2006	$6,352.36	$28,400.40	$220,756.93
2007	$6,484.92	$29,825.80	$247,218.00
2008	$6,617.48	$31,251.20	$301,659.00
2009	$6,750.04	$32,676.60	$278,087.00
2010	$6,882.60	$34,102.00	$336,216.00
2011	$7,015.16	$35,527.40	$303,831.00
2012	$7,147.72	$36,952.80	$325,975.83
2013	$7,280.28	$38,378.20	$340,721.14
2014	$7,412.84	$39,803.60	$355,466.45
2015	$7,545.40	$41,229.00	$370,211.76
2016	$7,677.96	$42,654.40	$384,957.07
2017	$7,810.52	$44,079.80	$399,702.38
2018	$7,943.08	$45,505.20	$414,447.69
2019	$8,075.64	$46,930.60	$429,193.00
2020	$8,208.20	$48,356.00	$443,938.31
2021	$8,340.76	$49,781.40	$458,683.62
2022	$8,473.32	$51,206.80	$473,428.93
2023	$8,605.88	$52,632.20	$488,174.25
2024	$8,738.44	$54,057.60	$502,919.56
2025	$8,871.00	$55,483.00	$517,664.87
2026	$9,003.56	$56,908.40	$532,410.18
2027	$9,136.12	$58,333.80	$547,155.49
2028	$9,268.68	$59,759.20	$561,900.80
2029	$9,401.24	$61,184.60	$576,646.11
2030	$9,533.80	$62,610.00	$591,391.42
	regression	regression	regression

Finally, Table 2-25 provides 15-year data on Bridges Let to Contract. We computed a column titled Cost per Square Foot, and this metric is graphed in Figure 2-42. The increase in cost per square foot for new bridges has averaged $4.11 per year as can be seen in the regression model:

Cost per square foot (bridges let to contract) = -8156 + 4.11*Year, R^2 = 79%.

Table 2-26 contains forecasted annual cost/square foot for bridges out to year 2030. The 2011 value of $87.66/sq.ft. escalates to $187.30/sq.ft. in 2030, slightly more than doubling in 19 years for an average escalation rate of 4.1% per year. The dollars needed to let the average total bridge square footage for these same 19 years is also shown. Bridge square footage let at the average annual bridge expenditure of $70.86M would be reduced from 808,436 sq.ft. in 2011 to only 378,342 sq.ft. in 2030. The average number of new bridges let would reduce from 40 in 2011 to 19 in 2030. Both of these represent a reduction in bridge construction of slightly more than 50%.

Table 2-25. Bridges Let to Contract, 1997-2011

Bridges Let to Contract				
Year	Number of Bridges	Total Square Feet	Total Contracts Cost	Cost per square foot
FY1997	32	672,127	$ 31,528,364.00	$ 46.91
FY1998	52	719,310	$ 36,212,058.00	$ 50.34
FY1999	47	1,123,078	$ 78,653,701.62	$ 70.03
FY2000	69	1,294,525	$ 73,873,882.92	$ 57.07
FY2001	50	1,281,435	$ 75,865,644.00	$ 59.20
FY2002	65	1,352,549	$ 83,578,968.00	$ 61.79
FY2003	72	1,249,620	$ 74,774,420.00	$ 59.84
FY2004	41	641,557	$ 45,730,740.00	$ 71.28
FY2005	36	824,250	$ 70,722,999.00	$ 85.80
FY2006	36	615,707	$ 57,378,297.16	$ 93.19
FY2007	48	868,109	$ 92,991,302.26	$ 107.12
FY2008	44	589,465	$ 57,761,541.71	$ 97.99
FY2009	29	588,537	$ 58,460,371.37	$ 99.33
FY2010	47	1,347,690	$ 140,264,498.83	$ 104.08
FY2011	43	971,488	$ 85,155,892.38	$ 87.66
Average	47	942630	$ 70,863,512.08	$ 76.78

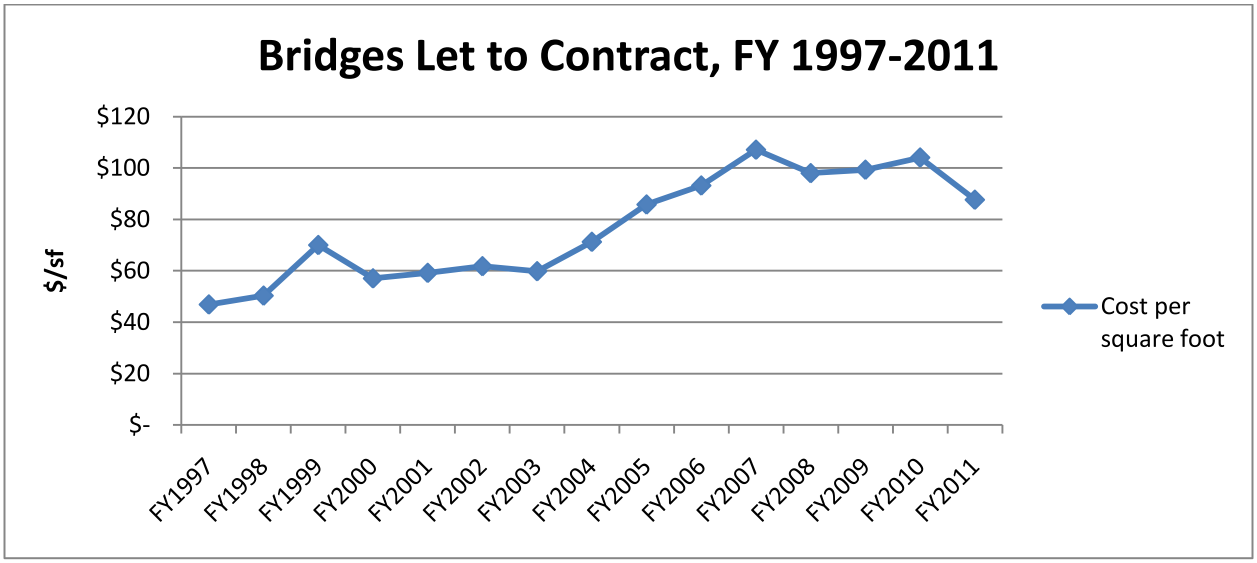

Figure 2-42. Cost per Square Foot, Bridges Let to Contract in 1997-2011

Table 2-26. Forecasts for Various Bridge Construction Metrics, 2012-2030

Bridges Let to Contract				
Year	Cost per square foot	Bridge $ to let average total square footage	Bridge Square Footage let at average bridge expenditures	Number of average size bridges let
1997	46.91	$44,217,216	1510680	75
1998	50.34	$47,454,590	1407621	70
1999	70.03	$66,016,179	1011844	50
2000	57.07	$53,792,483	1241773	62
2001	59.20	$55,807,157	1196945	60
2002	61.79	$58,248,550	1146777	57
2003	59.84	$56,404,835	1184261	59
2004	71.28	$67,191,489	994145	50
2005	85.80	$80,880,294	825888	41
2006	93.19	$87,844,588	760412	38
2007	107.12	$100,973,946	661538	33
2008	97.99	$92,368,100	723173	36
2009	99.33	$93,633,025	713403	36
2010	104.08	$98,106,779	680871	34
2011	87.66	$82,626,341	808436	40
2012	113.32	$106,818,832	625340	31
2013	117.43	$110,693,041	603453	30
2014	121.54	$114,567,250	583047	29
2015	125.65	$118,441,460	563975	28
2016	129.76	$122,315,669	546112	27
2017	133.87	$126,189,878	529346	26
2018	137.98	$130,064,087	513578	26
2019	142.09	$133,938,297	498723	25
2020	146.2	$137,812,506	484703	24
2021	150.31	$141,686,715	471449	24
2022	154.42	$145,560,925	458901	23
2023	158.53	$149,435,134	447004	22
2024	162.64	$153,309,343	435708	22
2025	166.75	$157,183,553	424969	21
2026	170.86	$161,057,762	414746	21
2027	174.97	$164,931,971	405004	20
2028	179.08	$168,806,180	395709	20
2029	183.19	$172,680,390	386831	19
2030	187.3	$176,554,599	378342	19
	regression			

2.5 Forecasted Revenue Shortfalls with Various Expenditure Scenarios

Baseline ALDOT Total Receipts for 2012-2030 were forecast in subsection 2.2.C.1, and will be shown to fall short of Baseline Total Expenditure forecasts made in subsection 2.4.A. The shortfall each fiscal year 2012-2030 will be calculated in subsection 2.5.A, and implications of these annual shortfalls will be explored through a series of nine "what if" excursions in subsection 2.5.B. It will be shown that each optional approach to handle expenditure reduction carries with it undesirable effects on ALDOT's ability to carry out its mission. Then, in a first sensitivity study, we address the question of what if ALDOT wishes to increase its construction expenditures to meet System Enhancement needs, as identified by its Division Engineers. Results of these sensitivity studies are presented in subsection 2.5.C.

Recall in subsection 2.2.C.2, we presented in Table 2-8 and Figure 2-23 forecasts for ALDOT Total Receipts for 2012-2030 that were adjusted downward from Baseline in order to recognize our forecast of declining gasoline consumption in Alabama brought on by the national CAFÉ Standards (see subsection 2.1.B.2). We shall use the two total revenue forecasts produced there, one we called "Best Case Gasoline Consumption Decline" and "Worst Case Gasoline Consumption Decline" along with the representative vehicle life of 14 years (175,000 miles)—as depicted in Figure 2-11—in combination first with Baseline Total Expenditures (subsection 2.5.D.1) and second with Expenditures adjusted upward based on an assumed 10% increase in Annual Construction Expenditures (subsection 2.5.D.2), to perform a second sensitivity study.

2.5.A Baseline Revenue Shortfalls to meet Baseline Expenditure Forecasts

Table 2-27 shows this study's Baseline forecasts (2012-2030) for total receipts and total expenditures, followed by columns containing the revenue shortfall as an absolute value (peaking at $152.85M in 2015) and as a percent of receipts (peaking at 10.55% in 2012 and remaining above 10% 2012-2015). The Baseline revenue shortfall in absolute and percentage terms falls off in the ten year period 2018-2027, is essentially zero in 2028, and is forecast to become positive (a revenue surplus) in FY 2029.

Table 2-27. Forecasted Baseline Receipts, Expenditures, and Revenue Shortfalls, 2012-2030

Year	Total Receipts ($M)	Total Expenditures($M)	Receipts-Expenditures ($M)	Underfunding as % Receipts
2012	$1,370.66	$1,515.20	-$144.54	-10.55%
2013	$1,412.52	$1,561.30	-$148.78	-10.53%
2014	$1,455.84	$1,607.40	-$151.56	-10.41%
2015	$1,500.65	$1,653.50	-$152.85	-10.19%
2016	$1,547.54	$1,699.60	-$152.06	-9.83%
2017	$1,595.38	$1,745.70	-$150.32	-9.42%
2018	$1,645.38	$1,791.80	-$146.42	-8.90%
2019	$1,696.78	$1,837.90	-$141.12	-8.32%
2020	$1,750.01	$1,884.00	-$133.99	-7.66%
2021	$1,804.85	$1,930.10	-$125.25	-6.94%
2022	$1,862.06	$1,976.20	-$114.14	-6.13%
2023	$1,921.40	$2,022.30	-$100.90	-5.25%
2024	$1,983.09	$2,068.40	-$85.31	-4.30%
2025	$2,046.37	$2,114.50	-$68.13	-3.33%
2026	$2,111.56	$2,160.60	-$49.04	-2.32%
2027	$2,179.26	$2,206.70	-$27.44	-1.26%
2028	$2,249.40	$2,252.80	-$3.40	-0.15%
2029	$2,322.14	$2,298.90	$23.24	1.00%
2030	$2,397.34	$2,345.00	$52.34	2.18%

Figure 2-43 shows Baseline expenditures vs. receipts for the entire study period 1997-2030; the gap between the linearly increasing forecast of expenditures and the non-linear, increasing curve of forecast revenues is the Baseline revenue shortfall or “gap” predicted by our research. Figure 2-44 shows the Baseline revenue shortfall as it climbs upward toward a slight revenue surplus in the years 2029-2030, according to our forecasts.

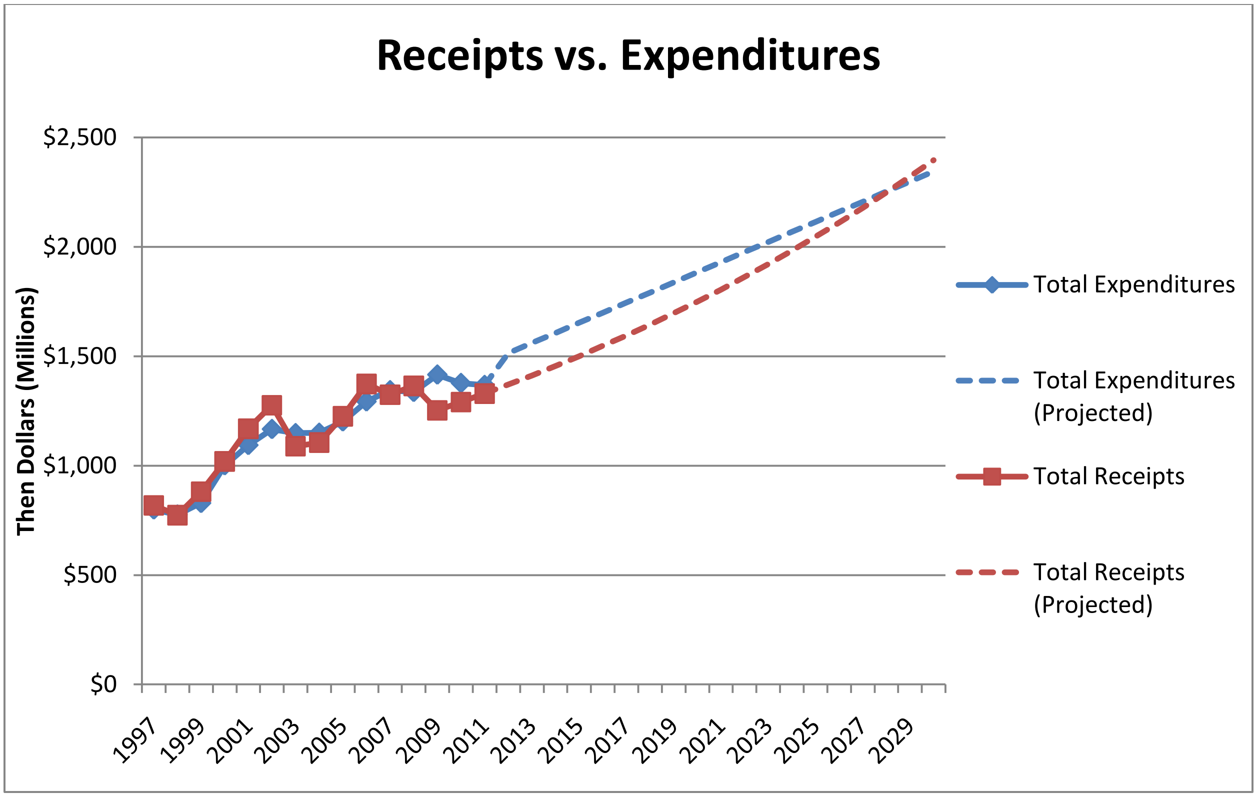

Figure 2-43. ALDOT Receipts vs. Expenditures, Actual 1997-2011 and Baseline Forecast 2012-2030

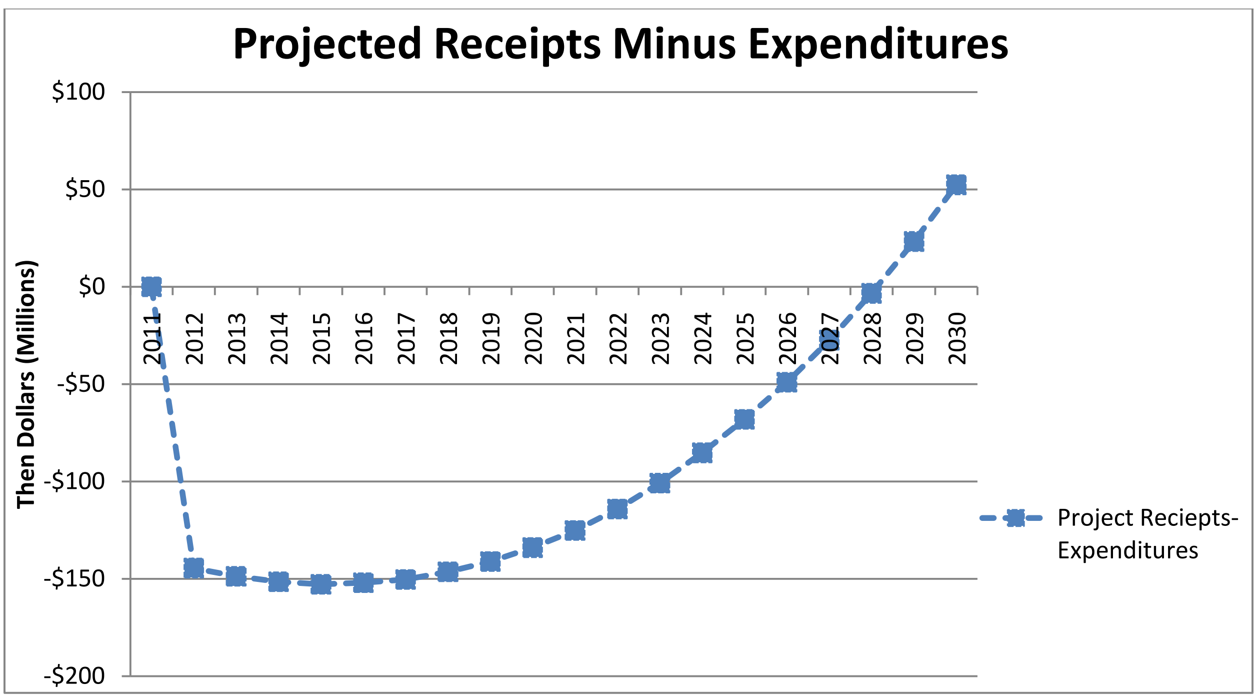

Figure 2-44. Forecasted Baseline Revenue Shortfall Profile, 2012-2030

2.5.B Expenditure Reduction Options to meet Forecasted Baseline Revenue Shortfall

Several expenditure reduction options ALDOT could implement to deal with the Baseline revenue shortfalls identified above were created, and will be analyzed one-by-one:

Option 1. Across-the-board cuts, that is, across the categories of expenditures ALDOT would enforce identical percent reductions. We will specifically investigate the impact on the larger categories: Federal and State Construction, Total Construction, and Total Maintenance.
Option 2: Reduction in Federal Construction only (holding State Construction and Maintenance categories at their respective forecasts).
Option 3: Zero out State Construction, then taking the remaining reduction out of Federal Construction (holding Maintenance at its forecast).
Option 4: Reduction in Construction only (holding Maintenance at its forecast).
Option 5: Reduction in Maintenance only (holding Construction at its forecast).
Option 6: Reduction in Total Obligations (Statutory Diversions).
Option 7: Reduction in Bridge Expenditures, estimated at forecasted expenditures for 15-year average of total square footage let, (holding Road Construction at forecast).
Option 8: Zero out Road Construction, then taking the remaining reduction out of Bridge Expenditures.
Option 9: Zero out Road Construction, then taking the remaining reduction out of Maintenance expenditures

The implications of each of these expenditure reduction options is addressed in the following:

Option 1: In this option, all seven categories listed under expenditures and all six categories listed under disbursements in Table 2-11 were reduced the identical proportion (for example, 10.55% in 2012) in order for the total expenditure to exactly match the forecasted Baseline receipts for each year. The resulting then-year dollar reductions in the four largest categories of expenditures are shown in Table 2-28.

Table 2-28. Impact of Reduction in Across-the-Categories Expenditures to match Shortfall

Year	Reduction in Federal Construction($M)	Reduction in State Construction($M)	Reduction in Construction($M)	Reduction in Maintenance($M)
2012	-$105.44	-$4.60	-$110.24	-$20.50
2013	-$108.53	-$4.73	-$113.47	-$21.10
2014	-$110.57	-$4.82	-$115.60	-$21.49
2015	-$111.51	-$4.86	-$116.58	-$21.67
2016	-$110.93	-$4.84	-$115.98	-$21.56
2017	-$109.66	-$4.78	-$114.65	-$21.31
2018	-$106.81	-$4.66	-$111.68	-$20.76
2019	-$102.95	-$4.49	-$107.64	-$20.01
2020	-$97.74	-$4.26	-$102.19	-$19.00

2021	-$91.37	-$3.98	-$95.53	-$17.76
2022	-$83.27	-$3.63	-$87.06	-$16.19
2023	-$73.61	-$3.21	-$76.96	-$14.31
2024	-$62.23	-$2.71	-$65.06	-$12.10
2025	-$49.70	-$2.17	-$51.97	-$9.66
2026	-$35.78	-$1.56	-$37.40	-$6.95
2027	-$20.02	-$0.87	-$20.93	-$3.89
2028	-$2.48	-$0.11	-$2.59	-$0.48
2029	$16.96	$0.74	$17.73	$3.30
2030	$38.18	$1.66	$39.92	$7.42

Option 2: In this option, the Federal Construction forecasted expenditure for 2012-2030 absorbs the entire reduction due to the Baseline revenue shortfall. In Table 2-29, we show the Federal Construction expenditure forecast before this reduction, and the percent reduction each year if this category absorbed the entire revenue shortfall. Initially, a 13% reduction in Federal Construction would cover the shortfall, remaining in the range 10-13% from 2012-2019, and lower 2020-2030. Maintenance follows its forecasted expenditures under this option

Table 2-29. Impact of Reduction in Federal Construction Expenditures to match Shortfall

Year	Federal Construction Baseline Forecast($M)	Percent Reduction if all Federal Construction
2012	$1,116.20	-12.95%
2013	$1,156.80	-12.86%
2014	$1,197.40	-12.66%
2015	$1,238.00	-12.35%
2016	$1,278.60	-11.89%
2017	$1,319.20	-11.39%
2018	$1,359.80	-10.77%
2019	$1,400.40	-10.08%
2020	$1,441.00	-9.30%
2021	$1,481.60	-8.45%
2022	$1,522.20	-7.50%
2023	$1,562.80	-6.46%
2024	$1,603.40	-5.32%
2025	$1,644.00	-4.14%
2026	$1,684.60	-2.91%
2027	$1,725.20	-1.59%
2028	$1,765.80	-0.19%
2029	$1,806.40	1.29%
2030	$1,847.00	2.83%

Option 3: Because State Construction is less than the revenue shortfall, this option "zeros out" State Construction, then uses a reduction in Federal Construction to make up the remaining shortfall. As can be seen in Table 2-30, under this option Federal Construction would take a reduction in the range 8.5-9.7% during the years 2012-2019, and lower 2020-2030. Maintenance follows its forecasted expenditures under this option.

Table 2-30. Impact of Option 3 (Zero State Construction, Reduction in Federal Construction)

Year	State Construction Forecast ($M)	Underfunding if State = $0	Resulting Reduced Federal Construction Forecast($M)	Percent Federal Construction Reduction if State = $0
2012	$40.34	-$104.19	$1,012.01	-9.33%
2013	$37.81	-$110.97	$1,045.83	-9.59%
2014	$35.27	-$116.30	$1,081.10	-9.71%
2015	$32.73	-$120.12	$1,117.88	-9.70%
2016	$30.19	-$121.87	$1,156.73	-9.53%
2017	$27.66	-$122.66	$1,196.54	-9.30%
2018	$25.12	-$121.30	$1,238.50	-8.92%
2019	$22.58	-$118.54	$1,281.86	-8.46%
2020	$20.04	-$113.94	$1,327.06	-7.91%
2021	$17.51	-$107.75	$1,373.85	-7.27%
2022	$14.97	-$99.17	$1,423.03	-6.52%
2023	$12.43	-$88.47	$1,474.33	-5.66%
2024	$9.89	-$75.42	$1,527.98	-4.70%
2025	$7.35	-$60.78	$1,583.22	-3.70%
2026	$4.82	-$44.22	$1,640.38	-2.63%
2027	$2.28	-$25.16	$1,700.04	-1.46%
2028	$0.00	-$3.40	$1,762.40	-0.19%
2029	$0.00	$23.24	$1,829.64	1.29%
2030	$0.00	$52.34	$1,899.34	2.83%

Option 4: In this option, Construction expenditures are reduced to cover the entire Baseline revenue shortfall. As can be seen in Table 2-31, Construction expenditures are reduced 9-12% during the years 2012-19, and lower in 2020-2030. Maintenance follows its forecasted expenditures under this option.

Table 2-31. Impact of Reduction in Construction Expenditures to match Shortfall

Year	Construction Forecast($M)	% Reduction if all Construction
2012	$1,183.88	-12.21%
2013	$1,223.87	-12.16%
2014	$1,263.86	-11.99%
2015	$1,303.85	-11.72%

2016	$1,343.84	-11.32%
2017	$1,383.83	-10.86%
2018	$1,423.82	-10.28%
2019	$1,463.81	-9.64%
2020	$1,503.80	-8.91%
2021	$1,543.79	-8.11%
2022	$1,583.78	-7.21%
2023	$1,623.77	-6.21%
2024	$1,663.76	-5.13%
2025	$1,703.75	-4.00%
2026	$1,743.74	-2.81%
2027	$1,783.73	-1.54%
2028	$1,823.72	-0.19%
2029	$1,863.71	1.25%
2030	$1,903.70	2.75%

Option 5: Maintenance expenditures are large enough to absorb the entire Baseline shortfall, however as shown in Table 2-32, in this option the annual Maintenance expenditures would drop by 60-75% in 2010-2019, and would be reduced by more than 20% until 2026. Construction follows its forecasted expenditures under this option.

Table 2-32. Impact of Reduction in Maintenance Expenditures to match Shortfall

Year	Maintenance Forecast ($M)	% Reduction if all Maintenance
2012	$198.75	-72.72%
2013	$202.09	-73.62%
2014	$205.42	-73.78%
2015	$208.75	-73.22%
2016	$212.09	-71.70%
2017	$215.42	-69.78%
2018	$218.76	-66.93%
2019	$222.09	-63.54%
2020	$225.42	-59.44%
2021	$228.76	-54.75%
2022	$232.09	-49.18%
2023	$235.42	-42.86%
2024	$238.76	-35.73%
2025	$242.09	-28.14%
2026	$245.42	-19.98%
2027	$248.76	-11.03%
2028	$252.09	-1.35%

2029	$255.42	9.10%
2030	$258.76	20.23%

Option 6: Total Obligations (Statutory Diversions) are large enough to absorb the entire shortfall, however because these obligations are a matter of federal or state law, it is doubtful that these obligations could be reduced to cover the revenue shortfall. Table 2-33 shows our forecast of Allocation of Federal Funds to Cities/Counties and Allocation of State Funds to Others, and their sum Total Obligations. If obligations were somehow voided to an extent to fund the revenue shortfall, the reductions necessary start in the range of 67% and remain above 60%, 2012-2019.

Table 2-33. Impact of Reduction in Total Obligations to match Shortfall

Year	Total Allocation of Federal Funds($M)	Total Allocation of State Funds to Others($M)	Total Obligations ($M)	% Reduction in Total Obligations if used to fund Shortfall
2012	$117.16	$98.16	$215.32	-67.13%
2013	$121.09	$101.45	$222.54	-66.85%
2014	$125.02	$104.74	$229.76	-65.97%
2015	$128.95	$108.03	$236.98	-64.50%
2016	$132.88	$111.33	$244.21	-62.27%
2017	$136.81	$114.62	$251.43	-59.78%
2018	$122.10	$102.29	$224.39	-65.25%
2019	$126.03	$105.58	$231.61	-60.93%
2020	$129.96	$108.88	$238.83	-56.10%
2021	$133.89	$112.17	$246.05	-50.90%
2022	$137.82	$115.46	$253.28	-45.07%
2023	$141.75	$118.75	$260.50	-38.73%
2024	$145.68	$122.05	$267.72	-31.86%
2025	$149.61	$125.34	$274.94	-24.78%
2026	$153.54	$128.63	$282.17	-17.38%
2027	$157.47	$131.92	$289.39	-9.48%
2028	$161.40	$135.22	$296.61	-1.15%
2029	$165.33	$138.51	$303.83	7.65%
2030	$169.26	$141.80	$311.06	16.83%

Option 7: Table 2-34 contains our Construction expenditure forecast, and from our analysis of costs of new bridge projects let (Table 2-26) the funding required to continue authorizing new bridges at the average square footage per year achieved during 1997-2011. The resulting funds for building new roads are forecast as the remaining construction funds. The final column in

Table 2-34 shows the percent reduction in New Bridge Expenditures if this sub-category of construction absorbs the entire Baseline revenue shortfall.

Table 2-34. Impact of Reduction in Bridge Construction Expenditures to match Shortfall

Year	Construction Forecast ($M)	$M to let new bridges at Average Sq.ft. per year	Resulting Road Construction($M)	Percent Reduction if all Bridge Construction
2012	$1,183.88	$1,115.96	$67.92	-12.95%
2013	$1,223.87	$1,153.66	$70.21	-12.90%
2014	$1,263.86	$1,191.35	$72.51	-12.72%
2015	$1,303.85	$1,229.05	$74.80	-12.44%
2016	$1,343.84	$1,266.74	$77.10	-12.00%
2017	$1,383.83	$1,304.44	$79.39	-11.52%
2018	$1,423.82	$1,342.14	$81.68	-10.91%
2019	$1,463.81	$1,379.83	$83.98	-10.23%
2020	$1,503.80	$1,417.53	$86.27	-9.45%
2021	$1,543.79	$1,455.22	$88.57	-8.61%
2022	$1,583.78	$1,492.92	$90.86	-7.65%
2023	$1,623.77	$1,530.61	$93.16	-6.59%
2024	$1,663.76	$1,568.31	$95.45	-5.44%
2025	$1,703.75	$1,606.01	$97.74	-4.24%
2026	$1,743.74	$1,643.70	$100.04	-2.98%
2027	$1,783.73	$1,681.40	$102.33	-1.63%
2028	$1,823.72	$1,719.09	$104.63	-0.20%
2029	$1,863.71	$1,756.79	$106.92	1.32%
2030	$1,903.70	$1,794.48	$109.22	2.92%

Option 8: Under this option, assume Road Construction is zeroed out and the revenue shortfall is taken out of Bridge Construction. Table 2-35 shows that the resulting underfunding percentage each year is cut by approximately half by this drastic measure, but to achieve a balanced budget either New Bridge Construction or a portion of Maintenance would have to be reduced as well to cover the residual revenue shortfall up through 2023. From 2024-2028 Road Construction can cover the declining shortfall and still have some funds left over. Table 2-36 shows that under Option 8, New Bridge Construction would have to be cut 4-7% during 2012-2019.

Option 9: Under this option, assume Road Construction is zeroed out and the revenue shortfall is taken out of Maintenance. Table 2-36 shows that under Option 9, Maintenance would have to be cut 25-39% during 2012-2019 to cover the residual revenue shortfall if Road Construction is zeroed out. From 2024-2028 Road Construction can cover the declining shortfall and still have some funds left over. Under Options 8 or 9, the cross-over from shortfall to surplus is around 2024.

Table 2-35. Zero Road Construction results in Residual Revenue Shortfall

Year	Predicted Road Construction ($M)	Resulting Underfunding if Road Construction is None ($M)	Total Receipts ($M)	Resulting Underfunding as % of Receipts if Road Construction None
2012	$67.92	-$76.62	$1,370.66	-5.59%
2013	$70.21	-$78.56	$1,412.52	-5.56%
2014	$72.51	-$79.06	$1,455.84	-5.43%
2015	$74.80	-$78.05	$1,500.65	-5.20%
2016	$77.10	-$74.97	$1,547.54	-4.84%
2017	$79.39	-$70.93	$1,595.38	-4.45%
2018	$81.68	-$64.74	$1,645.38	-3.93%
2019	$83.98	-$57.15	$1,696.78	-3.37%
2020	$86.27	-$47.71	$1,750.01	-2.73%
2021	$88.57	-$36.69	$1,804.85	-2.03%
2022	$90.86	-$23.28	$1,862.06	-1.25%
2023	$93.16	-$7.75	$1,921.40	-0.40%
2024	$95.45	$10.14	$1,983.09	0.51%
2025	$97.74	$29.61	$2,046.37	1.45%
2026	$100.04	$51.00	$2,111.56	2.42%
2027	$102.33	$74.89	$2,179.26	3.44%
2028	$104.63	$101.23	$2,249.40	4.50%
2029	$106.92	$130.17	$2,322.14	5.61%
2030	$109.22	$161.55	$2,397.34	6.74%

Table 2-36. Options 8 & 9 cover Residual Revenue Shortfall after Zero Road Construction

Year	Resulting Underfunding as a % of New Bridge Expenditures	Resulting Underfunding as a % of Maintenance
2012	-6.87%	-38.55%
2013	-6.81%	-38.88%
2014	-6.64%	-38.49%
2015	-6.35%	-37.39%
2016	-5.92%	-35.35%
2017	-5.44%	-32.92%
2018	-4.82%	-29.59%
2019	-4.14%	-25.73%
2020	-3.37%	-21.17%
2021	-2.52%	-16.04%
2022	-1.56%	-10.03%
2023	-0.51%	-3.29%
2024	0.65%	4.25%
2025	1.84%	12.23%

2026	3.10%	20.78%
2027	4.45%	30.11%
2028	5.89%	40.15%
2029	7.41%	50.96%
2030	9.00%	62.43%

2.5.C Baseline Revenue Shortfalls to meet Expenditure Forecasts with Construction Expenditure Increases for System Enhancement

We have shown in subsection 2.5.A that the Baseline Expenditure forecast results in revenue shortfalls from the Baseline Revenue forecast on the order of magnitude $150M or 10.5% of receipts, in the mid-2010s. We also showed in subsection 2.5.B how these funding shortfalls could be absorbed through various expenditure reductions. In this section, we address the needs for System Enhancement that have been identified in ALDOT Five-Year Plans and in the Report to Governor Bentley [3]. We treat System Enhancement funding as a step increase in forecast Construction Expenditures using two distinct approaches:

- Increase Construction Expenditures by 5, 10, 15, 20, or 25% in then-year dollars during each of the years 2011-2030;
- Increase Construction Expenditures by the $6B System Enhancement need (in 2010 dollars) that was identified to Governor Bentley in [3], spread over 5 years (2011-2015), 10 years (2011-2020), or 20 years (2011-2025), with appropriate adjustments for inflation; after the System Enhancement fund is expended, Total Expenditures are returned to their baseline values for the remaining years out through 2030.

Of course such increases in a year's forecast Construction Expenditures will boost the forecast year's Total Expenditures in an equivalent amount. In subsection 2.5.C.1, we will compare the percent increase total expenditure profiles with the Baseline Revenue forecast, and document the shortfall under each assumed percent increase. In subsection 2.5.C.2, we will compare the $6B adjusted total expenditure profiles with the Baseline Revenue forecast, and document the shortfall under each of three "spread" options. In both cases, the documented shortfall is shown to be so large that a new revenue source or sources would be necessary.

2.5.C.1 Baseline Revenue Shortfalls to meet Expenditures with 5, 10, 15, 20, and 25% increases in annual Construction Expenditures, 2011-2030

One approach to funding System Enhancement needs would be to simply increase ALDOT's Construction Expenditure budget by a fixed percentage such as 5% as illustrated in Table 2-37. In the last two columns of this table, one can see how under this option the Total Expenditures increase along with the budget shortfall. Note that in 2012, the 5% increase is about $59M and by 2030, the 5% increase is about $95M. A series of calculations extending Table 2-37 to 10, 15, 20, and 25% increases from Baseline Construction Expenditures resulted in the graphs for Construction Expenditures and Total Expenditures in Figures 2-45 and 2-46, respectively.

Figure 2-47 shows that in 2020, Total Expenditures under the 5, 15, and 25% Construction Expenditure increase alternatives would increase respectively from $1884M baseline to $1959M, $2110M, and $2260M; in 2030, Total Expenditures under these same three alternatives would increase respectively from $1904M baseline to $2440M, $2631M, and $2821M. Figure 2-48 shows that in 2020, budget shortfalls under the 5, 15, and 25% Construction Expenditure increase alternatives would grow respectively from -$145M to -$209M, -$360M, and -$510M; in 2030, budget shortfalls under these same three alternatives would grow respectively form a surplus of $52M to deficits of -$43M, -$233M, and -$424M.

Table 2-37. Baseline Revenue Shortfall for 5% Increase in Construction Expenditures, 2012-30

Year	Construction($M)	Total Expenditures($M) Baseline	Total Receipts ($M)	Receipts-Expenditures	Total Expend. w/Constr. Up 5%	Receipts-Expenditures (Constr. Up 5%)
2012	$1,183.88	$1,515.20	$1,370.66	-$144.54	$1,574.39	-$203.73
2013	$1,223.87	$1,561.30	$1,412.52	-$148.78	$1,622.49	-$209.97
2014	$1,263.86	$1,607.40	$1,455.84	-$151.56	$1,670.59	-$214.76
2015	$1,303.85	$1,653.50	$1,500.65	-$152.85	$1,718.69	-$218.05
2016	$1,343.84	$1,699.60	$1,547.54	-$152.06	$1,766.79	-$219.26
2017	$1,383.83	$1,745.70	$1,595.38	-$150.32	$1,814.89	-$219.51
2018	$1,423.82	$1,791.80	$1,645.38	-$146.42	$1,862.99	-$217.61
2019	$1,463.81	$1,837.90	$1,696.78	-$141.12	$1,911.09	-$214.31
2020	$1,503.80	$1,884.00	$1,750.01	-$133.99	$1,959.19	-$209.18
2021	$1,543.79	$1,930.10	$1,804.85	-$125.25	$2,007.29	-$202.44
2022	$1,583.78	$1,976.20	$1,862.06	-$114.14	$2,055.39	-$193.33
2023	$1,623.77	$2,022.30	$1,921.40	-$100.90	$2,103.49	-$182.09
2024	$1,663.76	$2,068.40	$1,983.09	-$85.31	$2,151.59	-$168.50
2025	$1,703.75	$2,114.50	$2,046.37	-$68.13	$2,199.69	-$153.32
2026	$1,743.74	$2,160.60	$2,111.56	-$49.04	$2,247.79	-$136.23
2027	$1,783.73	$2,206.70	$2,179.26	-$27.44	$2,295.89	-$116.63
2028	$1,823.72	$2,252.80	$2,249.40	-$3.40	$2,343.99	-$94.59
2029	$1,863.71	$2,298.90	$2,322.14	$23.24	$2,392.09	-$69.94
2030	$1,903.70	$2,345.00	$2,397.34	$52.34	$2,440.19	-$42.85

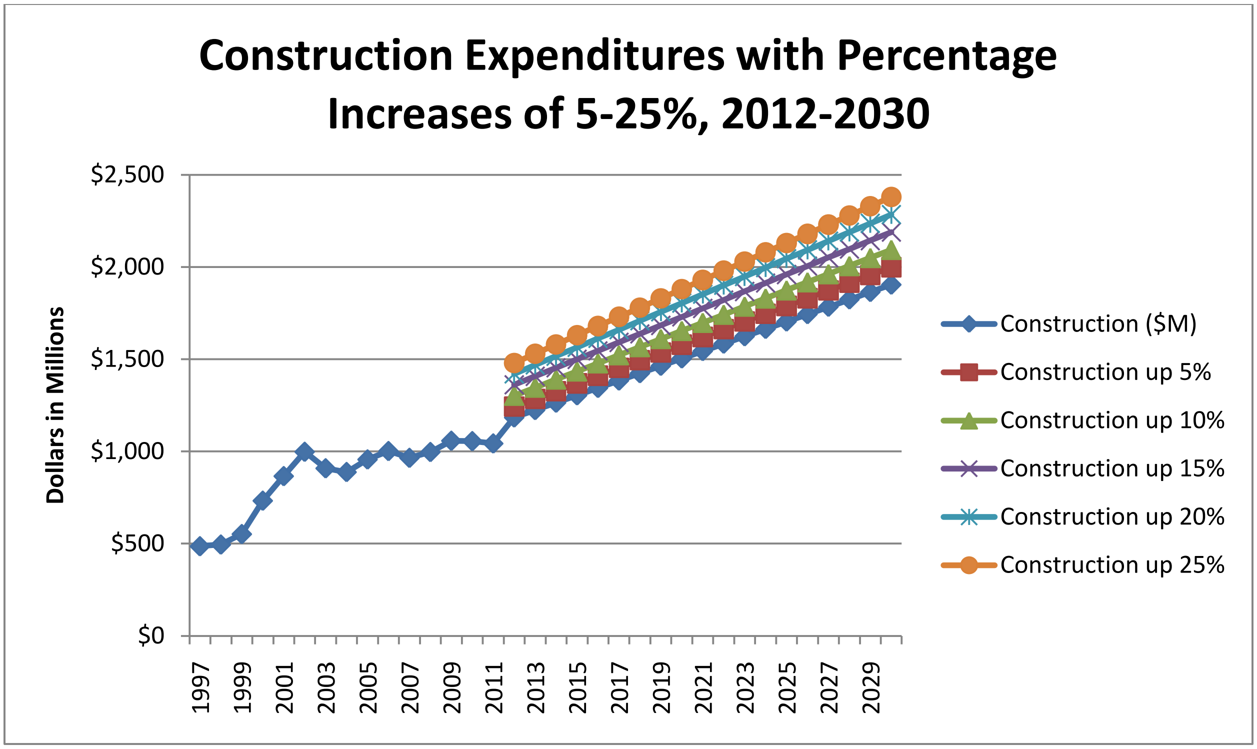

Figure 2-45. Construction Expenditures with Percent Increases ranging from 5 to 25%

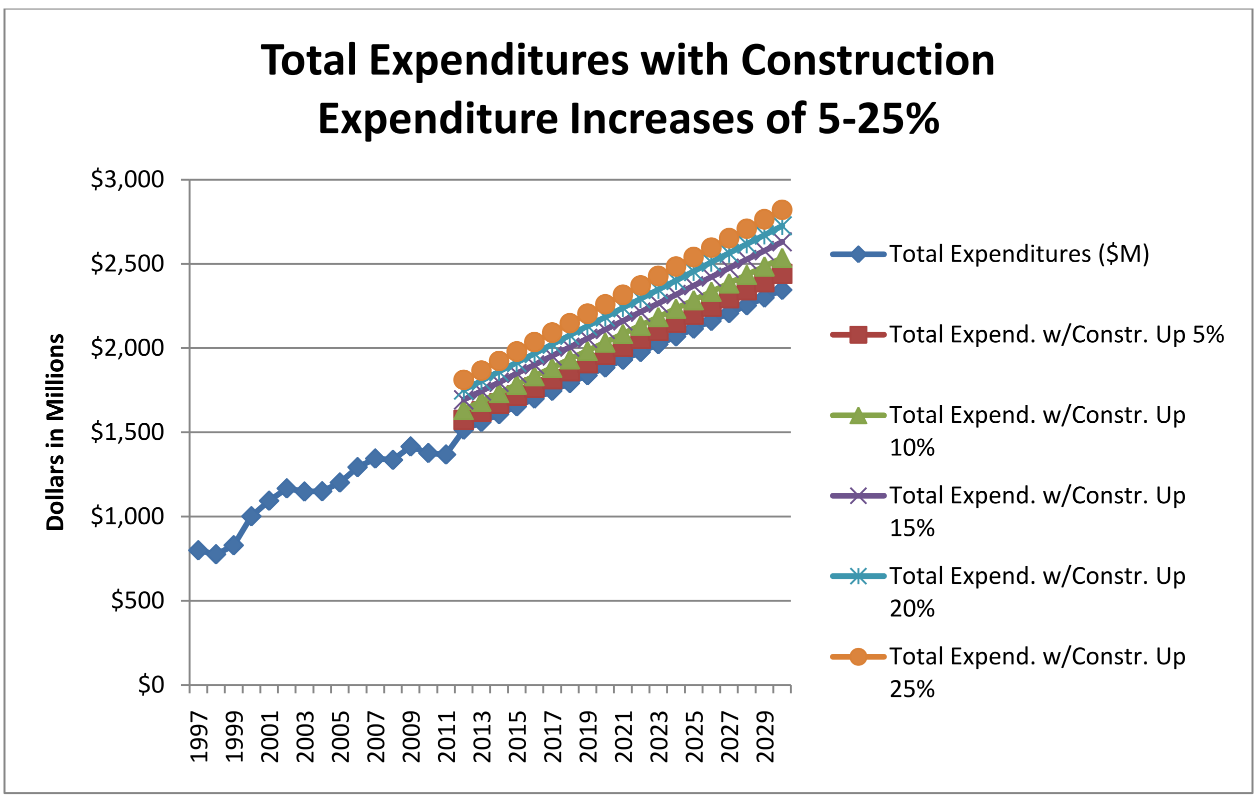

Figure 2-46. Total Expenditures with Construction Expenditure Increases of 5 to 25%

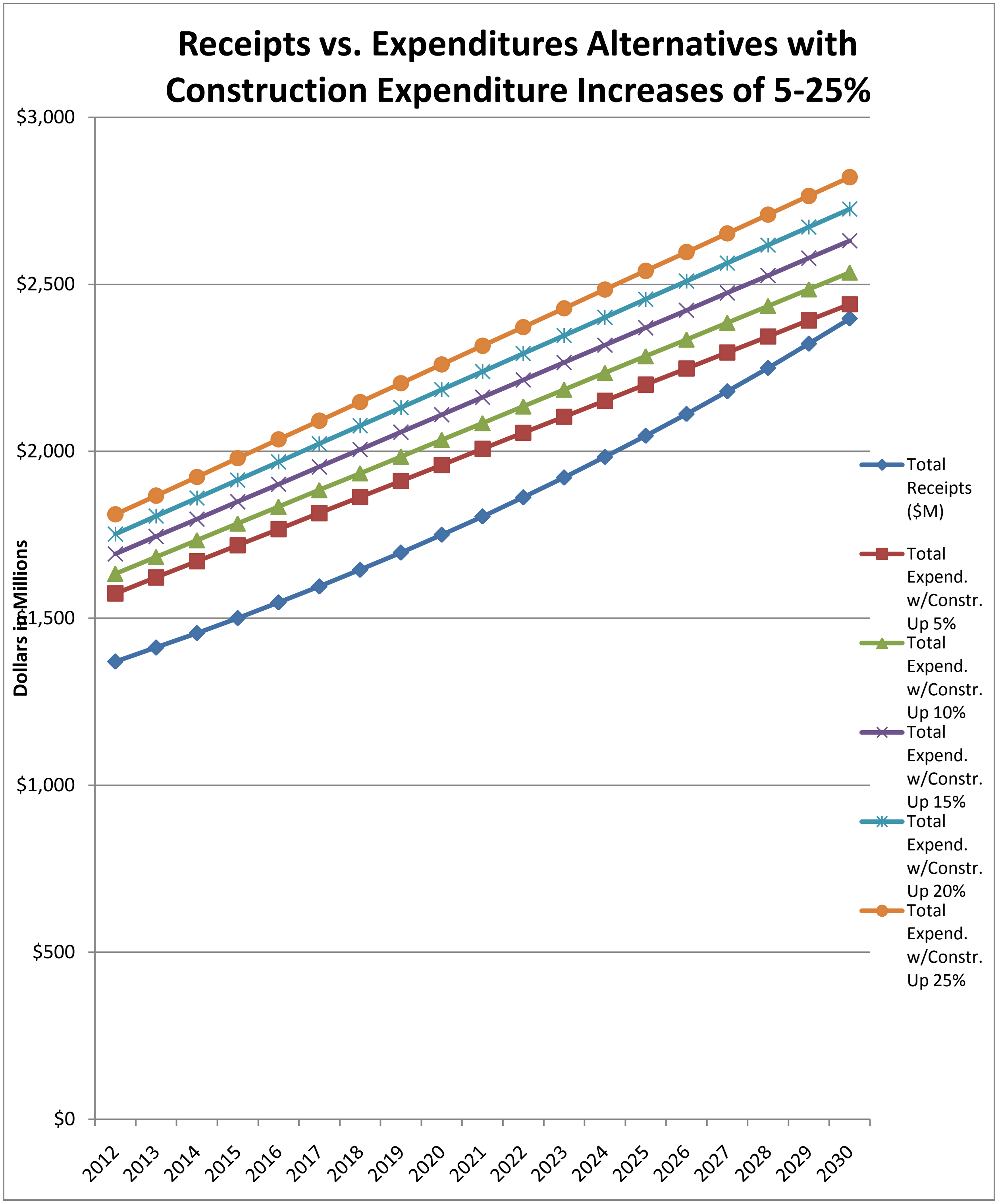

Figure 2-47. Total Receipts vs. Total Expenditures with Construction Expenditure Increases of 5-25%

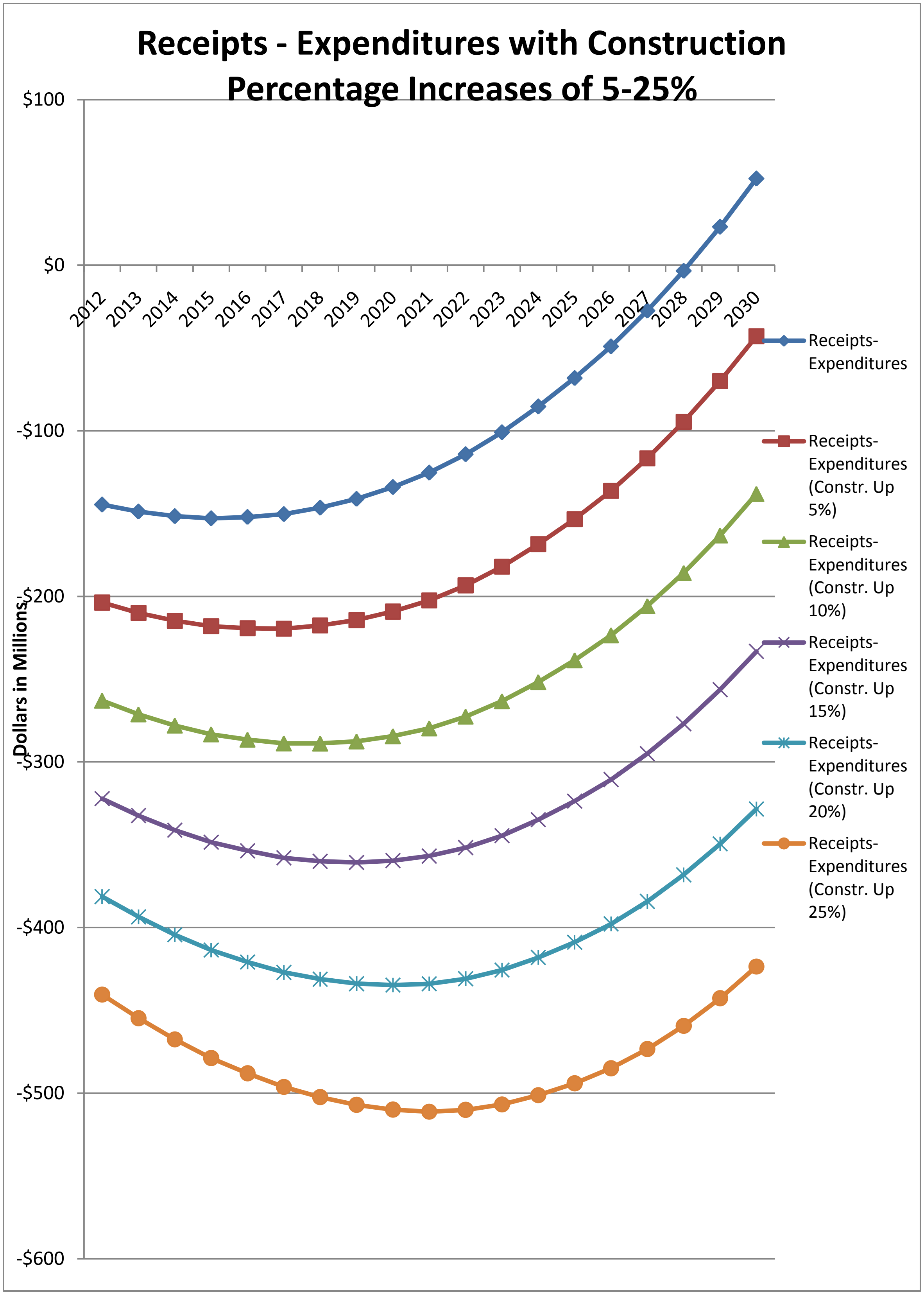

Figure 2-48. ALDOT Budget Shortfall, Baseline Receipts and Total Expenditures with Construction Expenditure Increases of 5 to 25%

2.5.C.2 Baseline Revenue Shortfalls to meet $6B System Enhancement need spread evenly over 5, 10, or 20 years starting 2011

In the September 2011 report to Governor Bentley [3] entitled "Alabama's Transportation Infrastructure Needs and Fiscal Reality," the following summary was made of the outcome of a two-day session of ALDOT transportation professionals to discuss infrastructure needs. "The department's nine division engineers presented their recommendations on transportation needs within their respective divisions to the transportation director and the chief engineer's office with several bureau chiefs' participation in the discussions…The transportation needs identified through this process were place in two broad categories: system enhancement and system preservation. Projects that address safety, congestion relief, economic development, and route continuity were considered as system enhancement projects…The estimated total cost of system enhancement projects identified as needed for one or more of the purposes outlined above was approximately $6.1 billion." No time frame nor profile for expending the approximately $6B in FY 2010 dollars was given, but it is reasonable to assume that the time frame would certainly be at least 10 years and perhaps as long as 20 years (through the end of the careers of most of the participants). Forty years was also considered, but that is beyond the scope of this project. The reasoning for 10-15-20 year plans was that if this magnitude of expenditure increment was attempted in 5 years, the annual amount ($1.2B) would be larger (114%) than the total 2010 construction budget, and approaching the magnitude of 2010 Total Expenditures.

Therefore, we study an annual SE Expenditure of $0.6B/year over 10 years, $0.4B/year over 15 years, and $0.3B over 20 years, where in each case the dollars would be inflated from the base year (2010) when they were estimated to then-year dollars in the year they were scheduled to be expended. Now, we were told by our PAC that ALDOT can only afford around $150 million per year expenditure in system enhancement type projects, and to take that budgeted amount into account when allocating the $6B SE need over the 20 years 2011-2030. Hence, the increments we added to the baseline construction and total expenditure forecasts were $.45B/year over 10 years, $.25B/year over 15 years, and $0.15B over 20 years, with inflation assumed the same average annual amount (2.27%) for the next twenty years as the past fifteen years. What this means is that we assume exactly *one-half* of the $6B SE need, that is $3B, is *already included* in the twenty year baseline forecasts for Construction and Total Expenditures. The remaining $3B is obtained from some new funding source, and is the actual increment over baseline. These increments have been added the forecasted Construction Expenditure budget and appear in Table 2-38 under the headings 20-year SE plan, 15-year SE plan, and 10-year SE plan. The resulting Total Expenditures with respective 10, 15, and 20-year SE plans are shown as well. Finally, the reader will note that after the respective increments were expended, and system enhancement (SE) completed, we assume the expenditure profile will revert to the baseline forecast out to 2030. This baseline still has the $150M for system enhancement included, in then-year dollars. Figures 2-49 and 2-50 respectively graph the Construction Expenditure and Total Expenditure profiles under the three time frames of SE funding.

Table 2-38. Allocation of $6B System Enhancement Funding over 10, 15, and 20-year Horizons

Year	20-year (2011-2030) SE plan	Total Expend. w/ 20-year SE plan	15-year (2011-2025) SE plan	Total Expend. w/ 15-year SE plan	10-year (2011-2020) SE plan	Total Expend. w/ 10-year SE plan
1997	$486.10	$799.80	$486.10	$799.80	$486.10	$799.80
1998	$495.20	$776.30	$495.20	$776.30	$495.20	$776.30
1999	$552.10	$829.40	$552.10	$829.40	$552.10	$829.40
2000	$732.90	$1,001.60	$732.90	$1,001.60	$732.90	$1,001.60
2001	$866.00	$1,093.90	$866.00	$1,093.90	$866.00	$1,093.90
2002	$997.80	$1,167.00	$997.80	$1,167.00	$997.80	$1,167.00
2003	$908.50	$1,148.20	$908.50	$1,148.20	$908.50	$1,148.20
2004	$888.20	$1,149.80	$888.20	$1,149.80	$888.20	$1,149.80
2005	$956.40	$1,201.80	$956.40	$1,201.80	$956.40	$1,201.80
2006	$1,001.80	$1,293.00	$1,001.80	$1,293.00	$1,001.80	$1,293.00
2007	$965.00	$1,344.20	$965.00	$1,344.20	$965.00	$1,344.20
2008	$996.60	$1,336.20	$996.60	$1,336.20	$996.60	$1,336.20
2009	$1,057.80	$1,415.65	$1,057.80	$1,415.65	$1,057.80	$1,415.65
2010	$1,055.60	$1,377.20	$1,055.60	$1,377.20	$1,055.60	$1,377.20
2011	$1,196.51	$1,521.41	$1,298.78	$1,623.68	$1,379.21	$1,704.11
2012	$1,340.77	$1,672.09	$1,445.36	$1,776.68	$1,527.62	$1,858.94
2013	$1,384.32	$1,721.75	$1,491.28	$1,828.71	$1,575.42	$1,912.85
2014	$1,427.95	$1,771.49	$1,537.34	$1,880.88	$1,623.39	$1,966.93
2015	$1,471.67	$1,821.32	$1,583.54	$1,933.19	$1,671.54	$2,021.19
2016	$1,515.47	$1,871.23	$1,629.88	$1,985.64	$1,719.87	$2,075.63
2017	$1,559.35	$1,921.22	$1,676.36	$2,038.23	$1,768.40	$2,130.27
2018	$1,603.33	$1,971.31	$1,723.00	$2,090.98	$1,817.12	$2,185.10
2019	$1,647.39	$2,021.48	$1,769.78	$2,143.87	$1,866.04	$2,240.13
2020	$1,691.55	$2,071.75	$1,816.71	$2,196.91	$1,915.16	$2,295.36
2021	$1,735.80	$2,122.11	$1,863.81	$2,250.12	$1,543.79	$1,930.10
2022	$1,780.15	$2,172.57	$1,911.06	$2,303.48	$1,583.78	$1,976.20
2023	$1,824.60	$2,223.13	$1,958.48	$2,357.01	$1,623.77	$2,022.30
2024	$1,869.14	$2,273.78	$2,006.07	$2,410.71	$1,663.76	$2,068.40
2025	$1,913.80	$2,324.55	$2,053.83	$2,464.58	$1,703.75	$2,114.50
2026	$1,958.55	$2,375.41	$1,743.74	$2,160.60	$1,743.74	$2,160.60
2027	$2,003.42	$2,426.39	$1,783.73	$2,206.70	$1,783.73	$2,206.70
2028	$2,048.40	$2,477.48	$1,823.72	$2,252.80	$1,823.72	$2,252.80
2029	$2,093.49	$2,528.68	$1,863.71	$2,298.90	$1,863.71	$2,298.90
2030	$2,138.69	$2,579.99	$1,903.70	$2,345.00	$1,903.70	$2,345.00

Add $150M/yr w/inflation to $150M/yr SE funding

Add $250M/yr w/inflation to $150M/yr SE funding for 15 yrs through 2025

Add $450M/yr with inflation to $150M/yr SE funding for 10 years through 2020

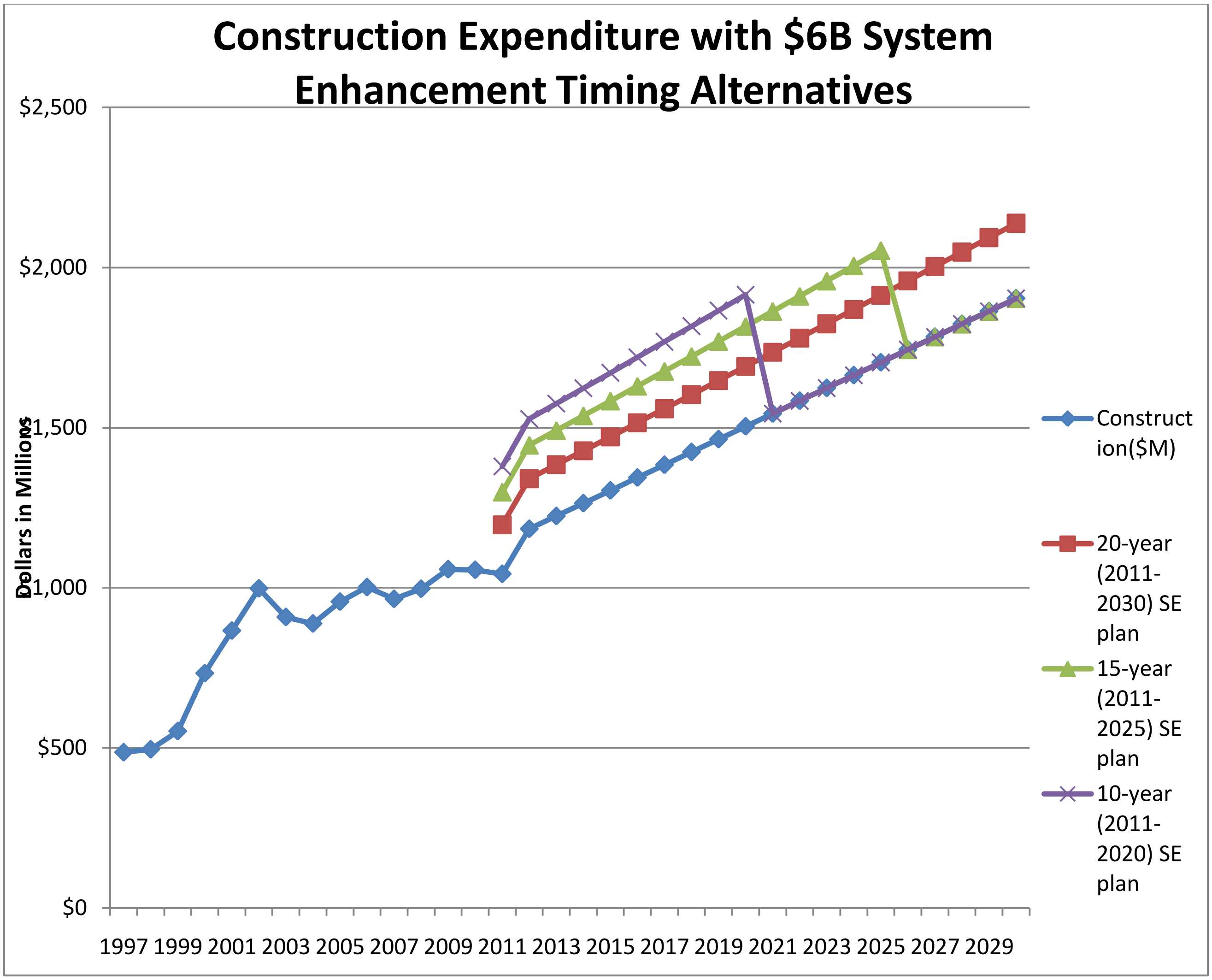

Figure 2-49. Construction Expenditures with $6B SE Funding over 10, 15, and 20-year Horizons

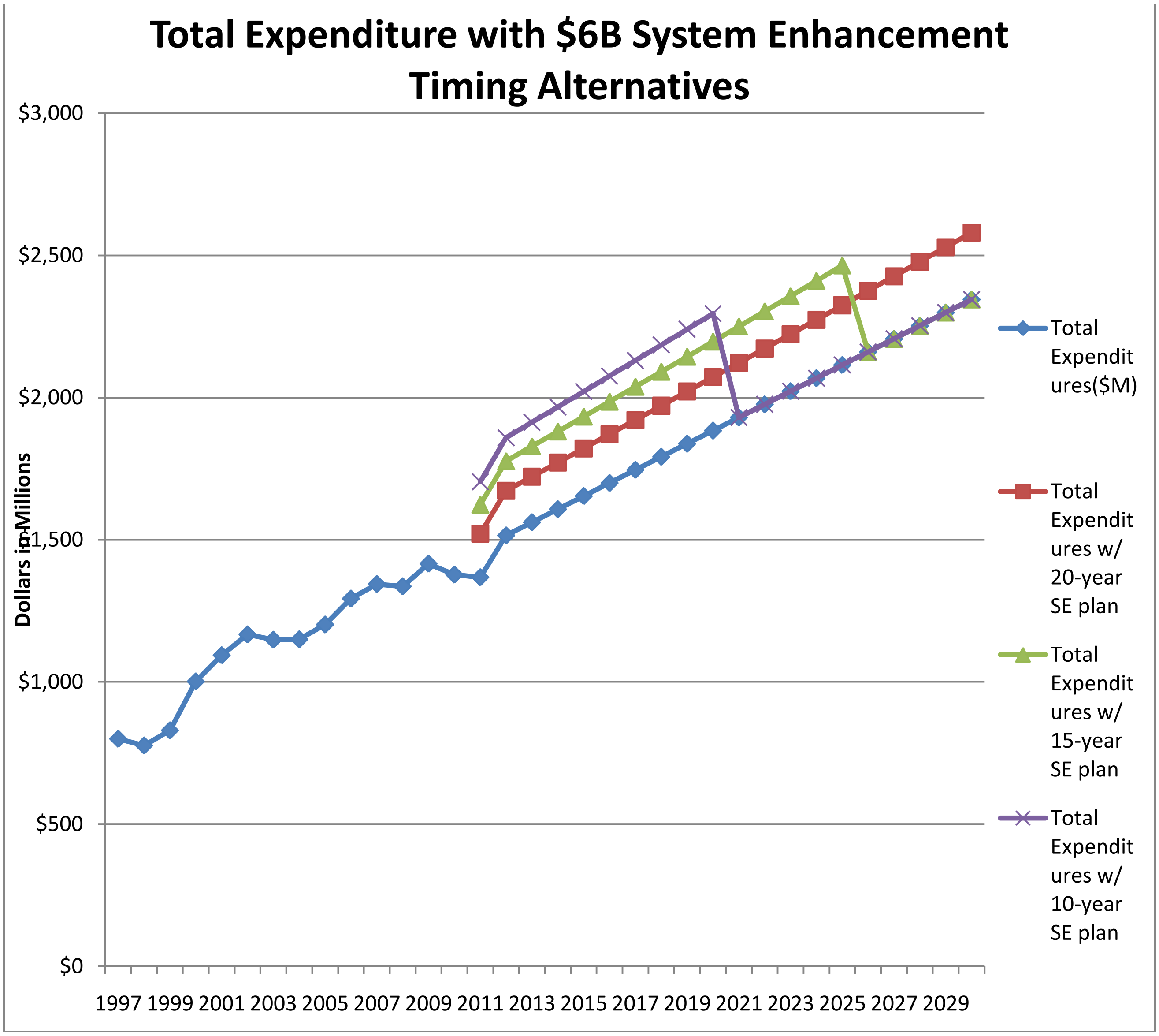

Figure 2-50. Total Expenditures with $6B SE Funding over 10, 15, and 20-year Horizons

Table 2-39 computes the budget shortfall when the three SE plan Total Expenditure profiles are subtracted from the Baseline Total Receipts. Figure 2-51 graphs Baseline Total Receipts illustrates the magnitude of the shortfall between receipts and expenditures that include the $6B SE funding, regardless of the timing of expenditure of the increment of $3B on top of the already programmed $150 M annually. Figure 2-52 graphs the resulting shortfall under Baseline Expenditures and the 10, 15, and 20-year horizons for SE incremental funding. The appearance of these graphs with the sudden return to baseline reflects our assumption that when the currently identified $6B SE needs have been "built out," the total expenditure profile will revert to baseline for the remaining years out to 2030.

Table 2-39. Revenue Shortfalls for Baseline Total Receipts minus Total Expenditures with $6B System Enhancement Funding over 10, 15, and 20-year Horizons

Year	Total Expend. w/20-year SE plan	Receipts-Expend. (20-year SE plan)	Total Expend. w/15-year SE plan	Receipts-Expend. (15-year SE plan)	Total Expend. w/10-year SE plan	Receipts-Expend. (10-year SE plan)
2012	$1,672.09	-$301.43	$1,776.68	-$406.02	$1,858.94	-$488.28
2013	$1,721.75	-$309.22	$1,828.71	-$416.19	$1,912.85	-$500.32
2014	$1,771.49	-$315.66	$1,880.88	-$425.05	$1,966.93	-$511.09
2015	$1,821.32	-$320.67	$1,933.19	-$432.55	$2,021.19	-$520.54
2016	$1,871.23	-$323.69	$1,985.64	-$438.10	$2,075.63	-$528.10
2017	$1,921.22	-$325.84	$2,038.23	-$442.85	$2,130.27	-$534.89
2018	$1,971.31	-$325.93	$2,090.98	-$445.60	$2,185.10	-$539.72
2019	$2,021.48	-$324.70	$2,143.87	-$447.09	$2,240.13	-$543.35
2020	$2,071.75	-$321.73	$2,196.91	-$446.90	$2,295.36	-$545.34
2021	$2,122.11	-$317.26	$2,250.12	-$445.27	$1,930.10	-$125.25
2022	$2,172.57	-$310.51	$2,303.48	-$441.42	$1,976.20	-$114.14
2023	$2,223.13	-$301.73	$2,357.01	-$435.61	$2,022.30	-$100.90
2024	$2,273.78	-$290.69	$2,410.71	-$427.62	$2,068.40	-$85.31
2025	$2,324.55	-$278.18	$2,464.58	-$418.21	$2,114.50	-$68.13
2026	$2,375.41	-$263.86	$2,160.60	-$49.04	$2,160.60	-$49.04
2027	$2,426.39	-$247.13	$2,206.70	-$27.44	$2,206.70	-$27.44
2028	$2,477.48	-$228.08	$2,252.80	-$3.40	$2,252.80	-$3.40
2029	$2,528.68	-$206.53	$2,298.90	$23.24	$2,298.90	$23.24
2030	$2,579.99	-$182.66	$2,345.00	$52.34	$2,345.00	$52.34

To summarize, under the 10-year SE plan, the ALDOT baseline receipts are short between $488-545M annually for 2012-2020; under the 15-year SE plan, the ALDOT baseline receipts are short between $406-477 annually for 2012-2025; and under the 20-year SE plan, the ALDOT baseline receipts are short between $183-326M annually for 2012-2030.

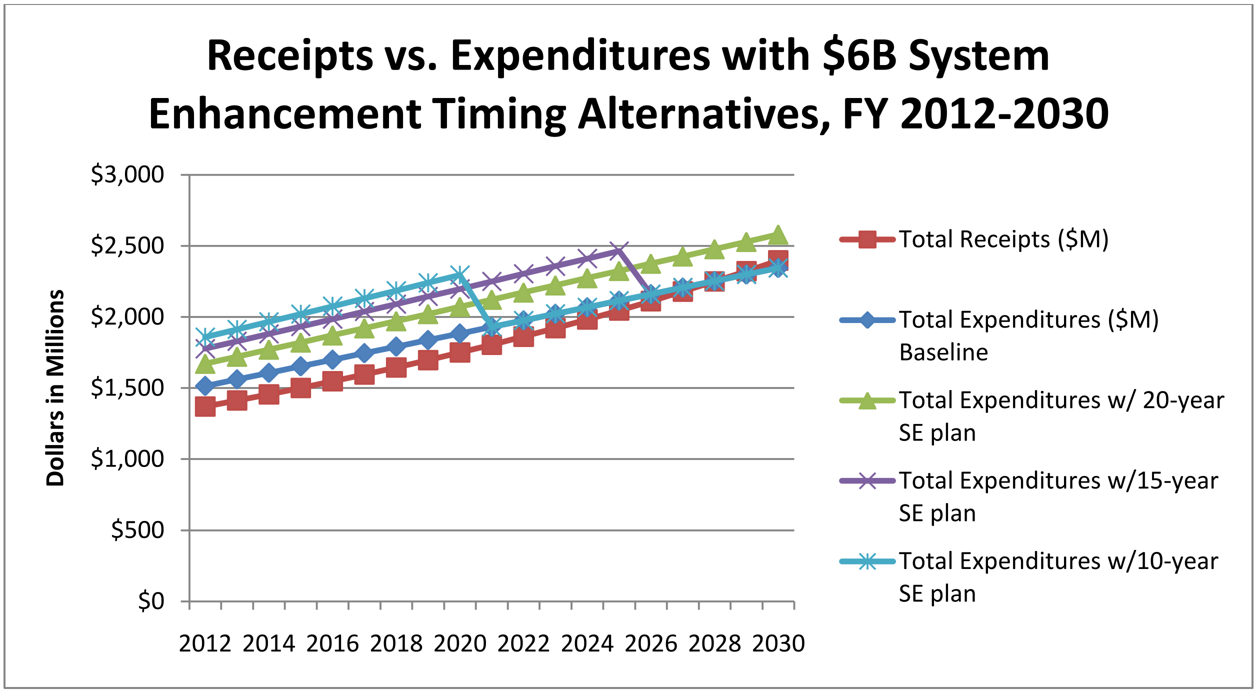

Figure 2-51. Total Receipts vs. Total Expenditures with $6B SE Funding over 10, 15, and 20-year Horizons

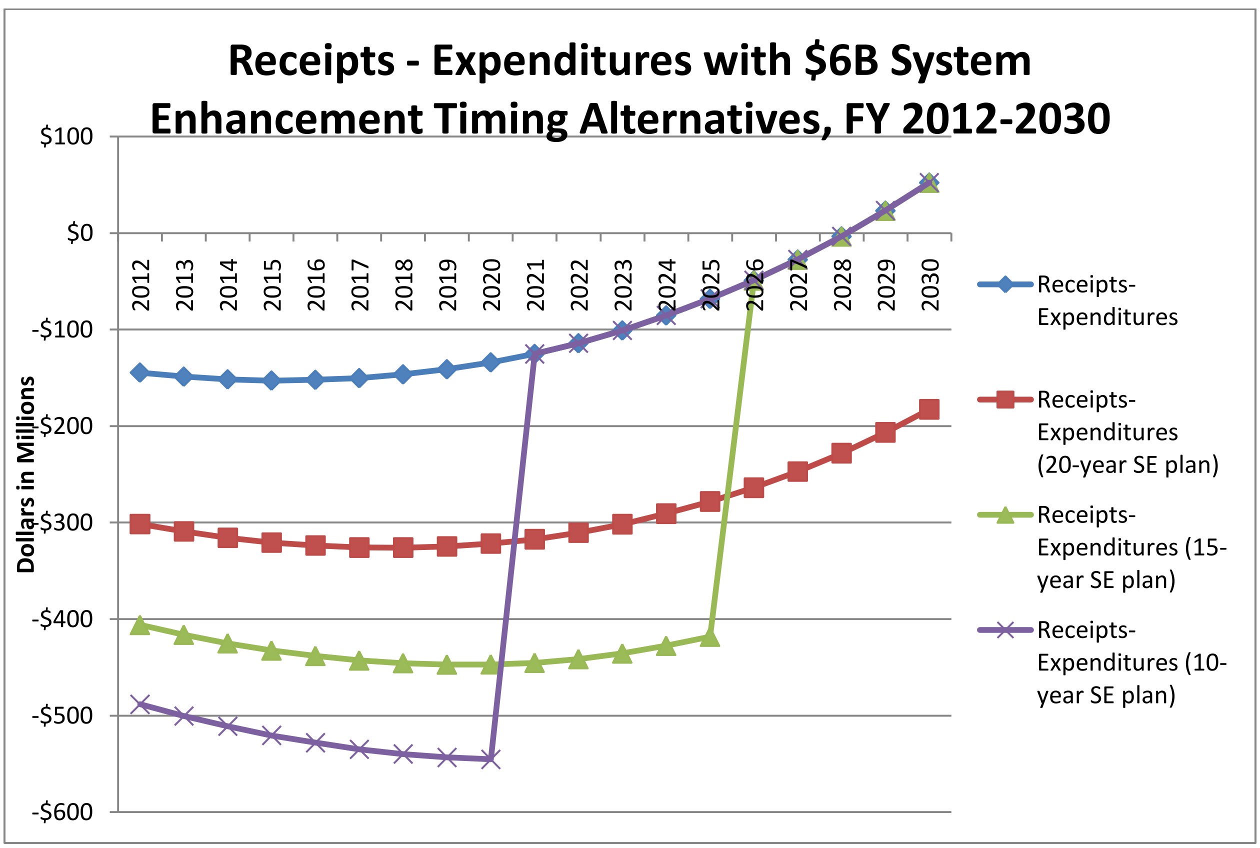

Figure 2-52. ALDOT Budget Shortfall, Baseline Receipts and Total Expenditures with $6B SE Funding over 10, 15, and 20-year Horizons

2.5.D Gasoline Consumption Decline-Adjusted Revenue Shortfalls to meet Expenditure Forecasts

Recall in subsection 2.2.C.2, we selected the 14-year (175,000 mile) vehicle life as a representative life for vehicles on the road in the time period 2012-2030, reasoning that 175,000 miles is longer than the current average of 140,000 but not so long as the 200,000 miles expected in 2030. We also used the Model 1 mileage forecast as a "Worst Case" scenario in Table 2-5 and the discussion of gasoline consumption that followed, and used the Model 3 mileage forecast as "Best Case" scenario. The reasoning was that Model 1 gave the slowest rise in annual vehicle miles driven in Alabama, hence the lowest gasoline consumption forecast under CAFÉ Standards; Model 3 gave the fastest rise in annual vehicle miles driven in Alabama, hence the highest gasoline consumption forecast under CAFÉ Standards. Continuing that line of discussion here, in Table 2-8 CBER has generated ALDOT state, federal, and total revenue forecasts for these two scenarios, where the first set of forecasts is for "Best Case Gasoline Consumption Decline" meaning the smallest decline relative to Baseline, and the second set of forecasts is for "Worst Case Gasoline Consumption Decline" meaning the largest decline relative to baseline. Refer to Figure 2-23 for the baseline forecast of ALDOT's total receipts in comparison to the total receipt forecasts under best case and worst case gasoline consumption declines, brought on by the CAFÉ Standards. Like the state and federal receipt forecasts, the two forecasts based on reduced gasoline consumption both return the total revenue levels in the late 2020s to the same level as the late 1990s.

In the subsections that follow, we investigate the magnitude of ALDOT funding shortfalls forecast under the two gasoline consumption decline-adjusted revenues:

- Assume Baseline Expenditures;
- Assume Expenditures with the 10% increase in annual Construction Expenditures, 2011-2030 discussed in 2.5.C.1.

2.5.D.1 Gasoline Consumption Decline-Adjusted Revenue Shortfalls to meet Baseline Expenditures

Table 2-40 combines the forecast of ALDOT Total Receipts under the Best Case Gasoline Consumption Decline with Baseline Expenditures, and computes the resulting Shortfall or funding gap. Table 2-41 does the same, but with Total Receipts forecast under Worst Case Gasoline Consumption Decline. Figure 2-53 illustrates the previously depicted forecast of Baseline Receipts with Baseline Expenditures, in stark contrast with the two Gasoline Consumption Decline-Adjusted Receipts. Figure 2-54 illustrates the budget shortfall or gaps produced by each of the three Total Receipt forecast. Of course, the gap is larger under Worst Case than Best Case Gasoline Consumption Decline, but the important point is that under either of these scenarios, the ALDOT budget shortfall just to fund Baseline Expenditures is order of magnitude larger ($1.5B vs. $150M) than it was under the Baseline Total Receipts forecast.

Table 2-40. Total Receipts based on Best Case Gasoline Consumption Decline with Shortfall in Baseline Expenditures

Year	Total Receipts Baseline	Total Receipts - Best Case Gasoline Consumption Decline	Total Expenditures Baseline	Shortfall (Funding Gap)
1997	817.95		799.80	
1998	773.88		776.30	
1999	881.48		829.40	
2000	1019.61		1001.60	
2001	1168.7		1093.90	
2002	1276.61		1167.00	
2003	1088.49		1148.20	
2004	1105.68		1149.80	
2005	1225.82		1201.80	
2006	1373.51		1293.00	
2007	1324.56		1344.20	
2008	1364.84		1336.20	
2009	1252.39		1415.65	
2010	1290.33		1377.20	
2011	1329.61	1400.00	1368.00	32.00
2012	1370.66	1450.00	1515.20	-65.20
2013	1412.52	1430.00	1561.30	-131.30
2014	1455.84	1390.00	1607.40	-217.40
2015	1500.65	1360.00	1653.50	-293.50
2016	1547.54	1340.00	1699.60	-359.60
2017	1595.38	1320.00	1745.70	-425.70
2018	1645.38	1290.00	1791.80	-501.80
2019	1696.78	1250.00	1837.90	-587.90
2020	1750.01	1210.00	1884.00	-674.00
2021	1804.85	1160.00	1930.10	-770.10
2022	1862.06	1120.00	1976.20	-856.20
2023	1921.4	1070.00	2022.30	-952.30
2024	1983.09	1020.00	2068.40	-1048.40
2025	2046.37	976.00	2114.50	-1138.50
2026	2111.56	929.00	2160.60	-1231.60
2027	2179.26	882.00	2206.70	-1324.70
2028	2249.4	836.00	2252.80	-1416.80
2029	2322.14	791.00	2298.90	-1507.90
2030	2397.34	747.00	2345.00	-1598.00

Table 2-41. Total Receipts based on Worst Case Gasoline Consumption Decline with Shortfall in Baseline Expenditures

Year	Total Receipts Baseline	Total Receipts - Worst Case Gasoline Consumption Decline	Total Expenditures Baseline	Shortfall (Funding Gap)
1997	817.95		799.80	
1998	773.88		776.30	
1999	881.48		829.40	
2000	1019.61		1001.60	
2001	1168.7		1093.90	
2002	1276.61		1167.00	
2003	1088.49		1148.20	
2004	1105.68		1149.80	
2005	1225.82		1201.80	
2006	1373.51		1293.00	
2007	1324.56		1344.20	
2008	1364.84		1336.20	
2009	1252.39		1415.65	
2010	1290.33		1377.20	
2011	1329.61	1390.00	1368.00	22.00
2012	1370.66	1420.00	1515.20	-95.20
2013	1412.52	1380.00	1561.30	-181.30
2014	1455.84	1310.00	1607.40	-297.40
2015	1500.65	1250.00	1653.50	-403.50
2016	1547.54	1210.00	1699.60	-489.60
2017	1595.38	1160.00	1745.70	-585.70
2018	1645.38	1100.00	1791.80	-691.80
2019	1696.78	1030.00	1837.90	-807.90
2020	1750.01	957.00	1884.00	-927.00
2021	1804.85	881.00	1930.10	-1049.10
2022	1862.06	807.55	1976.20	-1168.65
2023	1921.4	807.96	2022.30	-1214.34
2024	1983.09	808.90	2068.40	-1259.50
2025	2046.37	780.85	2114.50	-1333.65
2026	2111.56	715.90	2160.60	-1444.70
2027	2179.26	650.65	2206.70	-1556.05
2028	2249.4	616.01	2252.80	-1636.79
2029	2322.14	618.00	2298.90	-1680.90
2030	2397.34	623.94	2345.00	-1721.06

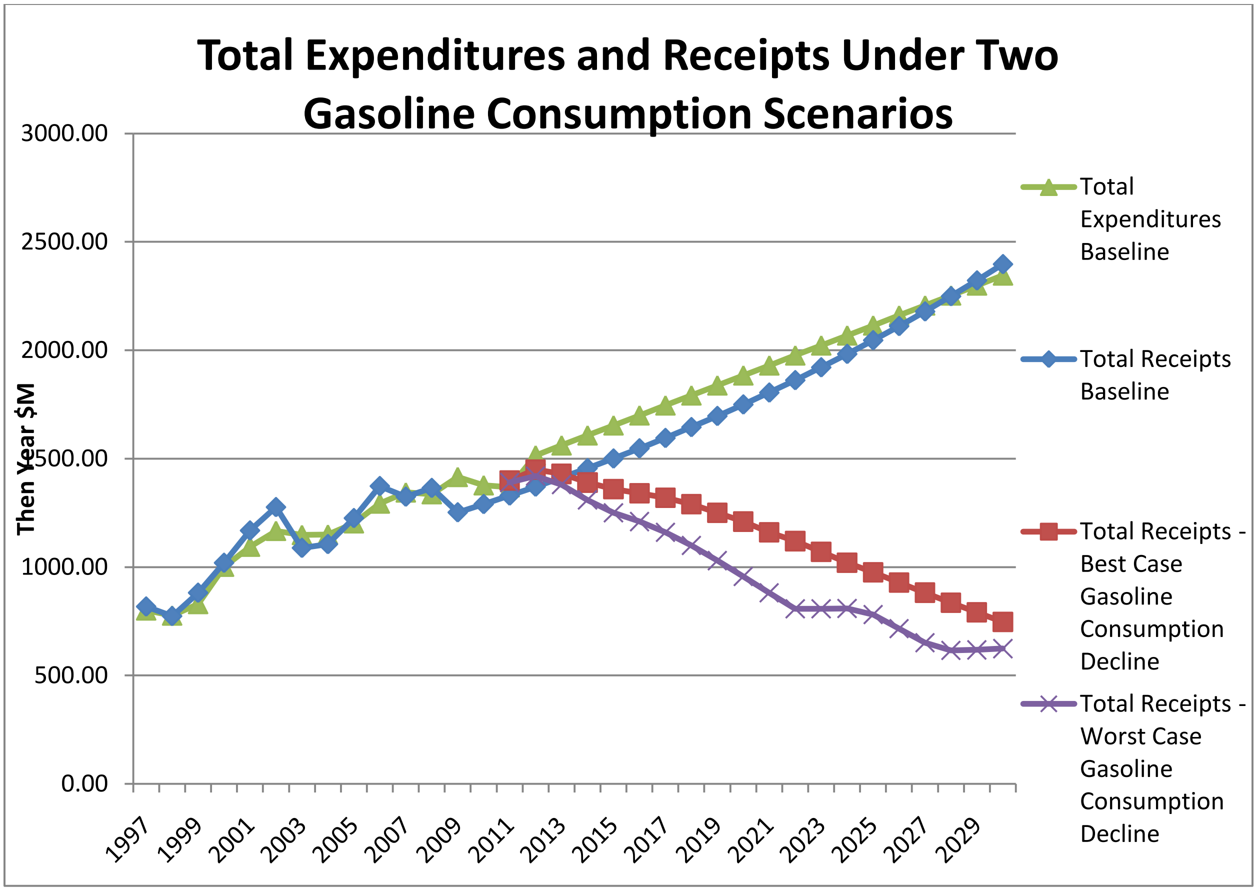

Figure 2-53. Baseline Total Expenditures with Baseline Total Receipts, and Total Receipts under Two Declining Gasoline Consumption Scenarios

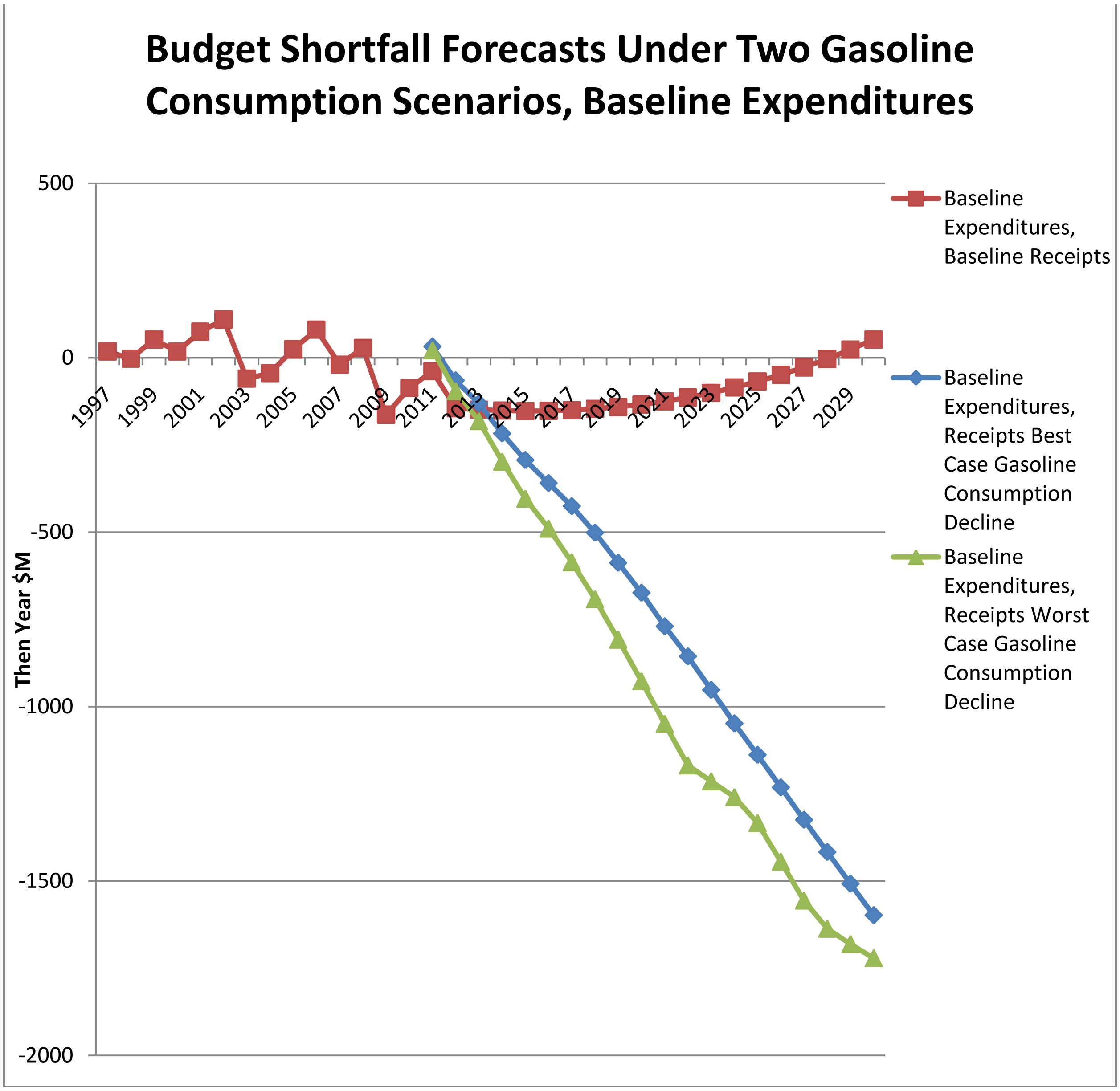

Figure 2-54. ALDOT Budget Shortfall Predictions for Baseline Total Expenditures with Baseline Total Receipts, and Total Receipts under Two Declining Gasoline Consumption Scenarios

2.5.D.2 Gasoline Consumption Decline-Adjusted Revenue Shortfalls to meet Expenditures with 10% increase in annual Construction Expenditures, 2011-1030

In this final sensitivity study, we combine the reduced revenues due to gasoline consumption declines, as depicted above, with the stated ALDOT need to increase its Construction Expenditures by a substantial amount annually in order to meet System Enhancement Needs. We have chosen a 10% increase in Construction Expenditures as a representative increase, which would amount to an increment in Baseline and Total Expenditures of around $120M in 2012, growing to $190M by 2030. Figure 2-55 shows the starting place for this sensitivity study: Total

Expenditures increased by an amount equal to 10% of forecast Baseline Construction Expenditures; Total Receipts reduced by either the Best Case or Worst Case Gasoline Consumption Decline due to CAFÉ Standards. Figure 2-56 illustrates the budget shortfall or gaps produced by each of the two Gasoline Consumption Decline-Adjusted Total Receipt forecasts. Of course, the gap is larger under Worst Case than Best Case Gasoline Consumption Decline, but the important point is that under either of these scenarios, the ALDOT budget shortfall to fund Baseline Expenditures plus 10% increase in Construction for SE is at least five times larger than it was to fund this same expenditure profile using Baseline Total Receipts ($0.3B vs. $1.5B), where the $0.3B shortfall may be retrieved from Figure 2-48.

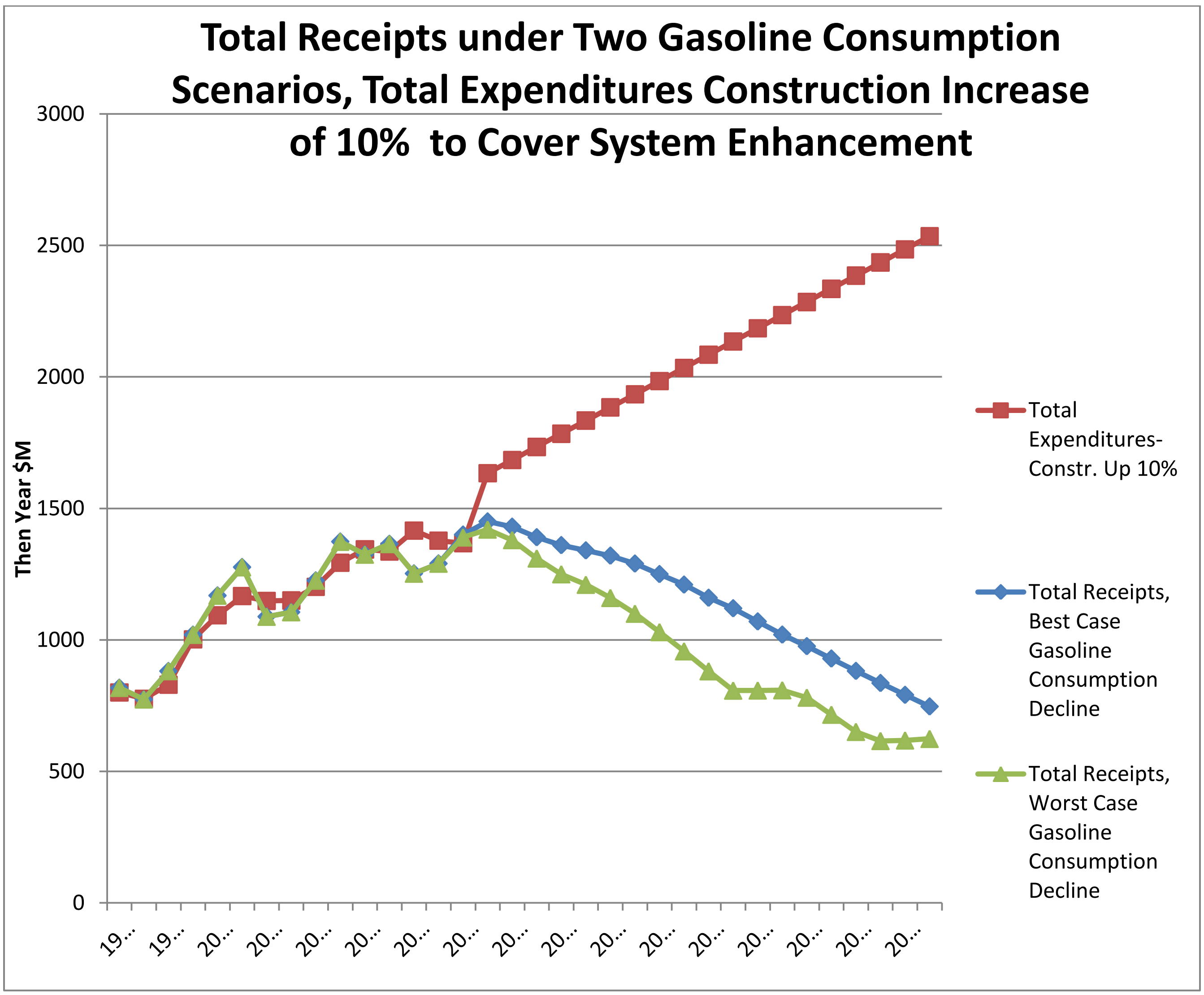

Figure 2-55. Total Receipts under Two Gasoline Consumption Scenarios, Total Expenditures with 10% Construction Increase to cover System Enhancement

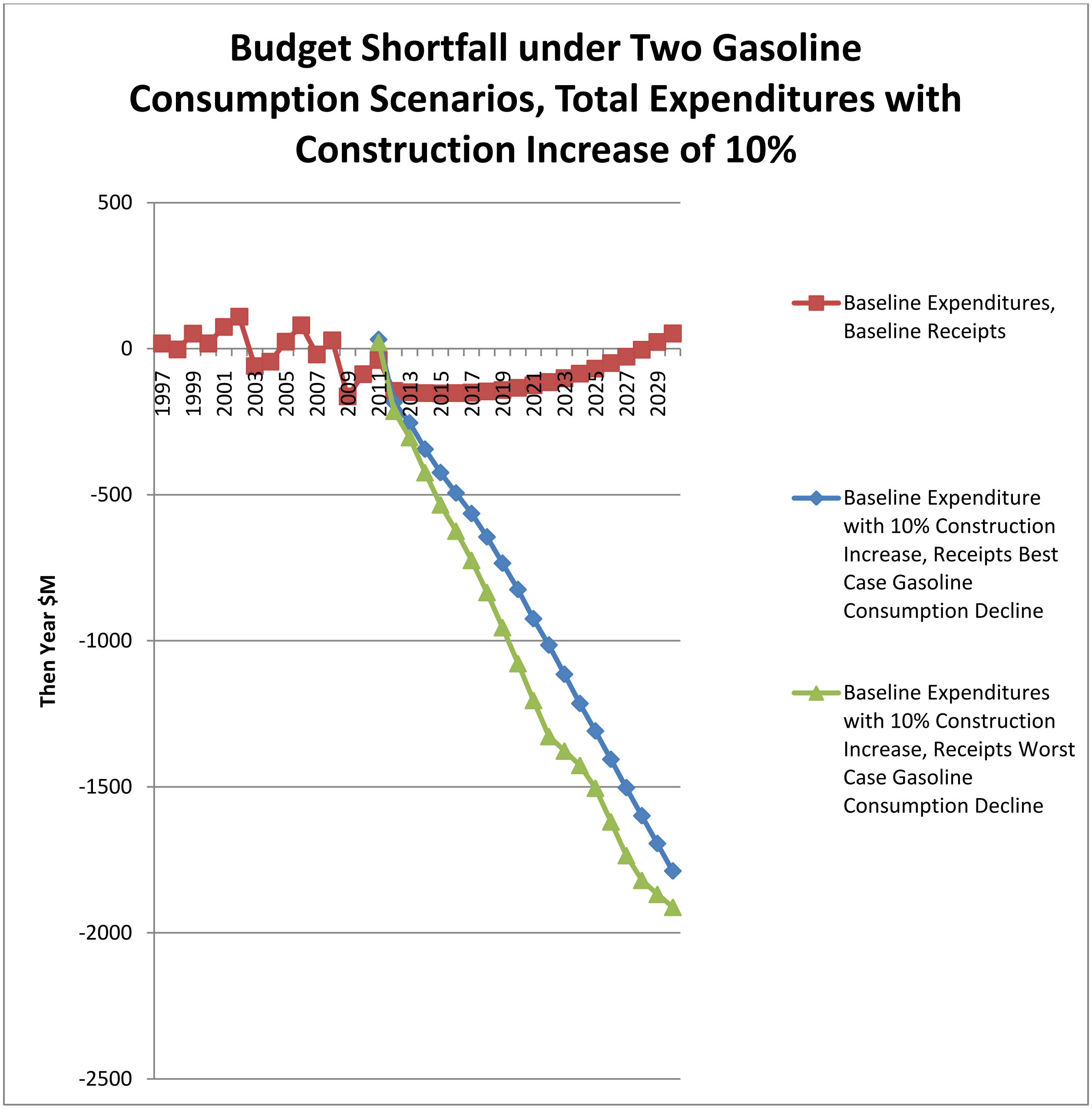

Figure 2-56. ALDOT Budget Shortfall under Two Gasoline Consumption Scenarios, Total Expenditures with 10% Construction Increase to cover System Enhancement

2.6 Econometric Analysis and Forecast of Alabama Gasoline Consumption

2.6.A Preliminary Examination of Data

Our analysis of gasoline demand begins in July 1992 after the effect of a 5¢ per gallon increase in the state gasoline tax appears to have had its full effect on revenue. Because data on the number of gallons of gasoline purchased in Alabama is not available, but total revenue from the gasoline tax is available and the per gallon tax rate is fixed over the sample, we use gasoline tax revenue as a proxy for the quantity of gasoline purchased.

The red line in Figure 2-57 is the State of Alabama's revenue from the gasoline tax, while the black line is a three-month moving average. It is clear from the figure that gasoline sales in the state (and revenue from those sales) are seasonal. The black line shows that much of the volatility is removed by using a three-month moving average, but the seasonality remains. Revenue is generally higher during the third quarter of the year (July-September or the summer) and lowest in the first quarter of the year (January-March, or the winter months). Although the summer month with the highest revenue is usually August, during some years it is July or September. Similarly, although the winter month with the lowest revenue is usually March, occasionally it is February. Below we will show that this seasonality is best handled by using seasonal (monthly or quarterly) dummy variables.

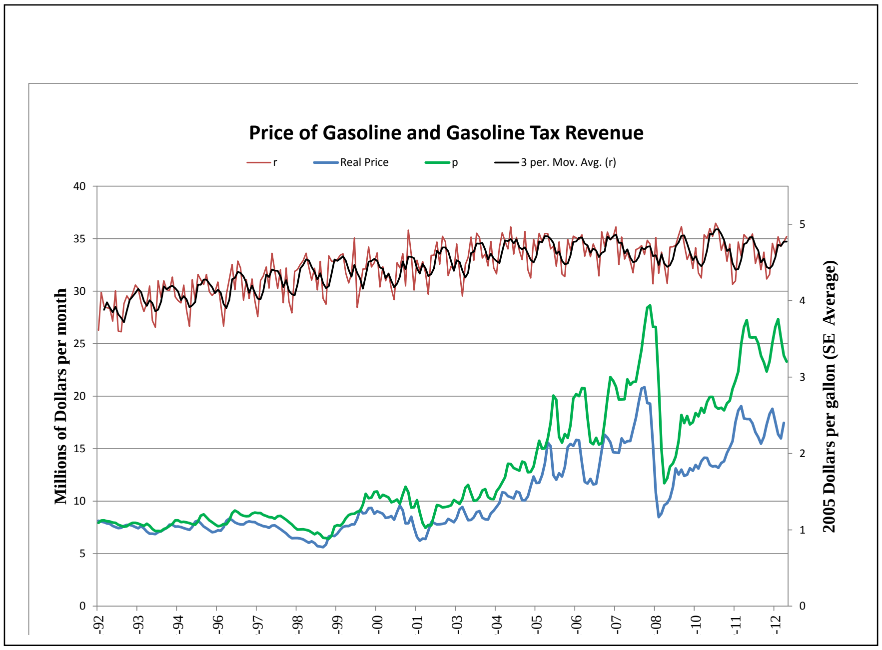

Figure 2-57. Price of Gasoline and Gasoline Tax Revenue

From Figure 2-57 one can see that from the summer of 1992 until the summer of 2004, tax revenue gradually increased. However, after the summer of 2004 there is no systematic growth in revenue from the gasoline tax. If we can understand the reason for this, it will help us produce a forecast of gasoline-tax revenue in which we have more confidence.

One variable that affects the quantity of gasoline sold is its price. Because there is no data on the average price of gasoline in the State of Alabama, we use (as a proxy) the average retail price of regular gasoline on the gulf coast of the United States available from the Energy Information Agency [5]. This is the green line in Figure 2-57. The blue line in the figure is the price of gasoline deflated by the (special) personal consumption expenditures implicit price deflator that excludes food and energy prices. Hence the blue line represents the price of gasoline relative to the average price of nonfood/nonenergy goods. The deflation is done in a manner that causes the nominal and relative prices of gasoline to be the same in July of 1992 (the beginning of the sample).

The relative price of gasoline did not change very much from July 1992 until April 1996 when it began to gradually decline until December 1998. It then rose slightly until May 2001, fell until November 2001 after which it began a gradual but dramatic increase that ended in June of 2008. The recession caused a dramatic fall through December 2008. Since that time it has increased and fluctuated around its value in March 2008, about \$2.31 per gallon in July 1992 dollars (or about \$3.50 per gallon in current dollars). In real terms gasoline is about twice as expensive as it was from the summer of 1992 through April of 1996.

The challenge in forecasting the demand for gasoline (and therefore the revenue from a gasoline tax) comes from the fact that gasoline tax revenue stopped increasing during 2004. Is this a change in tastes or a structural change and therefore cannot be explained by another economic variable, or is it related to the value of an economic variable that explains the quantity of gasoline demanded? Our answer is that it appears the sensitivity of demand to price increased during the recession. Before we begin addressing this issue it is appropriate to explain why we will use quarterly instead of monthly data.

Let *lr* be the logarithm of revenue from the gasoline tax, *lp* be the logarithm of the average retail price of regular gasoline on the gulf coast, and *lpc* be the logarithm of the personal consumption expenditures implicit price deflator (less food and energy). The subscript *t* means the current period, while the subscript *t-1* means the previous period. ε_t is a stochastic error term. The following is a regression equation estimated with monthly data using the sample period July 1993 to December 2006:

$$lr_t = \text{(monthly dummies)} - 0.22lr_{t-1} - 0.041lp_t + 1.0lpc_t + \varepsilon_t. \quad (1)$$

Although equation (1) explains about 90% of the variation in gasoline tax revenue and shows the negative coefficient on lp_t suggests that a higher price of gasoline reduces the quantity of gasoline demanded, and therefore revenue from the gasoline tax, the negative coefficient on lr_{t-1} represents a problem. The negative coefficient on lr_{t-1} implies that months with relatively high gasoline purchases are followed by months with relatively low gasoline purchases. Since we have monthly dummy variables in the regression equation, it is unlikely that this is the result of the behavior of drivers. Rather, it is more likely the result of changes in the speed with which tax payments are made to the Department of Revenue. That is, if receipts are unusually low one month, to some extent it will be the result of a failure of some tax payers to remit their tax payments in a timely fashion. The following month when the taxpayers "catch up", the payments will be higher than usual, as indicated by the negative coefficient on lr_{t-1}.

Now consider the following equation estimated for the same sample as equation (1) but with quarterly data (the first quarter of 1993 to fourth quarter 2006):

$$lr_t = \text{(quarterly dummies)} + 0.40lr_{t-1} - 0.026lp_t + 0.51lpc_t + \varepsilon_t. \quad (2)$$

Here the coefficient on the lagged dependent variable, lr_{t-1}, is positive. This implies that quarters of relatively high gasoline consumption are followed by quarters that also have relatively high gasoline consumption. Economists generally view the behavior implied by equation (2) as being more plausible than that implied by equation (1). The reason for this is the idea of partial adjustment. To understand this consider how a household might respond to a relatively large increase in the price of gasoline. Because of the pressure that the higher gasoline price puts on a household's budget, the household will look for ways it can economize on the use of gasoline. But these ways will not necessarily be obvious and once discovered, may take time to implement, such as finding a convenient partner with whom one can carpool. Hence the adjustment to a higher or lower gasoline price will take place typically over a period of several months. If this is the case, then the coefficient on the lagged quantity of gasoline (or in our case revenue collected from the gasoline tax) will be positive as in equation (2) rather than negative as in equation (1).

From equation (2) we can estimate the long-run elasticity of gasoline tax revenue with respect to the price of gasoline. This estimate is -0.0442 with a standard error of 0.0138. The point estimate implies that a 1% increase in the price of fuel causes only a 0.044% decrease in the amount of gasoline consumed.

2.6.B Is the Flattening of Gasoline Tax Revenue due to Increased Fuel Economy?

Our preliminary examination of this issue is that better fuel economy it is not the major cause of reduced gasoline tax revenue; instead a reduction in the rate of growth in miles driven is the major cause of the reduced growth rate in gasoline tax revenue. We were not able to find a monthly series of miles driven in Alabama, but were able to find annual data on miles driven in Alabama. Assuming the seasonality in monthly miles driven in Alabama is similar to that in the rest of the country, we used the annual Alabama data with the monthly national data on miles driven to create an estimate of monthly miles driven for the state. Figure 2-58 presents this data along with the data on gasoline tax revenue for the state of Alabama and the real price of gasoline previously presented in Figure 2-57. The black lines in Figure 2-58 are 12-month moving averages of the respective series. Notice that the black lines for revenue and miles driven are roughly parallel, suggesting that the major explanation for the failure of gasoline tax revenue to grow after the summer of 2004 is the failure of total miles driven to grow. Miles driven in 2011 and 2012, however, are slightly higher than in 2007, suggesting that better fuel economy has played a *small* role—a role that is not nearly as important as miles driven.

This should not be surprising since a household's (or a business's) decision to purchase gasoline is merely a way to implement the complementary decision to drive a certain number of miles, given the miles per gallon consumed by its vehicles. We can see this by looking at the following estimated regression equation (for vehicle miles traveled in Alabama, *lma*) and comparing it with equation (2) above (the sample period is first quarter of 1993 to fourth quarter 2006):

lma_t = (quarterly dummies) + $0.51 lma_{t-1} - 0.051 lp_t + 0.64 lpc_t + \varepsilon_t$. (3)

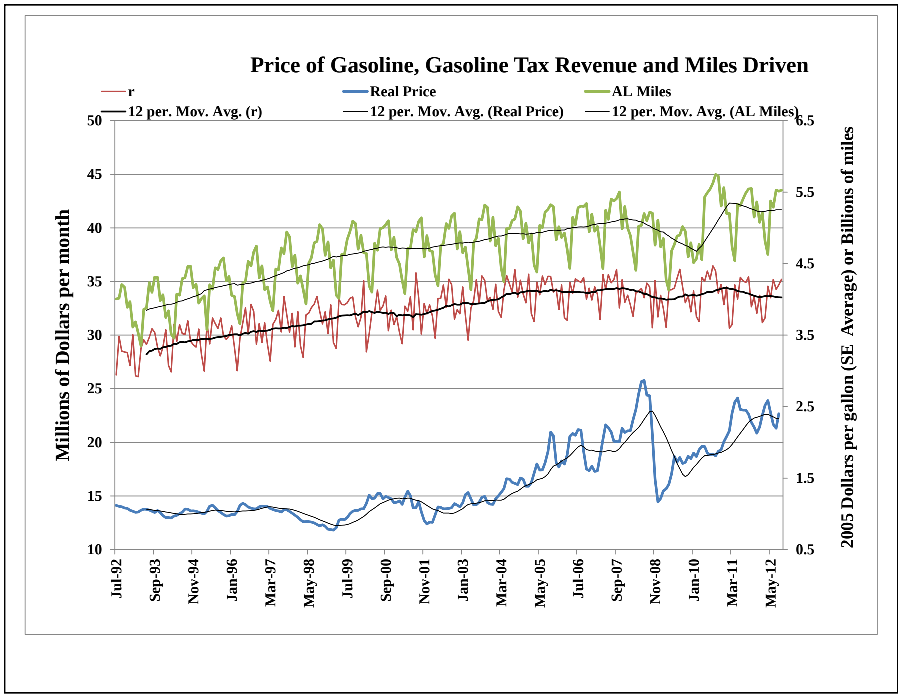

Figure 2-58. Price of Gasoline, Gasoline Tax Revenue, and Miles Driven

Notice that an increase in the price of gasoline causes a decrease in miles traveled. The coefficients on the lagged dependent variable in equation (3) is about 25% greater than that in equation (2), while the coefficient on price in equation (3) is about twice the size of that in equation (2). The long run effect of a 1% increase in the price of gasoline on miles driven in Alabama is -0.105%, the percentage decrease in miles driven is about twice the percentage decrease in revenue. (The difference in these percentages is statistically significant.)

It is worth reflecting on why we would expect the percentage change in miles driven to be larger than the percentage change in revenue collected (and therefore gasoline purchased). The estimates imply that the when drivers in Alabama respond to an increase in the price of gasoline they do so primarily by reducing that driving which yields better fuel economy. This means that drivers reduce their highway driving (such as vacation driving or shopping trips to a larger urban area) to a greater extent than their trips to and from work or their trips buying groceries and other everyday necessities.

2.6.C Forecasting Future Gasoline Tax Revenue

2.6.C.1 Econometric Models of Revenue and Miles Driven

This section proposes an economic model that can be used to forecast the demand for tax revenue. The basic idea is that both miles driven and gasoline purchased depend on the price of gasoline and the wealth/income of drivers in the state. Since the decisions to drive a certain number of miles and to buy gasoline are simulataneous, the same variables should affect both. If we obtain similar elasticities from the equations for these two variables, it will give us more confidence in the results. What are good proxies for the nonprice variables that affect the demand for gasoline?

We examined three series, total wages and salaries in Alabama, total employment in Alabama, and the unemployment rate in Alabama. It appears that the one that works best is total wages and salaries in Alabama. This variable is highly correlated with the consumer price index. (The correlation coefficient of total wages and salaries with the variable lpc_t is about 0.99, so we cannot really use the two variables in the same estimation procedure.) It also tends to increase when employment increases, and tends to decrease when employment decreases.

Using quarterly data, Table 2-42 presents coefficient estimates of regressions of the logarithm of revenue from the gasoline tax on one lagged value of revenue, the price of gasoline, and the income/employment variables. Table 2-42 repeats this exercise using miles driven in Alabama. The first thing to notice in column (1) of Table 2-42 is that when all of the economic variables are included in the regression the only estimated coefficient that is statistically significant is that on lagged revenue. Furthermore, the coefficient on the unemployment rate has the wrong sign. (This is true in every column that includes the unemployment rate). One would expect an increase in the unemployment rate to cause a decrease in purchases of gasoline rather than an increase. Column (2) drops the implicit price deflator as a variable, and this causes wages and salaries to become significant, while columns (3) and (4) respectively drop the unemployment rate and the level of employment. Although these variables have the wrong sign, suggesting a problem with the model, there is a good explanation for this discussed below.

Finally, column (5) drops both employment and unemployment. In each of columns (3)-(5) the coefficient on the price of gasoline is negative and significantly different from zero. In each of columns (2)-(5) the coefficient on total wages and salaries is positive and significantly different from zero.

Table 2-42. Regressions of Gasoline Tax Revenue on Various Variables

	(1)	(2)	(3)	(4)	(5)	
Constant	-1.417653 (2.330918)	-1.148446 (2.270315)	1.283326 (0.822447)	-0.361203 (0.168280)	-0.191416 (0.154053)	
QUARTER{1}	-0.002473 (0.007697)	-0.002035 (0.007608)	-0.001859 (0.007632)	-0.002217 (0.007521)	0.001273 (0.007611)	
QUARTER{2}	0.072340** (0.010217)	0.072806** (0.010116)	0.073554** (0.010129)	0.072710** (0.010019)	0.077681** (0.010104)	
QUARTER{3}	0.057242** (0.003955)	0.057111** (0.003921)	0.057436** (0.003924)	0.057158** (0.003883)	0.058027** (0.004002)	
Lagged Revenue	0.379708** (0.129161)	0.387922** (0.127524)	0.395700** (0.127767)	0.385946** (0.126226)	0.451882** (0.126908)	
Price of gas-oline	-0.019230 (0.013156)	-0.017641 (0.012790)	-0.026885** (0.009974)	-0.020786* (0.008961)	-0.019213* (0.009256)	
Total wages and salaries	0.131098 (0.149586)	0.213812** (0.053182)	0.233332** (0.050561)	0.222552** (0.046437)	0.188691** (0.045281)	
Employment	0.080634 (0.175860)	0.059459 (0.170993)	*-0.121526** (0.066629)			
Unemploy-ment Rate	*0.025947* (0.024704)	*0.027920* (0.024308)	....	*0.020131** (0.009354)		
Price level	0.199065 (0.336142)					

Sample Period: 1993:1-2006:4, quarterly.
Dependent Variable: Gasoline Tax Revenue.
Price of Gasoline:Gulf Coast Price of Gasoline.
Total Wages and Salaries: in Alabama taken from FRED database.
Unemployment Rate: in Alabama taken from FRED database.
Price Level: Personal Consumption expenditures implicit price deflator excluding food and energy.

Because the variables employed in the regessions presented in Table 2-42 are expressed in natural logarithms, the estimated coeficients are also estimated short-run elasticities. The estimated long-run elasticities can be calculated by the formula

$$\textit{long-run elasticity} = \frac{short-run\ elasticity}{1-(coefficient\ on\ lagged\ dependent\ variable)}.$$

There is very little difference in the estimated long-run price elasticities. In the long run a 1% increase in the price of gasoline causes anywhere from a 0.03 to 0.045 percent decrease in the amount of gasoline purchased. We can use this to estimate the effect of an increase in the gasoline tax on revenue earned. If the current price of gasoline (including all state and federal excise taxes) is about $3.50 per gallon, then a 3.5¢ increase in the state gasoline tax represents a 1% increase in price. Taking the larger (in absolute value) of the above range of estimates, this reduces the quantity demanded by only 0.045 percent, the resulting increase in total revenue will be about 0.99955 times (3.5/18) or 19.4%. The demand for gasoline is very inelastic. (Note: a 3.5% increase in the per gallon tax is a (3.5/18) = 0.1944 is about a 19.4% increase in the tax per gallon.) The estimated demand for gasoline in these equations is so insensitive to price, that one can assume there is no change in quantity demanded when taxes are raised. There is also very little difference in the estimated long-run income elasticities as well. They range from 0.34 to 0.386. For every 1% increase in total wages and salaries in Alabama, there is a 0.35 percent increase in revenue from the gasoline tax.

Table 2-43 presents estimates of equations for miles driven in Alabama. Because the decision to buy gasoline and the decision to drive a certain distance are made simultaneously by consumers, we would expect the same variables that explain gasoline demand to explain miles traveled. From the results presented in Table 2-43 one can see that lagged miles traveled is not significant in columns (1) and (2). Also notice that in columns (1) and (2) that the unemployment rate has the wrong sign. Once unemployment (column 3) or employment (column 4) is removed as an explanatory variable, lagged miles traveled is positive and significant.

Table 2-43. Regressions of Miles Traveled in Alabama on Various Variables					
	(1)	(2)	(3)	(4)	(5)
Constant	7.181586**	7.073240**	10.674450**	11.496793**	11.207749**
	(2.596030)	(2.520650)	(1.727612)	(1.759548)	(1.720173)
QUARTER{1}	-0.055362**	-0.055363**	-0.049326**	-0.046689**	-0.045878**
	(0.008492)	(0.008406)	(0.008008)	(0.007907)	(0.007823)
QUARTER{2}	0.067943**	0.068004**	0.081127**	0.086690**	0.088279**
	(0.015432)	(0.015272)	(0.014029)	(0.013655)	(0.013482)
QUARTER{3}	0.067115**	0.067196**	0.068921**	0.069471**	0.069495**
	(0.004439)	(0.004378)	(0.004402)	(0.004468)	(0.004454)
Lagged Miles	0.148359	0.148409	0.253226*	0.298424**	0.311916**
	(0.121308)	(0.120071)	(0.109849)	(0.106509)	(0.104966)
Price of gas-oline	-0.049194**	-0.049736**	-0.061841**	-0.064482**	-0.063383**
	(0.014388)	(0.014022)	(0.012865)	(0.013128)	(0.013023)
Total wages and salaries	0.421830*	0.387856**	0.381296**	0.377018**	0.374680**
	(0.168427)	(0.057577)	(0.059057)	(0.060052)	(0.059805)
Employment	*0.511223**	*0.519763**	*0.121862*		
	(0.226414)	(0.220627)	(0.077039)		
Unemploy-ment Rate	*0.058065**	*0.057244**	…	*-0.008896*	
	(0.030400)	(0.029852)	…	(0.010614)	
Price level	-0.078914				
	(0.367142)				

Sample Period: 1993:1-2006:4, quarterly.
Dependent Variable: Total Miles Traveled in Alabama.
Price of Gasoline:Gulf Coast Price of Gasoline.
Total Wages and Salaries: in Alabama taken from FRED database.
Unemployment Rate: in Alabama taken from FRED database.
Price Level: Personal Consumption expenditures implicit price deflator excluding food and energy.
**Statistically Significant at the 0.01 level.
*Statistically Significant at the 0.10 level.

Using the same technique as above, we can calculate the long-run elasticities of miles traveled with respect to the price of gasoline and total wages and salaries. Table 2-44 presents these for the models in columns (3) and (5) from Tables 2-42 and 2-43. Notice that the elasticities of miles traveled are larger than the elasticites of revenue. This suggests that miles per gallon declines as miles driven decreases. Why would this be expected?

Table 2-44. Comparison of Long-run Elasticities

	With respect to price of gasoline		With respect to total wages and salaries	
	Column (3)	Column (5)	Column (3)	Column (5)
Elasticity of revenue (or gasoline demand)	-0.044	-0.035	0.386	0.344
Elasticity of miles traveled	-0.083	-0.092	0.511	0.544

When incomes decline or gasoline prices increase, one would expect that optional travel would be the first travel eliminated. Optional travel includes long excursions (for say shopping trips or vacations) for which automobiles have better gasoline mileage. So the above results make economic sense, at least qualitatively.

If we accept the model represented by either column (3) or (4) in Tables 2-42 and 2-43, we must grapple with the fact that in Table 2-42 the coefficients on employment and unemployment are the wrong sign. It is the opinion of this researcher that this is because there is a difference between an increase in wages and salaries that occurs solely because of an increase in employment, and an increase in wages and salaries given employment. To demonstrate that this explanation is at least plausible, the regressions in Table 2-45 are presented. In these regressions the explanatory variables are the lagged dependent variable (either the logarithm of miles driven or revenue), the logarithm of the price of gasoline, the logarithm of wages and salaries per employee, and either the logarithm of total employment or the unemployment rate. In columns (1) and (2) of the table the dependent variable is miles driven, while in columns (3) and (4) it is revenue collected.

In the estimates presented in columns (1) and (3) of Table 2-45 the coefficient on the unemployment rate is negative, but is statistically significant at the 0.01 level only in column (1), the estimate for miles driven. The negative value of the coefficient on the unemployment rate in column (3) of Table 2-45 should be compared with the positive and statistically significant value of the coefficient on unemployment in column (4) of Table 2-42. If we use total wages and salaries per employee, the coefficient on the unemployment rate has the theoretically correct sign.

Table 2-45. Estimates using Wages and Salaries per Employee				
	Regression for Miles Driven		Regression for Revenue	
	(1)	(2)	(3)	(4)
Lagged revenue			0.444295** (0.126322)	0.395700** (0.127767)
Lagged Miles .	0.483606** (0.095610)	0.253226* (0.109849)		
Price of gasoline	-0.063713** (0.015439)	-0.061841** (0.012865)	-0.030317** (0.010873)	-0.026885** (0.009974)
Total wages and salaries per employee	0.315105** (0.062042)	0.381296** (0.059057)	0.230921** (0.053486)	0.233332** (0.050561)
Uemployment rate	-0.048539** (0.014282)		-0.011865 (0.009881)	
Employment		0.503158** (0.100335)		0.111805* (0.061109)
Variables definitions are as in Tables B1 and B2. All variables are in logarithms and each regression includes a constant and three quarterly dummy variables. **Statistically Significant at the 0.01 level. *Statistically Significant at the 0.10 level.				

Columns (2) and (4) in Table 2-45 present results that use wages and salaries per employee along with total employment. The coefficient on employment in each case is the sum of the coefficients on wages and salaries and employment in column (3) of Tables 2-42 and 2-43. (This is a property of the linear regression.) Column (2) shows that a 1% increase in wages and salaries per employee causes a 0.38 percent increase in miles driven, while column (4) shows that there is only a 0.23 percent increase in revenue from the gasoline tax. Similarly, the coefficients on employment in columns (2) and (4) show that a 1% increase in employment, given wages and salaries per employee, causes a 0.50% increase in miles driven and only a 0.11% increase in revenue from the gasoline tax.

2.6.C.2 Validation of Models to Forecast Revenue and Miles Driven using 2007-2012 Data

The above equations are estimated using quarterly data over a sample period from 1993:1 to 2006:4. To forecast future values of revenue and miles driven, we should use all the data available—at least that through 2012:2, second quarter of 2012. So, before forecasting we will re-estimate the model using the sample period 1993:1-2012:2. But first we must determine how well the model estimated for the period 1993:1-2006:4 forcasts for the period 2007:1-2012:2. Plots of these out-of-sample forecasts are presented in Figures 2-59 and 2-60.

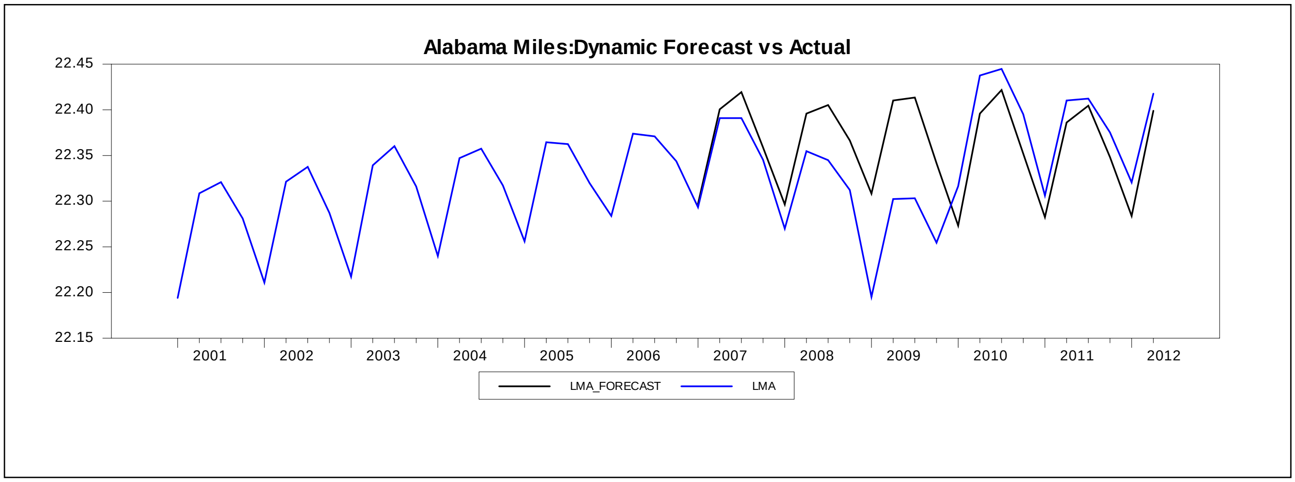

Figure 2-59. Alabama Miles: Dynamic Forecast vs. Actual

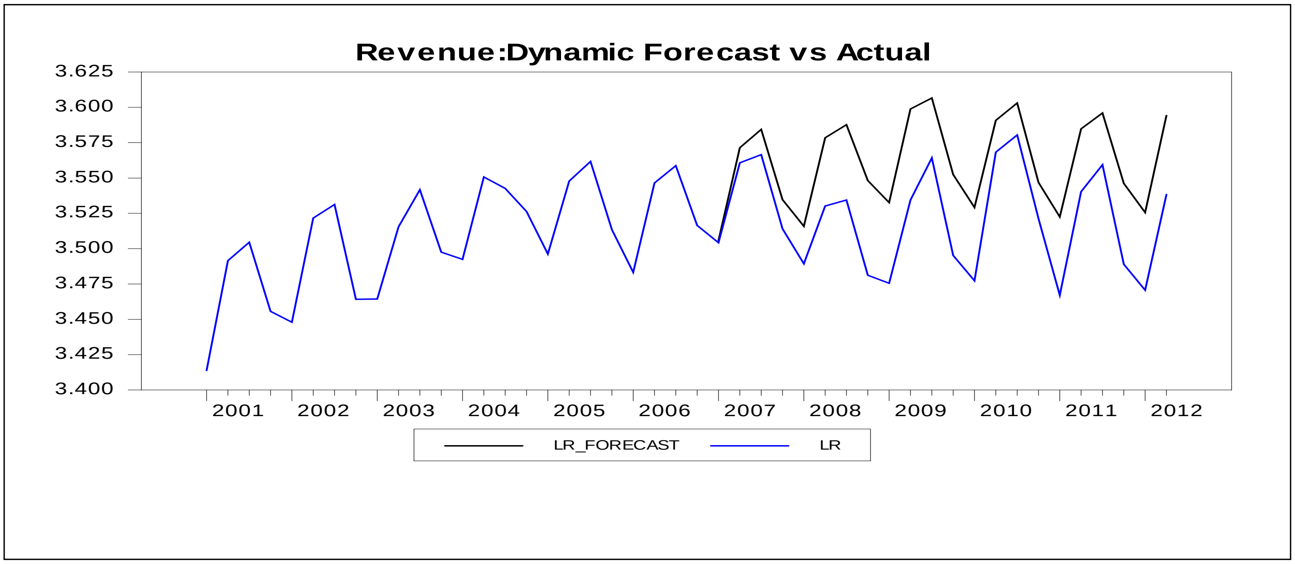

Figure 2-60. Revenue: Dynamic Forecast vs. Actual

The figures show that the models forecast values that are too high for both revenue and miles driven during the years 2008 and 2009. After 2009 the forecast for miles driven is very accurate. (Note: we are using the actual values of the price of gasoline, wages and salaries, and employment in the forecasts. The forecasts are called dynamic because they use the forecasted value of the lagged dependent variable, rather than the actual value of the lagged dependent variable.) On the other hand, the model continues to forecast revenue values after 2010 that are too high, but not to the same extent as during the recession. We conclude that the model is sufficiently reasonable to use for forecasting revenue and miles driven after 2012:2.

Table 2-46 presents the estimated long-run elasticities obtained from the models when they are estimated over the entire sample period. The most interesting item in Table 2-46 is the observation that the long-run elasticity of revenue earned with respect to price is quite a bit larger than that reported in Table 2-44. The other items are similar to the estimated values obtained

Table 2-46. Long-run Elasticities from Model Estimated for period 1993:1-2012:2

Estimation Period		(1)	(2)	(3)
		With Respect to Price	With Respect to Wages and Salaries Per employee	With respect to total employment
		Column (3)	Column (5)	Column (3)
1993:1-2012:2, quarterly	Revenue	-0.087** (0.028)	0.371** (0.055)	0.384** (0.133)
	Miles Driven	-0.079 (0.062)	0.461** (0.126)	0.389 (0.377)
1993:1-2006:4, quarterly	Revenue	-0.0445** (0.016)	0.386** (0.032)	0.185* (0.088)
	Miles Driven	-0.083** (0.014)	0.511** (0.03)	0.674 (0.08)
**Significant statistically at the 0.01 level. * Significant statistically at the 0.05 level.				

using the shorter sample period. The important implication of this is that during the period 2007:1-2012:2, the demand for gasoline, and therefore revenue earned from the gasoline tax, was much more sensitive to price and employment than implied by the point estimates obtained using data for a sample period ending in 2006:4. The sensitivity of revenue to wages and salaries is about the same in both samples. One oddity (probably resulting from the relatively large standard errors in the miles driven estimates for the sample ending in 2012:2) is that the elasticity of miles driven with respect to price in Table 2-46 for the longer sample period is less than that for revenue (in absolute value), while its elasticity with respect to wages and salaries per employee remains larger than that for price.

Another interesting item from Table 2-46 is that the long-run elasticities for revenue and miles driven are closer together for the longer sample period than for the shorter sample period. This verifies to some extent the hypothesis that the decision to drive and to buy gasoline are simultaneous. Finally, the point estimates for revenue are to be more precise (have lower standard errors) than those for miles driven when using the longer sample period. Because of the relatively low standard errors in the estimate for revenue all of the elasticities for revenue are statistically significant. This suggests that the forecasts of revenue using the revenue equation have a good chance of being better forecasts than those using the miles driven equation.

2.6.C.3 Nominal and Revenue Forecasts

Our forecasts of future revenue are based on the long-run elasticities in the equation for revenue presented in Table 2-46 for the sample period 1993:1-2012:2. In order to make out-of-sample forecasts we must have estimates of or make assumptions about future growth rates of wages and salaries and employment. Because the price elasticity of demand for gasoline is so small, we will assume that gasoline prices do not change. When examining how a change in the state gasoline tax affects revenue we will assume the price of gasoline is $3.50 per gallon (including current taxes), but demand is so insensitive to price this has no economically meaningful effect on the forecasts.

What should we assume about the growth rates of employment and incomes in Alabama in the future. Table 2-47 summarizes some data on the growth of these data series since 1993. From 1993 to 2006 total wages and salaries as well as employment on average grew at 1.1% per year. From 2007 to 2012 wages and salaries increased at a rate of 0.36% per year, while employment fell. The second half of this period (2010 to the middle of 2012), however, employment has grown at 2.1% per year, while total wages and salaries have grown at only 0.7% per year.

What should we assume about the future growth rates of these variables? First of all it appears that there has been no upward movement in wages and salaries per worker. Hence, we will assume that this variable does not grow. Second, we have the issue of whether employment growth is going to return to the pre-recession average of about 1.1% per year, or continue to grow at about 2% per year. Since a long-run employment growth rate of 2% is very high for Alabama, we will do forecasts in two ways. First in Table 2-48 we will assume employment grows at 1.1% per year. In Table 2-49 we will assume that employment grows at 2.1% for 5 years and then returns to the 1.1%.

Table 2-47. Average Growth Rates per Year

Period	Wages and Salaries	Employment
1993 to 2006	1.1%	1.1%
2007 to middle of 2012	0.36%	-1.2%
2010 to middle of 2012	0.7%	2.1%

During the 12-month period from October 2011 to September 2012 gasoline tax revenues in Alabama were approximately $402 million dollars. If we assume that this is total revenue for the 2012 fiscal year, we can project that revenue from the gasoline tax will grow very slowly based on the above considerations. As is shown in the first column of Table 2-48, by 2020 revenue from the gasoline tax will only have grown to about $416 million per year assuming that employment grows at a rate of 1.1% per year, using the point estimate of the employment elasticity of revenue. If we assume, as shown in the first column of Table 2-49, that employment grows by 2% per year for the next 5 years and then reverts back to the 1.1% growth rate, then revenues in 2020 will on be only $6 million higher.

The second and third columns of Tables 2-48 and 2-49 present what we are calling "optimistic" and "pessimistic" cases. The optimistic case for revenue uses the point estimate plus one standard error for the employment elasticity of revenue, while the pessimistic case uses the point estimate minus one standard error. Because of the precision of the estimates, these standard errors are relatively small, so revenue growth remains very low in the optimistic case.

Table 2-48. Revenue Forecasts under alternate assumption of employment Elasticity assuming growth rate of employment of 1.1% per year. (millions of current dollars)
Based on model estimated for period 1993:1-2012:2

Year			optimistic	Pessimistic	
		Point Estimate	Plus one Standard Error	Minus one standard Error	5¢ Higher Tax in 2014
2012		402.00	402.00	402.00	402.00
2013		403.70	404.29	403.11	403.70
2014		405.40	406.59	404.22	517.68
2015		407.12	408.90	405.34	519.87
2016		408.84	411.22	406.46	522.06
2017		410.56	413.56	407.58	524.27
2018		412.30	415.91	408.71	526.48
2019		414.04	418.28	409.83	528.71
2020		415.79	420.66	410.97	530.94
2021		417.54	423.05	412.10	533.18
2022		419.31	425.46	413.24	535.44
2023		421.08	427.88	414.38	537.70
2024		422.86	430.31	415.52	539.97
2025		424.64	432.76	416.67	542.25
2026		426.44	435.22	417.82	544.54
2027		428.24	437.69	418.97	546.84
2028		430.05	440.18	420.13	549.15
2029		431.86	442.68	421.29	551.47
2030		433.69	445.20	422.45	553.80
2031		435.52	447.73	423.62	556.14
2032		437.36	450.28	424.79	558.49
2033		439.21	452.84	425.96	560.85
2034		441.06	455.42	427.14	563.22
2035		442.92	458.01	428.32	565.60
2036		444.80	460.61	429.50	567.98

Assuming increase in gasoline tax of 5¢ per gallon in Fiscal Year 2014 and the price of gasoline is $3.50 per gallon.

Table 2-49. Revenue Forecasts under alternate assumption of employment Elasticity assuming growth rate of employment of 2.1% per year for 5 years and then reverting to 1.1% per year. (millions of current dollars) Based on model estimated for period 1993:1-2012:2					
Year			optimistic	Pessimistic	
		Point Estimate	Plus one Standard Error	Minus one standard Error	5¢ Higher Tax in 2014
2012		402	402	402	402
2013		405.09	404.29	403.11	405.09
2014		408.20	406.59	404.22	520.94
2015		411.33	408.90	405.34	524.94
2016		414.49	411.22	406.46	528.97
2017		417.68	413.56	407.58	533.03
2018		419.44	415.91	408.71	535.28
2019		421.21	418.28	409.83	537.55
2020		422.99	420.66	410.97	539.82
2021		424.78	423.05	412.10	542.10
2022		426.57	425.46	413.24	544.39
2023		428.37	427.88	414.38	546.69
2024		430.18	430.31	415.52	549.00
2025		432.00	432.76	416.67	551.31
2026		433.83	435.22	417.82	553.64
2027		435.66	437.69	418.97	555.98
2028		437.50	440.18	420.13	558.33
2029		439.35	442.68	421.29	560.69
2030		441.20	445.20	422.45	563.06
2031		443.07	447.73	423.62	565.44
2032		444.94	450.28	424.79	567.82
2033		446.82	452.84	425.96	570.22
2034		448.70	455.42	427.14	572.63
2035		450.60	458.01	428.32	575.05
2036		452.50	460.61	429.50	577.48
Assuming increase in gasoline tax of 5¢ per gallon in Fiscal Year 2014 and the price of gasoline is $3.50 per gallon.					

The results presented in the first 3 columns of Tables 2-48 and 2-49 imply that there is very little chance of an economicially meaningful increase in revenues from the gasoline tax unless the tax is increased. Hence the last column of each table presents forecasts of revenue based on the assumption that there is 5¢ per gallon increase in the state gasoline tax beginning in October of 2013. This will raise an additional $110 million dollars per year initially, but increasing only to an extra $120 million by 2029.

Elsewhere in this report it is pointed out that the use of a constant per gallon tax rate on gasoline has gradually been eroded by inflation. Indeed, the $402 million in revenue for fiscal year 2012 represents about the same revenue the state was collecting per year before the July 1992 5¢ per gallon increase in the gasoline tax. The benefit of that tax increase has been completely eroded by inflation. How will inflation affect the real value of the revenue forecasts presented in Tables 2-48 and 2-49?

The estimates presented in Table 2-50 provide some possible answers. Before discussing that table it is appropriate to address the question how can we determine, forecast or estimate future rates of inflation. One way is to use the difference between the nominal and real rate of interest. On December 3, 2012 the rate of interest on a constant maturity 20-year United States government bond was 2.37% per year, while that on an inflation protected 20-year constant maturity bond was -0.05%. These two number suggest the rate of inflation over the next 20 years is expected to average about 2.42% per year.

Table 2-50. Comparison of *real* (2012 dollars) and *nominal* revenue from gasoline tax assuming growth rate of employment of 2% per year for 5 years and then reverting to 1.1% per year. Based on model estimated for period 1993:1-2012:2						
	No tax increase		5¢ in 2014		10¢ in 2014	
Year	Nominal Forecast	Real Value (infl.=2.0%)	Nominal Forecast	Real Value (infl.=2.0%	Nominal Forecast	Real Value (infl.=2.0%
2012	402.00	402.00	402.00	402.00	402.00	402.00
2013	405.09	395.78	405.09	397.14	405.09	397.14
2014	408.20	389.66	520.94	500.71	633.40	608.80
2015	411.33	383.63	524.94	494.66	638.26	601.45
2016	414.49	377.70	528.97	488.69	643.16	594.18
2017	417.68	371.86	533.03	482.78	648.10	587.01
2018	419.44	366.11	535.28	475.32	650.84	577.93
2019	421.21	360.45	537.55	467.97	653.59	568.99
2020	422.99	354.87	539.82	460.73	656.35	560.19
2021	424.78	349.38	542.10	453.60	659.12	551.52
2022	426.57	343.98	544.39	446.59	661.91	542.99
2023	428.37	338.66	546.69	439.68	664.70	534.60
2024	430.18	333.42	549.00	432.88	667.51	526.33
2025	432.00	328.26	551.31	426.18	670.33	518.19
2026	433.83	323.19	553.64	419.59	673.16	510.17
2027	435.66	318.19	555.98	413.10	676.00	502.28
2028	437.50	313.27	558.33	406.71	678.86	494.51
2029	439.35	308.42	560.69	400.42	681.73	486.86
2030	441.20	303.65	563.06	394.23	684.61	479.33
2031	443.07	298.95	565.44	388.13	687.50	471.92
2032	444.94	294.33	567.82	382.13	690.40	464.62
2033	446.82	289.78	570.22	376.22	693.32	457.44
2034	448.70	285.30	572.63	370.40	696.25	450.36
2035	450.60	280.88	575.05	364.67	699.19	443.39
2036	452.50	276.54	577.48	359.03	702.14	436.54
Assuming the price of gasoline is $3.50 per gallon.						

Another way is to use forecasts of inflation taken obtained from a macroeconomic model. Every quarter the Federal Reserve Bank of Philadelphia [6] surveys professional economic forecasters. The report includes forecasts of the rate of inflation. The report issued for the 4th quarter of 2012 reveals that the mean forecast for the average rate of inflation from 2012 to 2021 is approximately 2.0 per cent per year. The University of Alabama's Center for Business and Economic Researh subscribes to a professional forecasting service. The forecasts from this service predict the rate of inflation is going to increase steadily from around 2.3% per year during 2013 to 3.46% per during the early 2030's.

Because the situation for real revenue is dire enough if we use the lowest expected inflation rate, 2% per year, the results in Table 2-50 on based on the assumption that this is the future rate of inflation. The first two columns of the table show the nominal (from Table 2-50) and real forecasts assuming no tax increases. The next two columns present the forecasts assuming a 5¢ increase in the gasoline tax in 2014, while the last two columns show results based on a 10¢ per gallon tax increases that takes effect at the beginning of fiscal year 2014. The table shows that with a rate of inflation of only 2% per year most of the benefits of a gasoline tax increase are erased within 15 years (5¢ increase) or 20 years (10¢ increase). If the higher inflation forecasts turn out to be more accurate, the situation is even less optimistic.

2.6.D Conclusion from Econometric Model Forecasts

One result obtained from estimating econometric models of revenue collected and miles driven is similar to what one might have expected to obtain from looking at Figures 2-57 and 2-58. The revenue from the gasoline tax is not going to grow unless Alabama drivers increase their driving and they will not do this until more Alabamians are working. Furthermore, the additional revenue from the July 1992 increase in gasoline taxes has been completely eroded by inflation and the real revenue earned from this tax is going to continue to decline unless the tax is increased and the new total tax is indexed to the price level. At this time it does not appear that better fuel economy is an important source of declining revenues from the gasoline tax.

2.7 Summary of Study Findings

In this section, we summarize the significant findings of this research, with a focus on the fiscal years 2012, 2020, and 2030:

1. Gasoline consumption in Alabama has increased the past 15 years, but at a declining rate. The past eight years (2004-2011), the trend has been flat at an average of 2.584 billion gallons per year. If one ignores the two recession years 2008-09, a very small increase of 4.824 million gallons per year would best describe 2004-2011. However, new U.S. CAFÉ Standards increasing average mpg by 5% per year for light vehicles are being phased in 2011-2025. When one accounts for these standards in new vehicles, and assumes a 14-year (175,000 mile) average vehicle lifetime across all vehicles, then the slow increase in vehicle miles traveled (vmt) in Alabama over the period 2012-2030 will not offset the rapid decline in gallons per mile, and gasoline consumption is forecast to decline from the 2011 level of 2.584 billion gallons by 8% in 2020, and by 33% in 2030.

2. ALDOT receipts have increased from $817.95M in 1997 to $1329.61M in 2011, a compound growth rate of 3.29% per year. Total expenditures during this same 15 year

period increased at a compound growth rate of 3.76% per year, which we perceive was enabled by borrowing (bonds). Specifically, during 1997-2011:

a. State receipts grew by only 1.22%, and have been more or less flat the past six years, as expected due to the leveling off in gasoline demand in the State;
b. Federal receipts grew by 5.98% over this period, but have been essentially flat the past six years;
c. Other receipts contribute a small portion ($45-50M annually) to total receipts.

3. State receipts under two gasoline consumption decline models are forecast to decrease 2012-2030, in stark contrast to the baseline forecast which shows an increase from $514M in 2011 to $810M by 2025. Specifically, the two gasoline consumption decline models forecast State receipts in 2025 to decline to the range of $393-475M. Federal receipts under two gasoline consumption decline models are also forecast to decrease 2012-2030. In fact, the baseline model has Federal receipts increasing by 50% by 2025, whereas the two gasoline consumption decline models have Federal receipts decreasing by at least 50% by 2025.

4. In FY 2010, 16.6% (one sixth) of ALDOT revenues were diverted by statutory obligations or bond payments:
   6.7% to Allocation of State Funds to Others
   9.9% to Allocation of Federal Funds to Cities/Counties (Federal Aid Apportionments + Garvee Bond Payments)

5. The Baseline forecast of ALDOT Total Receipts has them increasing from $1330M in 2011, to $1750M in 2020, $2046M in 2025, and $2379M in 2030. However, using the gasoline consumption decline models, Total Receipts will decline to a range of $957-1210M in 2020, $780-976M in 2025, and $624-747M in 2030. Again focusing on 2025, total receipts were forecast to be up 54% assuming gasoline consumption continues to increase, but are forecast to be down 33% if one takes average (not extreme) impacts of the CAFÉ Standards.

6. During 1997-2011, Federal Construction increased from 53% to 74% of Total Expenditures; State Construction dropped from 8% to 3% of Total Expenditures. If current trends continue 2012-2030, then State Construction will hit 1% in 2020 and Federal Construction 76.5%.

7. During 1997-2011, Construction Expenditures dominated Maintenance Expenditures 3-to-1. The past five years, 2007-2011, Construction Expenditures dominated Maintenance Expenditures 5-to-1, making up 75% and 15% of Total Expenditures, respectively.

8. In base-year1997 dollars, Total Expenditures increased 1.5% over inflation (2.3%), which explains the 3.8% overall annual growth rate in Total Expenditures. In 1997 base-year dollars, over the past eight years, Construction Expenditures have declined slightly and Maintenance Expenditures have increased slightly.

9. If 15-year trends continue 2012-2030, then Construction Expenditures are forecast to grow as a percent of Total Expenditures while Maintenance Expenditure percentage decreases, as follows:

Year	Construction as % Total Expenditures	Maintenance as % Total Expenditures
2012	76.25%	13.12%
2020	79.82%	11.97%
2030	81.18%	11.03%

10. Over the past six years, the unit costs quoted by ALDOT winning bidders for three construction materials have been increasing sharply:

Asphalt Concrete Pavement	5.25% annual increase in unit cost
Rebar	6.84% annual increase in unit cost
Aggregate Base	7.22% annual increase in unit cost.

These same materials have shown decreases in unit costs to TXDOT over these same years. In 2011, the unit cost of Asphalt Concrete Pavement was 18% higher in Alabama than Texas, the unit cost of rebar was 72% higher in Alabama than Texas ($1.22/lb vs. $.71/lb), and the unit cost of Aggregate Base was 83% higher in Alabama than Texas ($30.58/ton vs. $16.72/ton). However, Texas separates the cost of asphalt into aggregate and liquid, so the asphalt cost comparisons may be invalid.

11. We predict construction cost/mile to increase from $8.47M/mile in 2012 to $9.41M/mile in 2030, while we predict maintenance cost to remain stable at about $145,000/mile, averaged over all types of maintenance.

12. Resurfacing costs per mile have been on a linear trend, 1997-2011, growing at about $15,000/mile per year. Resurfacing with Widening is approximately 10 times as expensive per mile as resurfacing, and has been increasing as a proportion of Maintenance by 3.5% per year, reaching 36% in 2011. Resurfacing (only) has been decreasing as a proportion of maintenance at a rate of 3.5% per year, and stood at 56% in 2011.

13. As for Bridges Let, the cost per square foot has been increasing $4.11 per square foot per year, 1997-2011. Projecting this cost increase into the future, the $87.66/square foot cost in 2011 increases to $187.30/square foot in 2030, slightly more than doubling for an average annual escalation factor of 4.1%.

14. To let the same average total square footage of new bridges in 2012-2030 as the past 15 years (942,630) requires the New Bridge expenditure commitments to grow from $82.63M in 2012, to $137.81M in 2020, to $176.56M in 2030.

15. If bridges of current average size are let each year, using the forecast New Bridge Expenditures, we project a 50% reduction in bridge square footage or more likely, in number of bridges let, to compensate for the annual escalation in cost per square foot mentioned above.

16. Baseline Revenue shortfalls, based on subtracting forecast Baseline Total Expenditures from forecast Baseline Total Receipts, are forecast for FY 2012-2030 and include:

Year	Shortfall	Shortfall as Percent of Total Expenditures
2012	-$144.54M	-10.55%
2020	-$139.99M	-7.66%
2030	+ $52.34M*	+2.18%

*Cross-over point in FY 2029

17. Nine options to absorb these shortfalls with reduction in forecast expenditures were defined, and the impact on ALDOT operations is as follows:

Option 1: Across-the-board cuts in expenditures to match revenue shortfalls:

Year	Federal Construction	State Construction	Construction	Maintenance
2012	-$105.44M	-$4.60M	-$110.24M	-$20.50M
2020	- $97.74M	-$4.26M	-$102.19M	- $19.00M
2030	+ $38.18M	+$1.66M	+ $39.92M	+ $7.42M

Option 2: Federal Construction absorbs the shortfall:

Year	Federal Construction	Percent of Baseline Forecast
2012	-$144.54M	-12.95%
2020	-$139.99M	- 9.30%
2030	+$52.34M	+2.83%

Option 3: Zero State Construction, residual reduction in Federal Construction:

Year	Federal Construction	Percent of Baseline Forecast
2012	-$104.19M	-9.33%
2020	-$113.94M	- 7.91%
2030	+$52.34M	+2.83%

Option 4: Construction absorbs the shortfall:

Year	Construction	Percent of Baseline Forecast
2012	-$144.54M	-12.21%
2020	-$139.99M	- 8.91%
2030	+$52.34M	+2.75%

Option 5: Maintenance absorbs the shortfall:

Year	Maintenance	Percent of Baseline Forecast
2012	-$144.54M	-72.72%
2020	-$139.99M	- 59.44%
2030	+$52.34M	+20.23%

Option 6: Total Obligations are rescinded to absorb the shortfall:

Year	Total Obligations	Percent of Baseline Forecast
2012	-$144.54M	-67.13%
2020	-$139.99M	- 56.10%
2030	+$52.34M	+16.83%

Option 7: Bridge Construction Expenditures absorb the shortfall:

Year	Bridge Construction	Percent of Baseline Forecast
2012	-$144.54M	-12.95%
2020	-$139.99M	- 9.45%
2030	+$52.34M	+2.92%

Option 8: Zero Road Construction through 2023, residual reduction in Bridge Construction through 2023; Road construction can cover the declining shortfall starting 2024, and recovers during 2024-2028.

Year	Bridge Construction	Percent of Baseline Forecast
2012	-$76.62M	-6.87%
2020	-$47.71M	- 3.37%
2023	-$7.75M	-0.51%

Option 9: Zero Road Construction through 2023, residual reduction in Maintenance through 2023; Road construction can cover the declining shortfall starting 2024, and recovers during 2024-2028.

Year	Maintenance	Percent of Baseline Forecast
2012	-$76.62M	-38.55%
2020	-$47.71M	- 21.17%
2023	-$7.75M	+62.43%

18. In 2020, Total Expenditures under the 5, 15, and 25% Construction Expenditure increase alternatives would grow respectively from $1884M baseline to $1959M, $2110M, and $2260M; in 2030, Total Expenditures under these same three alternatives would grow respectively from $1904M baseline to $2440M, $2631M, and $2821M. In 2020, budget shortfalls under the 5, 15, and 25% Construction Expenditure increase alternatives would grow respectively from -$145M to -$209M, -$360M, and -$510M; in 2030, budget shortfalls under these same three alternatives would grow respectively form a surplus of $52M to deficits of -$43M, -$233M, and -$424M.

19. In the 2011 Report to Governor Bentley [3], the ALDOT Division Engineers identified $6B (in 2010 dollars) System Enhancement needs but with no fixed timetable. In annual Baseline Construction Expenditures, ALDOT can only afford around $150 million per year expenditure on SE-type projects, yet that budgeted amount should be taken into account when budgeting for the $6B SE need during 2011-2030. Hence, the increments we added to the baseline construction and total expenditure forecasts were $.45B/year over 10 years, $.25B/year over 15 years, and $0.15B over 20 years, with inflation assumed the same average annual amount (2.27%) for the next twenty years as the past fifteen years. What this means is that we assume exactly *one-half* of the $6B SE need, $3B, is *already included* in the twenty year baseline forecasts for Construction and Total Expenditures. The findings were that under the 10-year SE plan, the ALDOT baseline receipts are short between $488-545M annually for 2012-2020; under the 15-year SE plan, the ALDOT baseline receipts are short between $406-477 annually for 2012-2025; and under the 20-year SE plan, the ALDOT baseline receipts are short between $183-326M annually for 2012-2030.

20. CBER has generated ALDOT state, federal, and total revenue forecasts for two gasoline consumption decline scenarios, where the first set of forecasts is for “Best Case Gasoline Consumption Decline” meaning the smallest decline relative to Baseline, and the second set of forecasts is for “Worst Case Gasoline Consumption Decline” meaning the largest decline relative to baseline. Like the state and federal receipt forecasts, the two forecasts based on reduced gasoline consumption both return the total revenue levels in the late 2020s to the same level as the late 1990s. Of course, the gap is larger under Worst Case than Best Case Gasoline Consumption Decline, but the important point is that under either of these scenarios, the maximum ALDOT budget shortfall during 20120-2030 just to fund Baseline Expenditures is an order of magnitude larger ($1.5B vs. $150M) than it was under the Baseline Total Receipts forecast. Specifically, assuming best case gasoline consumption decline, to fund Baseline Expenditures over 2012-2030, a revenue source is needed which would generate additional annual funds to ALDOT of magnitude: $675M in FY2020, $1150M in FY 2025, and $1600M in FY 2030. Depending on

gasoline tax alone, the tax rate per gallon would have to increase by $0.27 in 2020, $0.53 in 2025, and $0.88 in 2030. Clearly, new sources of revenue would be needed.

21. In a final sensitivity study, we combined the reduced revenues due to gasoline consumption declines, as just described, with the stated ALDOT need to increase its Construction Expenditures by a substantial amount annually in order to meet System Enhancement needs. We have chosen a 10% increase in Construction Expenditures as a representative increase, which would amount to an increment in Baseline and Total Expenditures of around $120M in 2012, growing to $190M by 2030. Under either gasoline consumption decline, with this 10% construction expenditure increment, the ALDOT budget shortfall is around $1.3B in by 2025 and approaches $1.8B in 2030. Specifically, assuming best case gasoline consumption decline, to fund Total Expenditures resulting from a 10% annual Construction Expenditure increase over 2012-2030, a revenue source is needed which would generate additional annual funds to ALDOT of magnitude: $825M in FY2020, $1300M in FY 2025, and $1800M in FY 2030. Depending on gasoline tax alone, the tax rate per gallon would have to increase by $0.33 in 2020, $0.59 in 2025, and $0.99 in 2030. Clearly, new sources of revenue would be needed. The need for new sources of revenue is even more pressing under this scenario, which essentially covers the unfunded $3B part of the State's $6B SE needs.

22. One challenge in forecasting the demand for gasoline (and therefore the revenue from a gasoline tax) comes from the fact that gasoline tax revenue stopped increasing during 2004. We develop econometric models of gasoline tax revenue and miles driven using quarterly data for the period 1992:2 through 2006:4. We find that these models do a reasonably good job of forecasting revenue and miles driven for the period 2010:1-2012:2, but over estimate both during the period 2008-09. These models suggest that the sensitivity of the demand for gasoline to price increased during the recession. However, we find that a 1% increase in the price of gasoline at most causes only a 0.087% decrease in the quantity demanded, a value so low it might as well be zero for purposes of forecasting the additional tax revenue an increase in the gasoline tax would generate.

23. We found that better fuel economy it is not the major cause of essentially flat Alabama gasoline tax revenue since 2004; instead a reduction in the rate of growth in miles driven is the major cause of the reduced growth rate in gasoline tax revenue. Our analyses imply that when drivers in Alabama respond to an increase in the price of gasoline, they do so primarily by reducing that driving which yields better fuel economy. This means that drivers reduce their highway driving (such as vacation driving or shopping trips to a larger urban area) to a greater extent than their trips to and from work or their trips buying groceries and other everyday necessities. Miles driven and therefore tax revenues stopped growing after 2004 because wages per worker in the state have not grown appreciably since 2004.

24. We can use an estimate of the sensitivity of gasoline demand to price to estimate the effect of an increase in the gasoline tax on revenue earned. If the current price of gasoline (including all state and federal excise taxes) is about $3.50 per gallon, then a 3.5¢ increase in the state gasoline tax represents a 1% increase in price. Assuming that a 1% increase in price reduces the quantity demanded by only 0.045 percent, the resulting increase in total revenue will be about 0.99955 times total percentage increase in the gasoline tax (3.5/18) or 19.4%. The demand for gasoline is very inelastic. The estimated long-run income elasticitity of gasoline demand ranges from 0.37 to 0.39: For every 1% increase in total wages and salaries in Alabama, there is approximately a 0.38 percent increase in revenue from the gasoline tax.

25. For the sample period 1992:2-2006:4 we estimate that a 1% increase in wages and salaries per employee in the long run causes a 0.51% increase in miles driven, while there is only a 0.39% increase in revenue from the gasoline tax. Similarly, we estimate that a 1% increase in employment, given wages and salaries per employee, causes a 0.67% increase in miles driven and only a 0.19% increase in revenue from the gasoline tax.

26. Econometric forecasts show that by 2020, revenue from the gasoline tax will only have grown from $402 million in 2012 to about $416 million per year assuming that employment grows at a rate of 1.1% per year, using the point estimate of the employment elasticity of revenue. If we assume, that employment grows by 2% per year for the next 5 years and then reverts back to the 1.1% growth rate, then revenues in 2020 will be only $6 million higher.

27. Our econometric forecasts imply that there is very little chance of an economicially meaningful increase in revenues from the gasoline tax unless the tax is increased. Hence we created forecasts of revenue based on the assumption that there is 5¢ per gallon increase in the state gasoline tax beginning in October of 2013. This will raise an additional $110 million dollars per year initially, but increasing only to an extra $120 million by 2029. Elsewhere in this report it is pointed out that the use of a constant per gallon tax rate on gasoline has gradually been eroded by inflation. Indeed, the $402 million in revenue for fiscal year 2012 represents about the same revenue the state was collecting per year before the July 1992 5¢ per gallon increase in the gasoline tax. The benefit of that tax increase has been completely eroded by inflation.

28. One conclusion we can draw from estimating the econometric models of revenue collected and miles driven is that the revenue from the gasoline tax is not going to grow unless Alabama drivers increase their driving, and they will not do this until more Alabamians are working. Furthermore, the additional revenue from the July 1992

increase in gasoline taxes has been completely eroded by inflation and the real revenue earned from this tax is going to continue to decline unless the tax is increased and the new total tax is indexed to the price level. At this time it does not appear that better fuel economy is an important source of declining revenues from the gasoline tax, but that could change in the future as the forecasts incorporating phase-in of the CAFÉ standards seem to indicate.

29. The additional revenue earned from the 1992 increase in the gasoline tax has been completely eroded by inflation. If the tax is increased by only 5¢ per gallon beginning in October 2013, the additional revenue earned would be completely eroded away by 2029 if the rate of inflation in these future years equals current consensus forecasts.

3.0 Conclusions and Recommendations

This research used quantitative methods to document 15-year trends in various economic factors, from the very detailed (e.g., cost per ton for aggregate) to the very broad (total ALDOT annual receipts and expenditures), and for categories of receipts and expenditures as found in ALDOT annual reports [1]. Based on these trends and accepted statistical forecasting methods, forecasts are developed and presented in tabular and graphical form for the 19-year period 2012-2030, with particular interest in 2020 and 2030. Econometric methods were used on monthly and quarterly records of Alabama gasoline consumption 1992-2011 to identify causal variables, such as Alabama employment levels, income, and gasoline tax rate, and their elasticities. The overall objective of this research was to provide an unbiased analysis of the Department's ability to sustain its current program of maintenance and new construction, or to expand the construction expenditures to create transportation system enhancement. Where expenditure reductions could fund shortfalls in forecasted baseline budget, the impact (difficult trade-offs) of absorbing the shortfall in alternative ways has been quantified. Growth in demand for construction activity is analyzed as a factor affecting ALDOT's economic sustainability, as is the projected decline in gasoline consumption in the state. Both of these factors in ALDOT's future were shown to create huge shortfalls in total revenue that cannot be absorbed by cost cutting; an increase in the fuel tax rate, or new sources of revenue, are clearly needed to sustain ALDOT in the next nineteen years.

An Interim Report was delivered at the end of October 2012, representing a concerted effort during the months of September and October 2012 to capture data from ALDOT Annual Reports and other sources, conduct a variety of trend analyses and forecasts, and present preliminary results in a timely manner to ALDOT administrators. During November and December 2012, the research team developed forecasts for gasoline consumption 2012-2030, assessed the impact of those forecasts on ALDOT revenues, and forecast revenue shortfalls under various scenarios of gasoline tax decline combined with baseline or enhanced construction expenditures. Also during November and December 2012, econometric methods were employed to estimate the sensitivities (or elasticities) of Alabama gasoline consumption with respect to appropriate economic variables for the period from mid-1993 to mid-2012.

Conclusions and recommendations of this research include:

- The slow increase in vehicle miles traveled (vmt) in Alabama over the period 2012-2030 will not offset the rapid decline in gallons per mile brought on by the U.S. CAFÉ Standards, and gasoline consumption is forecast to decline from the 2011 level of 2.584 billion gallons by 8% in 2020, and by 33% in 2030.
- State receipts under two gasoline consumption decline models are forecast to decrease 2012-2030, in stark contrast to the baseline forecast which shows an increase from

$514M in 2011 to $810M by 2025. Specifically, the two gasoline consumption decline models forecast State receipts in 2025 to decline to the range of $393-475M.

- The Baseline forecast of ALDOT Total Receipts has them increasing from $1330M in 2011, to $1750M in 2020, $2046M in 2025, and $2379M in 2030. However, using the gasoline consumption decline models, Total Receipts will decline from $1330M to a range of $957-1210M in 2020, $780-976M in 2025, and $624-747M in 2030.
- Over the past six years, the average unit costs quoted by ALDOT winning bidders for three construction materials have been increasing sharply: Asphalt Concrete Pavement, 5.25% annual increase in unit cost; Rebar, 6.84% annual increase in unit cost; Aggregate Base, 7.22% annual increase in unit cost. These same materials have shown decreases in unit costs to TXDOT over these same years, although Texas separates the cost of asphalt into aggregate and liquid, so those cost comparisons may be invalid.
- As for Bridges Let, the cost per square foot has been increasing $4.11 per square foot per year from 1997 to 2011. Projecting this cost increase into the future, the $87.66/square foot cost in 2011 increases to $187.30/square foot in 2030, slightly more than doubling for an average annual escalation factor of 4.1%. To let the same average total square footage of new bridges in 2012-2030 as the past 15 years (942,630 sq.ft.) requires the New Bridge expenditure commitments to grow from $82.63M in 2012, to $137.81M in 2020, to $176.56M in 2030.
- Baseline Revenue shortfalls, based on subtracting forecast Baseline Total Expenditures from forecast Baseline Total Receipts, are forecast for FY 2012-2030 and include:

Year	Shortfall	Shortfall as Percent of Total Expenditures	
2012	-$144.54M	-10.55%	
2020	-$139.99M	-7.66%	
2030	+ $52.34M*	+2.18%	*Cross-over point in FY 2029.

- Sensitivity study found that: in 2020, Total Expenditures under the 5, 15, and 25% Construction Expenditure increase alternatives would grow respectively from $1884M baseline to $1959M, $2110M, and $2260M; in 2030, Total Expenditures under these same three alternatives would grow respectively from $1904M baseline to $2440M, $2631M, and $2821M. In 2020, budget shortfalls under the 5, 15, and 25% Construction Expenditure increase alternatives are forecast to grow respectively from -$145M to -$209M, -$360M, and -$510M; in 2030, budget shortfalls under these same three alternatives would grow respectively form a baseline surplus of $52M to deficits of -$43M, -$233M, and -$424M.
- Under either of these two gasoline consumption decline scenarios, the maximum ALDOT budget shortfall during 2012-2030 just to fund Baseline Expenditures is an order of magnitude larger ($1.5B vs. $150M) than it was under the Baseline Total Receipts forecast. Clearly, new sources of revenue would be needed.
- In a final sensitivity study, we combined the reduced revenues due to gasoline consumption declines with the stated ALDOT need to increase its Construction

Expenditures by a substantial amount annually in order to meet System Enhancement (SE) needs. We have chosen a 10% increase in Construction Expenditures as a representative increase, which would amount to an increment in Baseline and Total Expenditures of around $120M in 2012, growing to $190M by 2030. Under either gasoline consumption decline, with this 10% construction expenditure increment, the ALDOT budget shortfall is around $1.3B in by 2025 and approaches $1.8B in 2030. The need for new sources of revenue is even more pressing under this scenario, which moderately funds SE needs.

- Econometric analysis showed: in the long run a 1% increase in the price of gasoline causes anywhere from a 0.045 to 0.087 percent decrease in the amount of gasoline purchased; that is, the demand for gasoline is very inelastic, and is so insensitive to price that one can assume there is no change in quantity demanded when taxes are raised. Also, for every 1% increase in total wages and salaries in Alabama, there is approximately a 0.38 percent increase in revenue from the gasoline tax.
- Econometric forecasts show that by 2020, revenue from the gasoline tax will only have grown from $402 million in 2012 to about $416 million per year assuming that employment grows at a rate of 1.1% per year, using the point estimate of the employment elasticity of revenue. If we assume, that employment grows by 2% per year for the next 5 years and then reverts back to the 1.1% growth rate, then revenues in 2020 will be only $6 million higher.
- Our econometric forecasts imply that there is very little chance of an economicially meaningful increase in revenues from the gasoline tax unless the tax is increased. Therein, we created forecasts of revenue based on the assumption that there is 5¢ per gallon increase in the state gasoline tax beginning in October of 2013. This will raise an additional $110 million dollars per year initially, but increasing only to an extra $120 million by 2029.
- The additional revenue earned from the 1992 increase in the gasoline tax has been completely eroded by inflation. If the tax is increased by only 5¢ per gallon beginning in October 2013, the additional revenue earned would be completely eroded away by 2029 if the rate of inflation in these future years equals current consensus forecasts.

Specific recommendations to ALDOT are:

- Use cost-cutting in FY 2013 to buy time to convincingly demonstrate to the Governor, State Legislators, and Public that a new gasoline tax rate and/or new revenue sources are needed to fund transportation infrastructure:
    - Action is needed soon because gasoline receipts are forecast to decline at an accelerated pace
    - It may help to show ALDOT constituencies that ALDOT has explored all avenues to reduce costs or improve productivity, such as in Minnesota, and are implementing these activities.

- Investigate strategies used in other state DOTs, such as Texas, to achieve lower unit costs for construction materials used in state transportation projects.

- To fund Baseline Expenditures (continue the status quo), over 2012-2030, ALDOT needs a revenue source that generates additional annual funds to ALDOT of magnitude:
  - $675M in FY 2020
  - $1150M in FY 2025
  - $1600M in FY 2030.
- If such an increase was funded by gasoline taxes alone, a steadily increasing gasoline tax rate ($.45/gal in 2020, $.71/gal in 2025, $1.06/gal in 2030) would be required and is probably not realistic—other new revenue sources would be needed .
- Gasoline consumption is very insensitive to price, however increases in a range of $0.27/gal to $.88/gal if price was $4/gal would reduce consumption by 0.44% to 1.43%, respectively, and should be considered.
- To fund either a 10% increase in baseline Construction Expenditures, or equivalently the unfunded $3B part of ALDOT's $6B System Enhancement needs, over 2011-2030 ALDOT needs a revenue source that generates additional annual funds to ALDOT of magnitude:
  - $825M in FY 2020
  - $1300M in FY 2025
  - $1800M in FY 2030.
- If such an increase was funded by gasoline taxes alone, a steadily increasing gasoline tax rate ($.51/gal in 2020, $.77/gal in 2025, $1.17/gal in 2030) would be required and is probably not realistic—other new revenue sources would be needed.
- Gasoline consumption is very insensitive to price; however, increases in a range of $0.33/gal to $.99/gal if price was $4/gal would reduce consumption by 0.53% to 1.61%, respectively, and should be considered.
- ALDOT cannot depend on employment or income growth in Alabama to generate gasoline tax revenue increases outside a range of $2M-$20M/year.

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