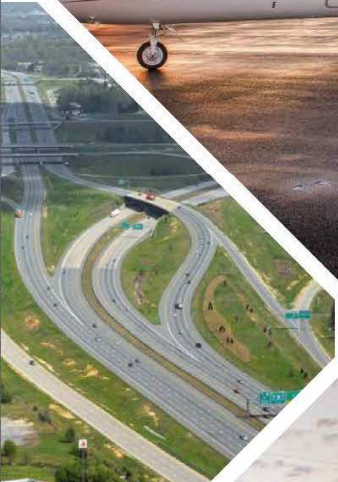
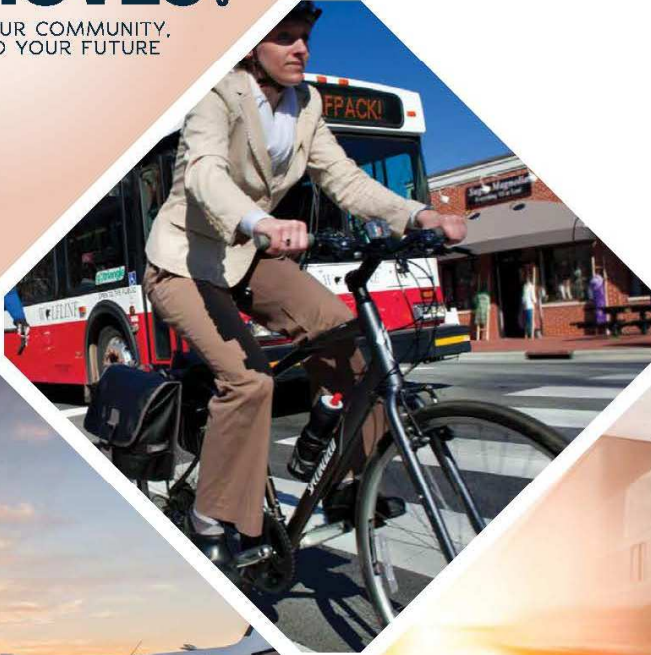




# NC MOVES 2050

CONNECTING YOUR COMMUNITY,  
YOUR VOICE AND YOUR FUTURE



## NC MOVES 2050 REVENUE FORECAST Technical Memo 2 May 2020

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# 1. INTRODUCTION AND OVERVIEW

## 1.1 INTRODUCTION

To advance NC Moves 2050 the North Carolina Department of Transportation (NCDOT) developed an approach to forecast future transportation revenue to compare to the short- and long-term transportation needs assessment. The approach included creation of a spread-based tool sensitive to revenue potential based on economic and transportation industry changes. The tool met the following objectives:

- Project NCDOTs’ existing funding sources over the 2050 Plan period considering economic, demographic, and policy factors that may influence the Department’s current revenue sources. This would constitute a “baseline” forecast.
- Assess the extent of future funding available from existing revenue relative to the alternative futures and forecasted transportation needs developed in NC Moves 2050. Define the funding gaps between projected revenues and needs.
- Define and forecast alternative revenue options to close identified gaps. Evaluate continued motor fuel tax rate indexing and increases for existing funding sources and for the distribution of funds between other NCDOT programs.
- Consider the impacts of potential revenue available through new sources based on projected economic, demographic and other travel variables and influences. Develop a feature within the spreadsheet-based tool which can model new revenue sources as they are considered or recommended.

## 1.2 APPROACH

The approach developed a baseline revenue forecast to 2030 and 2050 to compare to forecasted multimodal transportation needs. It was presented to NCDOT in late 2019 and the analysis was completed prior to COVID-19 impacts on resulting short term transportation revenue. The 2030 baseline forecast grew the three major sources of state funds and federal aid expected over the next decade based on population growth, vehicle ownership, fuel consumption and vehicle registration. The 2030 baseline forecast was independently compared to NCDOT’s Cash Model and the 10-year assumptions correlated closely with underlying and incremental year over year changes associated with the Cash Model. For example, NC Department of Motor Vehicles (NCDMV) fees were assumed to increase every 4 years tied with inflation (Consumer Price Index) and vehicle ownership rates. The federal aid forecast was assumed to grow more conservatively given the continued trend of shorter reauthorization cycles and rescissions by Congress.

Nearly \$60B in revenue is forecasted by 2030 which tracks closely to recent NCDOT's projections. However, the forecast was discounted to 2018 dollars and reviewed for appropriate comparison to capital, operations, and asset management assumptions in the 2030 transportation needs forecast. The analysis was constrained further by subtracting revenues assumed for administration, debt services, transfers, etc. The result was a forecast of approximately \$29B.

The baseline (also referred to as "trend") forecast to 2050 introduced more uncertainty into the overall assumptions. Year over year changes to state and federal sources were extended over a longer planning period. A series of additional assumptions about the timing and impact of industry changes on revenue were assumed, including:

- Conservative approach to the transition and penetration rate of electric and driverless vehicle levels – this would occur more quickly in urban areas but grow more slowly in rural areas and statewide.
- Engine technology, cleaner burning fuel, and electric vehicle (EV) ownership begins to flatten and ultimately decline revenues generated from NC's Motor Fuel Tax in the latter part of the planning period.
- Size of the federal program and funding remains constant shifting the burden to state and local governments to fund more of their transportation needs.
- Shift to more non-highway travel as technology creates more convenient multimodal options which subsequently impact Motor Fuel Tax and Highway Use Tax.
- Decline in commercial vehicle fuel consumption as the industry adopts electric and mixed fleet and more freight is dispersed across other modes and technologies (Hyperloop, drones, etc.).

The data, assumptions and projections supporting both forecasts are built to explore the sensitivity of revenue change based on "what if" scenarios and futures. In particular, the 2050 revenue analysis was linked to assumptions about alternative futures introduced in NC Moves 2050 development - Trend, Innovative, Globally Connected, Renewed, Unstable. Each future focuses on a set of conditions (such as widespread technology in the Innovative future) but also assume a degree of overlapping demographic, economic, development and other underlying forces. From a revenue forecast perspective, this approach provided insight into the relationships and correlation between variables that drive transportation demand and impact NC's economy. For example, a decline in vehicle ownership and freight Vehicle Miles Traveled could have a corresponding impact on NC's gross domestic product. Based on the level of sensitivity and correlation, different revenue pictures of the future emerge.

The analysis also explored what the average state fleet size and standard miles per gallon efficiency might have on revenue projections – such assumptions were especially appropriate for the Innovative future scenario. The approach led to developing high and low ranges by alternative future similar to

the process to estimate multimodal transportation needs to develop NC Moves 2050. More information regarding those estimates can be found in the plan's first technical memorandum which describes the needs forecast approach.

## 1.3 MODEL OVERVIEW

The North Carolina State Transportation Revenue Estimation and Evaluation Tool (STREET) is an Excel-based model built on user-based inputs and components maintained in worksheet tabs. Key component attributes of the model are described in Section 3 and include:

- Separate modules which incorporate user-based assumptions to forecast specific sources of transportation revenue.
- Adjustable, revenue streams based on statistical relationships between economic, demographic, and technical factors.
- Baseline forecast calibrated with FY2019-20 to FY2028-29 Office of State Budget and Management and NCDOT consensus 10-year forecast.
- Models NC Moves 2050 alternative futures and other user-defined scenario impacts on agency revenues.

STREET forecasts revenues for the following NC sources:

- Motor fuel taxes
- NCDMV license and registration fees
- Highway Use Tax
- Federal contributions
- Miscellaneous fees and income

Numerous economic, demographic, technical and societal data and their statistical relationships to NCDOT revenues were explored as potential model inputs. The factors with the most statistically robust relationships to revenue were selected, such as taxable gallons and type of motor fuel used and the number and type of vehicles operated. Other input factors were screened based on their broad and credible use in the industry, specifically by governmental agencies and research firms. The model is modular which means that new revenue sources can be readily incorporated into the forecast.

The economic and demographic inputs that drive the NCDOT revenue forecast include:

- Real state Gross Domestic Product and forecast rates of change in the Real Gross Domestic Product.
- State population and forecast change in population.
- Forecasted rates of inflation.

- Number of light and heavy vehicles and forecast change in their numbers.
- Forecasted light and heavy vehicle fuel efficiency.
- Projected Vehicle Miles Traveled.
- Adoption rates for electric vehicles.

The short- and long-term forecast assumes that current trends, tax and fee rates, and allocation of revenues are maintained over the forecast period. A range of revenue forecasts provide a comparison to the long-term baseline forecast. These ranges were established through the influence of NC Moves 2050 alternative futures which provide differing transportation visions and impacts in NC. STREET automatically adjusts the input factors to simulate future conditions and render new revenue forecasts. Similarly, STREET users can manually adjust the inputs to create revenue forecasts tailored to other specific future scenarios.

## **2. NORTH CAROLINA DEPARTMENT OF TRANSPORTATION REVENUES**

North Carolina has a large and diverse transportation system consisting of all modes of transportation, including highways, rail, aviation, ferries, public transit and bicycle and pedestrian transportation. With an annual operating budget of about \$5 billion, NCDOT is primarily responsible for building and maintaining the highway network and overseeing the NCDMV. NCDOT also plays a pivotal role in providing state funds to support non-highway modes such as operating assistance for passenger rail, operating assistance and improvements to transit systems, grants for bicycle improvements, aid to local governments for sidewalks, oversight of ferries, and support of general aviation development.

As illustrated in Figure 2.1, NCDOT funding comprises approximately 75 percent state revenues and 25 percent federal revenues.

Approximately 54 percent of state revenues are derived from motor fuel tax. The tax is adjusted at the beginning of each year based on a statutory formula that takes into consideration population and energy cost inflation. NCDMV fees represent 25 percent of state revenues and consist of various fees that the NCDMV collects from licensed drivers and through vehicle registrations. The Highway Use Tax on vehicle title transfers is approximately 21 percent of state revenues. The NC General Assembly set the

Highway Use Tax at 3 percent of a motor vehicle's net retail value (after trade-in allowance) when a certificate of title is issued in North Carolina.

Federal transportation funding appropriated by the U.S. Congress, comes from a federal motor fuel tax and vehicle fees (mostly on trucks) and accounts for approximately 25 percent of NCDOT's overall budget and about 50 percent of its construction budget.

## 2.1 MOTOR FUEL TAX

More than half of the state revenue for NCDOT comes from the motor fuel tax. This is based on gallonage of fuel purchased/consumed and taxed at a rate that changes at the beginning of each year based on a statutory formula. Effective January 1, 2017, the motor fuels tax rate was set at a flat rate of 34 cents per gallon multiplied by a percentage. The percentage is based on the annual change in state population and the annual change in the Consumer Price Index for Energy (CPI-E).

Of the motor fuel tax, 71 percent goes to the Highway Fund<sup>1</sup> and 29 percent goes to the Highway Trust Fund<sup>2</sup>.

## 2.2 NCDMV FEES

Accounting for a quarter of state revenues, NCDMV fees are distributed to the Highway Fund (approximately 85 percent) and the Highway Trust Fund (approximately 15 percent) and are derived from the following sources:

<sup>1</sup> The Highway Fund primarily supports projects that help take care of the state's existing transportation system. This includes resurfacing highways, replacing bridges and paving unpaved secondary roads. Funds are distributed across North Carolina based on need. The Highway Fund also supports the Powell Bill Program, which provides state aid to municipalities for pedestrian, bicycle and road improvements.

<sup>2</sup> A special account, designated the North Carolina Highway Trust Fund, was created within the State treasury. The Trust Fund consists of the following revenue: motor fuel, alternative fuel, and road tax revenue deposited in the Fund under G.S. 105-449.125, 105-449.134, and 105-449.43, respectively.

# Funding Sources and Allocation

NCDOT has an annual budget of about \$5 billion to build, operate and maintain the state's diverse transportation network.

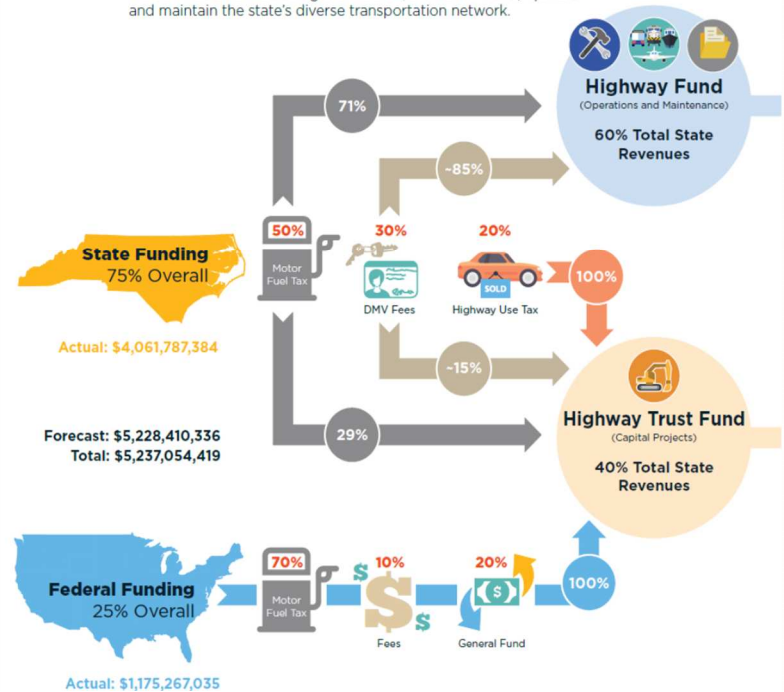


Figure 2.1 NCDOT Funding and Allocation FY2018  
Source: NCDOT

- Issuance of regular, commercial and provisional licenses and permits (Highway Fund)
- Title & Registration Fees:
  - Staggered Registrations (Highway Fund)
  - International Registration Plan (Highway Fund)
  - Other Licenses and Fees (Highway Fund)
  - Certificate of Title Fees (Highway Trust Fund)
  - Miscellaneous Title Fees (Highway Trust Fund)
  - Lien Recording (Highway Trust Fund)

The N.C. General Assembly sets the various fees that the NCDMV collects. Most fees are adjusted quadrennially based on inflation. The first quadrennial adjustment takes effect July 2020 and every 4 years thereafter.

### **2.3 HIGHWAY USE TAX ON VEHICLE TITLE TRANSFERS**

North Carolina collects the Highway Use Tax on vehicles whenever a title is transferred. Revenue from the Highway Use Tax goes to the Highway Trust Fund and the General Fund and is earmarked for road improvements. The tax is three percent of the vehicle sale transaction net of trade-in assessed at the time of title transfer, subject to a maximum of \$2,000 for commercial vehicles and \$250 for vehicles purchased outside of North Carolina.<sup>3</sup>

### **2.4 FEDERAL FUNDING**

NCDOT forecasts federal funding at \$1.289 billion per year through FY 2029. At the time of model creation, a zero percent growth rate is assumed through 2050, per NCDOT recommendation.

### **2.5 MISCELLANEOUS REVENUE SOURCES**

These revenue sources are relatively small compared to the overall NCDOT budget but are included in the model to provide a complete capture of revenues:

- Gasoline Inspection Fee
- Highway Usage Registration
- Jet Fuel Sales
- Highway Use Tax Lease
- Interest and investment income

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<sup>3</sup> <https://www.ncdot.gov/dmv/title-registration/taxes/Pages/default.aspx>



### 3. STREET MODEL COMPONENTS

#### 3.1 MOTOR FUEL TAX

Regression analysis was used to determine the statistical relationship between change in North Carolina real (inflation-adjusted) Goss Domestic Product and change in taxable motor fuel gallonage in the state. Using forecast rates of change for the Gross Domestic Product <sup>4</sup>, the gallons of motor fuel was calculated in response to change in state real Gross Domestic Product (or VMT).<sup>5</sup> The raw gallonage is split into gasoline and diesel forecasts based on trend then adjusted by:

- Projections of light and heavy vehicle fuel efficiency increases
- Projections of Electric Vehicle adoption rates
- Growth or decline in vehicle fleet size

The adjusted gallonage is multiplied by the motor fuel tax rate to provide the motor fuel tax revenue. Figure 3.1 provides an overview of the process for forecasting motor fuel tax revenues.

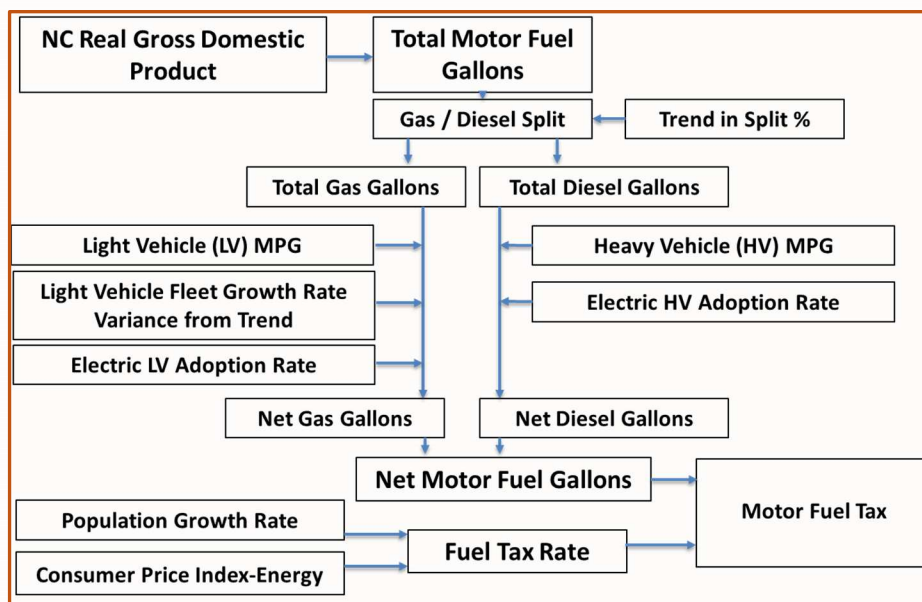


Figure 3.1 Estimation of Motor Fuel Tax

#### TOTAL MOTOR FUEL GALLONS

Calculating total motor fuel gallons occurs in the model component “GROSS MotorFuel.” The regression intercept value is added to real Goss Domestic Product multiplied by the regression slope

<sup>4</sup> The Regional Economic Model Inc. (REMI) provided a national estimate of Gross Domestic Product growth. Historically, North Carolina Gross Domestic Product has consistently been approximately 2.7 percent of national Gross Domestic Product, therefore forecast growth rates in national Gross Domestic Product are used for the state.

<sup>5</sup> Real Gross Domestic Product for the state and Vehicle Miles Traveled historically have a correlation of .99+, or nearly perfect correlation.

and yields the forecasted gallonage. The value is reduced by four percent to account for historic levels of motor fuel refunds. This is done for each year out to 2050.

This value is linked to the component “Est MotorFuel Tax (HF & HTF)” where adjustments to the gallonage is made and the motor fuel tax is calculated.

### GAS /DIESEL SPLIT

NCDOT’s trending historical data on motor fuel collections provides a baseline split of total motor fuels between the two primary components of motor fuel. This is done to treat adjustments to gasoline and diesel gallons separately as the consumers of each type of fuel are significantly different. Light vehicles are assumed to be fueled by gasoline, while heavy commercial vehicles are fueled by diesel. The initial split is approximately 80-20 percent, changing to 76-24 percent gas-diesel by 2050. The split occurs in the “Est MotorFuel Tax (HF & HTF)” component.

### ADJUSTMENTS TO GASOLINE VOLUME

Three adjustments are made to the forecasted gallons of gasoline consumed. These include improvements in light vehicle fuel economy, changes in the light vehicle fleet size, and the rate of electric vehicle adoption.

The starting point for these adjustments is a trend forecast of the total light vehicle fleet for North Carolina based on historical vehicle data, new car sales rates<sup>6</sup> and an average service life of 12 years. This trend forecast is developed in component “LV\_EVS\_Est Rates” which provides baseline growth rates and fleet size that is used in the same component to calculate the percent of fleet that is electric, based on user defined electric vehicle adoption rates. The growth rates of the light vehicle fleet are also adjustable by the user but are guided by published estimates.<sup>7</sup>

The trend forecast also informs the component “LVFuelEffADJ” which uses the fleet size and growth rates with fuel efficiency values weighted by average age of the light vehicles in the fleet. The source for the light vehicle fuel efficiency was the US Bureau of Transportation Statistics.<sup>8</sup>

The components “LV\_EVS\_Est Rates” and “LVFuelEffADJ” link to “Est MotorFuel Tax (HF & HTF)” as the variables:

- Light Vehicle Fleet Reductions in Gallons
- Light Vehicle/Electric Vehicle Adjustment Gallons

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<sup>6</sup> <https://www.statista.com/statistics/605157/projected-car-sales-in-united-states/>

<sup>7</sup> Sources include: the U.S. Energy Innovation Agency : [https://www.eia.gov/conference/2017/pdf/presentations/melissssa\\_lynes.pdf](https://www.eia.gov/conference/2017/pdf/presentations/melissssa_lynes.pdf); or Bloomberg : <https://about.bnef.com/electric-vehicle-outlook/>

<sup>8</sup> Average Fuel Efficiency of U.S. Light Duty Vehicles : <https://www.bts.gov/content/average-fuel-efficiency-us-light-duty-vehicles>

- Light Vehicle Fuel Efficiency Adjustment Gallons

These variables adjust the volume of gasoline to be taxed. The fuel efficiency gains are associated with those non-electric vehicles.

The result of the adjustments are net taxable gas volumes.

### ADJUSTMENTS TO DIESEL VOLUME

The base diesel volume is the total taxable volume, less the unadjusted gasoline volume. From these, values are deducted to adjust for fuel efficiency and adoption of electric heavy vehicles. These adjustments are calculated based on the user defined inputs:

- Heavy vehicle annual percent increase in gleet MPG
- Annual increase in electric commercial vehicles

A base assumption for fuel efficiency is a 0.2 percent annual increase in miles per gallon. This is based on historical fuel efficiency for heavy vehicles.<sup>9</sup>

Zero annual increase in electric commercial vehicles is assumed as a default. A change in this variable is reflected in the component “Electric CVs”.

Both variables are linked to the component “Est MotorFuel Tax (HF & HTF)” adjusting the taxable diesel fuel value.

The result of the adjustments is net taxable special fuels (diesel) volumes.

### NET MOTOR FUEL GALLONS

The net taxable gallons are the combined net taxable gas and special fuels (diesel) volumes.

### FUEL TAX RATE

The motor fuel tax rate is calculated annually based on 75-25 NCDOT formula using forecast population change and “CPI-E” (inflation) rates as shown below.

$$\text{Rate}_x = \text{Rate}_{x-1} \times \frac{75\% (\text{Population Change}_{x \text{ and } x-1})}{25\% (\text{Change CPI-E}_{x \text{ and } x-1})}$$

Given that the tax rate is dynamic, the model forecasts what the rates will be based on estimated population growth and Personal Consumption Expenditures Price Index which is strongly influenced by energy prices.<sup>10</sup> This Index, like the growth in Gross Domestic Product were obtained from the REMI national model and was considered a suitable proxy for the CPI-E for the purpose of forecasting fuel tax rates.

<sup>9</sup> Table VM1 - Vehicle miles of travel and related data, by highway category and vehicle type. <https://www.fhwa.dot.gov/policyinformation/statistics/>

<sup>10</sup> Regional Economic Models Inc. (REMI) model provided a national estimate of PCE to 2050.

The forecast of fuel tax rates is developed in the component “MotorFuelRate” and the rates linked to component “Est MotorFuel Tax (HF & HTF)”. This is multiplied by the variable “MF Gallons Adj. with REFUND” to calculate the motor fuel tax. The tax is then allocated to the Highway Fund and Highway Trust Fund using the NCDOT allocation split 71-29%, respectively.

### 3.2 NCDMV FEES

The level of NCDMV licenses and fees are forecast based on ratios of average annual change in population to average annual change in individual licenses and fees for those years in which an inflationary adjustment is not made. The percent annual growth in the individual fees is the forecast percent population change multiplied by the ratios. An inflation adjustment to fees every 4 years is also applied, except to International Registration Plan fees on commercial motor vehicles. Population change as a driving factor in the forecast of NCDMV fees is an accepted practice within NCDOT.

The NCDMV registration fees are modified by changes in vehicle fleet size. Figure 3.2 provides an overview of the process for forecasting NCDMV fees.

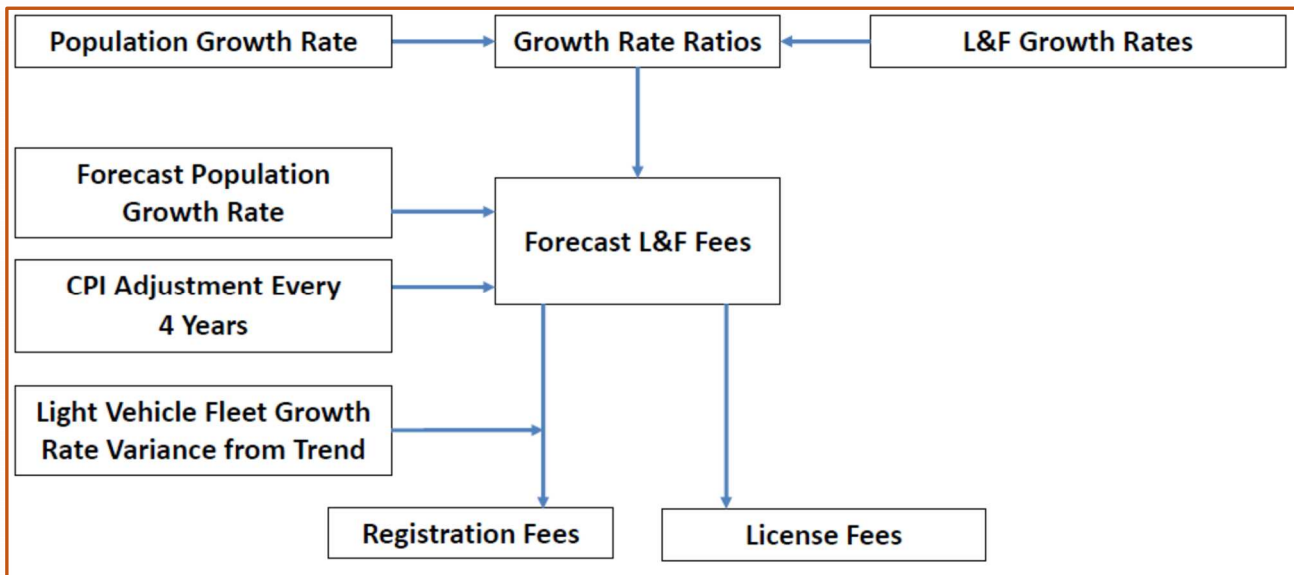


Figure 3.2 Estimation of NCDMV Licenses and Fees

#### GROWTH RATIOS

The ratios of license and fee growth change to population change are calculated in component “Growth-Licenses and Fees (HF)”. The rates of change for the fees are applied to all future years plus every four years the fees are adjusted for inflation.

## MODIFYING REGISTRATION FEES

The trend forecast for fleet size growth developed in component “LV\_EVS\_Est Rates” (described in section 3.1) is the basis for adjusting registration fees. The adjustment is based on the percent deviation in fleet growth rate from the trend forecast and is used to increase or reduce the registration fees. Deviations from the trend are based on user defined growth rates entered through selection of a future scenario (component “Scenario Selection”) or direct input to variable “Annual % Growth in Light Vehicle Fleet” in component “User Inputs”.

The adjustment is calculated in the component “Est Licenses and Fees (HF)”.

## REGISTRATION AND LICENSE FEES

The growth rates developed in component “Growth-Licenses and Fees (HF)” are linked to component “Est Licenses and Fees (HF)” where they are applied to the base values to forecast revenues. It is in this component that adjustments to registration fees is made as well.

## OTHER FEES (HIGHWAY TRUST FUND)

Other fees that are considered are Certificate of Title Fees, Miscellaneous Title Fees, and Lien Recording Fees. The growth rate of the Highway Use Tax, discussed in section 3.3, is used to escalate these fees, plus every four years the fees are adjusted for inflation. The percent annual increases are calculated in the component “Growth-HTF Fees” which obtains the Highway Trust Fund growth rates from component “Est Highway Use Tax”. The component “Growth-HTF Fees” annual increase with inflation adjustment is linked to component “Est Fees (HTF)” and applied to base values to calculate future revenues.

### 3.3 HIGHWAY USE TAX ON VEHICLE TITLE TRANSFERS

As described in section 2.3, the tax is a percentage of the vehicle sale transaction net of trade-in assessed at time of title transfer, subject to a maximum amount depending on the vehicle type and point of purchase. Rather than attempt to forecast the Highway Use Tax based on a number of assumptions regarding vehicle values, in-out of state purchase, types and amounts of vehicle transfers, the research shows that a very close approximation to the NCDOT forecast values out to FY 2028-2029 is made by increasing the Highway Use Tax by the change in population multiplied by the ratio of light vehicles to population for the given year, based on trend in population and the light vehicle fleet size. The ratio of population to light vehicle fleet size is found in the component “Econ” which contains base economic and demographic data for the model.

The Highway Use Tax is then modified by changes in light vehicle fleet size. Figure 3.3 provides an overview of the process for forecasting the Highway Use Tax.

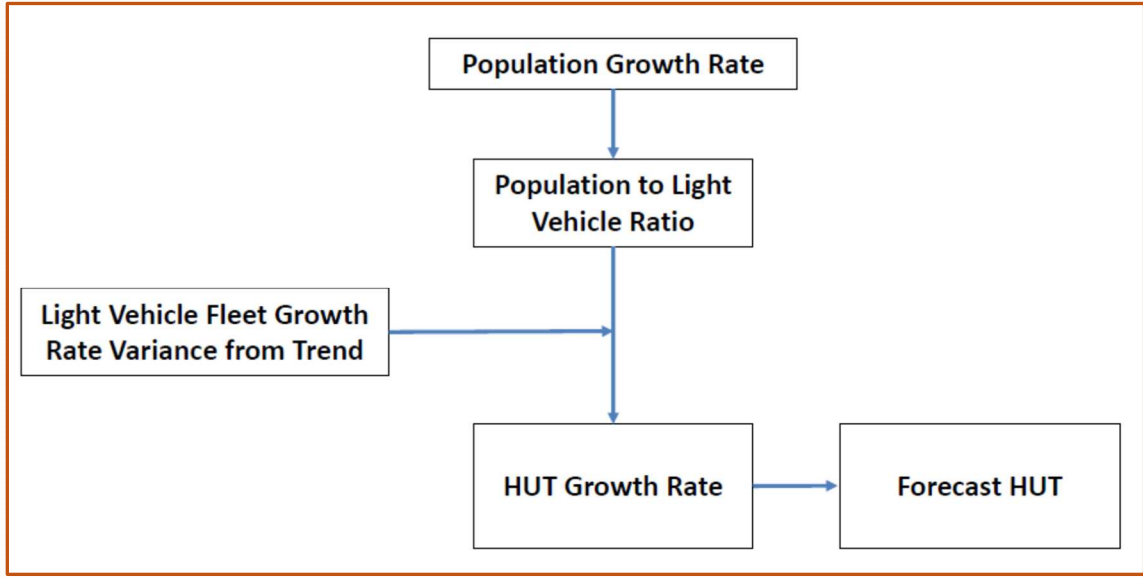


Figure 3.3 Estimation of NCDMV Licenses and Fees

#### MODIFYING THE HIGHWAY USE TAX

The trend forecast for fleet size growth developed in component “LV\_EVS\_Est Rates” is the basis for adjusting the Highway Use Tax. As with the modifications to the registration fees, the adjustment is based on the percent deviation in fleet growth rate from the trend forecast and is used to increase or reduce the Highway Use Tax.

The component “Est Highway Use Tax” makes the fleet size adjustment and calculates the Highway Use Tax.

### 3.4 FEDERAL REVENUE SOURCES

As discussed previously, federal revenues are held constant at \$1.289 billion per year over the forecast horizon. This assumption can be adjusted in the “User Inputs” component along with the annual percent change in Federal funding from zero to a new growth rate.

### 3.5 MISCELLANEOUS REVENUE SOURCES

The Miscellaneous Revenue Sources are either calculated within the model based on a relationship to other factors or are adjustable through user inputs like the Federal Funding. These include:

- Gasoline Inspection Fee – 1% of Highway Fund Motor Fuel Tax
- Highway Usage Registration –0.026% of Highway Fund Motor Fuel Tax
- Jet Fuel Sales –approximately \$7 million per year, growth rates adjustable
- Highway Use Tax Lease – \$10 million flat rate per year, adjustable
- Interest and investment income –approximately \$5 million per year, adjustable

## 4. BASE (TREND) FORECAST AND VALIDATION

### 4.1 BASELINE ASSUMPTIONS

Using the base assumptions and trends discussed in the previous sections, a forecast was developed. Table 4-1 presents the baseline model input assumptions.<sup>11</sup>

**Table 4-1. Input Assumptions for Baseline Forecast**

Input Variable	Base Forecast Annual Amounts or % Changes FY20-21 to FY49-50	Revenues Impacted
Real Gross Domestic Product Change	1.6% - 1.8%	Motor Fuel Tax
CPI-E (Used as a proxy for CPI)	2.1% - 2.0%	NCDMV Fees
Population Growth	1.1% - 0.8%	NCDMV Fees
Light Vehicle Annual Increase in Fleet MPG	1.0% - 0.8%	Motor Fuel Tax NCDMV Fees Highway Use Tax
Heavy Vehicle Annual Increase in Fleet MPG	0.2% - 0.2%	Motor Fuel Tax
Annual Growth in Light Vehicle Fleet	0.6% - 0.5%	Motor Fuel Tax NCDMV Fees Highway Use Tax
Growth in Sales of Electric Light Vehicles	0.0% - 6.2%	Motor Fuel Tax
Annual Increase in Electric Commercial Vehicles	0.00%	Motor Fuel Tax
Jet Fuel Sales (Trend)	3.2% - 1.9%	Misc. Motor Fuel Taxes
Vehicle Miles Traveled	0.8% - 0.8%	Motor Fuel Tax
Total Interest (Trend)	1.9% - 1.3%	Interest and Investment Income
HTF- Investment Income	\$ 2,000,000 (Fixed)	Interest and Investment Income
HF - Investment Income	\$ 1,000,000 (Fixed)	Interest and Investment Income
Federal Funding Growth	0.0% - 0.0%	Federal Funding

<sup>11</sup> This model forecasts nominal values. These values can be used outside of the model framework, with appropriate discounting to create benefit-cost analyses or alignment of future program costs versus revenues to support them.



## 4.2 BASE (TREND) REVENUE FORECAST AND VALIDATION

### TREND FORECAST

Table 4-2 and Table 4-3 present the Trend Revenue Forecast. The forecast values are not discounted; they are in nominal dollars.

**Table 4-2. Trend Revenue Forecast and Fund Allocations (\$ Millions)**

Years	Highway Fund	Highway Trust Fund	Total State Revenues	Federal Funding	Total Funding
<b>FY20-21 to FY29-30</b>	\$26,260	\$18,574	\$44,834	\$12,890	\$57,724
<b>FY30-31 to FY39-40</b>	\$32,497	\$23,073	\$55,570	\$12,890	\$68,460
<b>FY40-41 to FY49-50</b>	\$40,406	\$28,366	\$68,772	\$12,890	\$81,662

**Table 4-3. Trend Revenue Forecast by State Revenue Type (\$ Millions)**

Revenue Source	Years		
	FY20-21 to FY29-30	FY30-31 to FY39-40	FY40-41 to FY49-50
<b>Highway Fund</b>	<b>\$26,260</b>	<b>\$32,497</b>	<b>\$40,406</b>
<b>Total Motor Fuels Taxes</b>	\$17,125	\$21,204	\$26,282
<b>Total Licenses and Fees</b>	\$9,070	\$11,228	\$14,048
<b>Investment, Interest, Dividends</b>	\$66	\$66	\$76
<b>Highway Trust Fund</b>	<b>\$18,574</b>	<b>\$23,073</b>	<b>\$28,366</b>
<b>Motor Fuels Taxes</b>	\$7,018	\$8,699	\$10,793
<b>Highway Use Tax</b>	\$9,589	\$11,544	\$13,545
<b>Total Fees</b>	\$1,947	\$2,810	\$4,008
<b>Investment Income</b>	\$20	\$20	\$20

## VALIDATION

The Trend forecast developed through STREET was compared to the NC Office of State Budget and Management (OSBM)-NCDOT consensus forecast for the years FY20-21 to FY 28-29 to validate the model assumptions. Table 4-4 presents the comparison.

**Table 4-4. Comparison of STREET to NC OSBM-DOT Forecast  
FY20-21 to FY 28-29 (\$ Millions)**

Source	OSBM-DOT	STREET	Variance
Motor Fuel Tax	\$21,314	\$21,240	-0.4%
Highway Use Tax	\$8,551	\$8,542	-0.1%
NCDMV Fees	\$9,761	\$9,779	0.2%

As shown in the table, STREET performs favorably compared to the NC-agency revenue forecast.

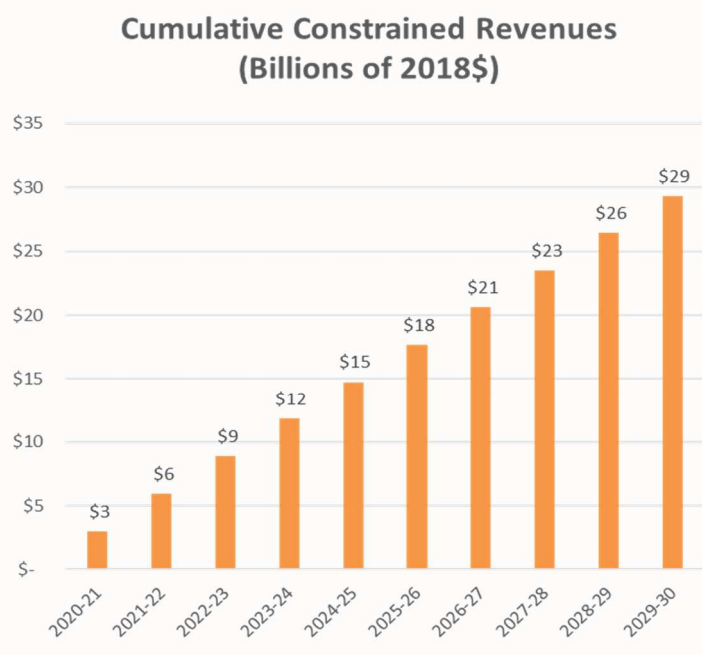
## DISCOUNTED AND CONSTRAINED REVENUE FORECAST

The revenue streams from the baseline forecast were reduced first by non-construction NCDOT costs. These include debt service, administration, transfers and other non-construction costs. On average, these historically amounted to approximately 15 percent of the agency’s budget. The remaining funds were discounted to 2018 dollars. This created a forecast that could be directly compared to the 2018 forecast of future construction needs. This was done for the near term (2030) and long term (2050).

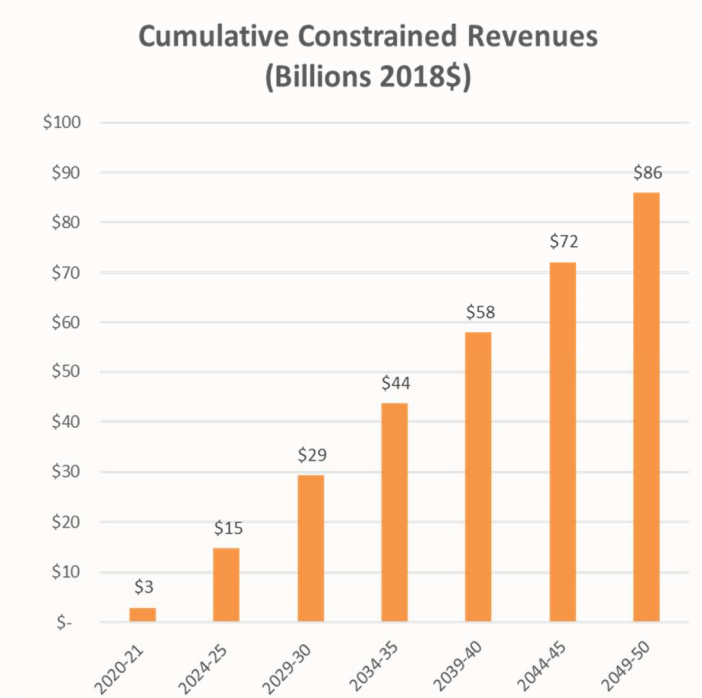
As illustrated in Figure 4.1 and Figure 4.2, constrained and discounted revenues out to 2030 are forecast at approximately \$29 Billion and \$80-90 Billion out to 2050. It should be noted that the model creates forecasts for discrete values, but a range around the forecast values can be assumed.

Assumptions for the 2050 baseline analysis are:

- Longer transition to electric and driverless vehicle levels
- Conservative decline in fuel consumption impacts motor fuel tax
- No growth in federal program
- Shifts to non-highway travel as more convenient options emerge
- Mixed truck fleet; dispersed freight movement
- Less non-construction



*Figure 4.1 Near-Term Discounted, Constrained Revenues to 2030*



*Figure 4.2 Near-Term Discounted, Constrained Revenues to 2050*

## 5. ADJUSTING THE REVENUE FORECAST

### 5.1 USER ADJUSTMENT OF STREET

STREET allows the user to adjust the model inputs to create forecasts for alternative future scenarios of the economy, demographics and transportation requirements for North Carolina. This capability allows the user to conduct “What if” and sensitivity analyses, changing variables such as:

- Economic and demand variables:
  - Gross Domestic Product
  - Population
  - Vehicle Miles Traveled
  - Auto ownership rates
- Future fleet size
- Miles per gallon efficiency
- Adoption of electric vehicles
- Change in fee and tax growth rates (component “RateAdjustments”)

The model can be adjusted by selecting a predefined scenario developed in the NC Moves 2050 Plan (Innovation, Globally Connected, Renewed and Unstable), or by selecting “User Defined Inputs” in the component “Scenario Selection”. If a predefined scenario is selected, the model inputs are automatically adjusted to that scenario and a new forecast created. The component also calculates the forecast change from the baseline forecast.

Additional information on the NC Moves scenarios is presented in section 5.2

Figure 5.1 shows the scenario selection options.

Forecast		
	User Defined Inputs	0
Alternative Futures	2050 Trend (Base)	1
	Innovation	2
	Globally Connected	3
	Renewed	4
	Unstable	5
	Enter Forecast Number:	1

Figure 5.1 Scenario Selection Sheet

If the user prefers to manually adjust inputs to model future conditions, then they would select “0” as a scenario and make adjustments directly in component “User Inputs”, Table 5-1. The “User Input” table is initially loaded with the baseline assumptions.

**Table 5-1. User Defined Variables**

Factor - Annual	FY2020-21 to FY2024-25	FY2025-26 to FY2029-30	FY2030-31 to FY2034-35	FY2035-36 to FY2039-40	FY2040-41 to FY2044-45	FY2045-46 to FY2049-50
Real Gross Domestic Product Change	1.6%	1.7%	1.7%	1.7%	1.8%	1.8%
CPI-E (Used as a proxy for CPI)	2.1%	2.0%	2.0%	2.0%	2.0%	2.0%
Population Growth	1.1%	1.1%	1.0%	1.0%	0.9%	0.8%
Light Vehicle Annual Increase in Fleet MPG	1.0%	1.0%	1.0%	0.9%	0.9%	0.8%
Heavy Vehicle Annual Increase in Fleet MPG	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Annual Growth in Light Vehicle Fleet	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%
Growth in Sales of Electric Light Vehicles	0.0%	0.0%	6.2%	6.2%	6.2%	6.2%
Annual Increase in Electric Commercial Vehicles	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Jet Fuel Sales (Trend)	20.8%	3.2%	2.7%	2.4%	2.1%	1.9%
Vehicle Miles Traveled	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
Total Interest (Trend)	1.9%	1.7%	1.6%	1.5%	1.4%	1.3%
HFT - Investment Income (Fixed)	\$ 2,000,000	\$ 2,000,000	\$ 2,000,000	\$ 2,000,000	\$ 2,000,000	\$ 2,000,000
HF - Investment Income (Fixed)	\$ 1,000,000	\$ 1,000,000	\$ 1,000,000	\$ 1,000,000	\$ 1,000,000	\$ 1,000,000
Federal Funding Growth %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

As the changes are made to the variables, a new forecast is created and the variance from the baseline forecast is presented in the same component.

In addition to the revenue drivers that can be preselected as a scenario or defined by direct user input, the user can also adjust tax and fee rates. This is done in component “RateAdjustments” where the user can enter a percent change to a baseline economic growth, inflation, tax or fee rates.

All user defined variables can be revisited and reviewed for future revenue forecast updates.

## 5.2 FUTURE SCENARIOS

The NC Moves 2050 Plan explores four different scenarios to help picture the North Carolina transportation future. These scenarios describe what could happen, not predict what will happen.

**Innovation:** Technology in transportation drives new development patterns and economic growth, resulting in a low-carbon, low-cost, shared, and more accessible multimodal system. It envisions transportation shifts based on rapid growth in shared mobility, drones, driverless and electric vehicles. Selection of this scenario perturbs the growth in electric vehicle adoption (rapid increase), Vehicle Miles Traveled (decrease)<sup>12</sup> and population (stable).

**Globally Connected:** Economic growth in manufacturing, technology, automation and services positions North Carolina as a leading market for a skilled workforce, connected to the world by international gateways and an efficient freight system. Selection of this scenario perturbs the growth in electric vehicle adoption (modest increase), Vehicle Miles Traveled (significant increase) and population (stable).

**Renewed:** A more decentralized and balanced growth scenario where small towns and rural communities grow and are more connected to each other and urban centers by various forms of transportation. The model adjusts the growth in electric vehicle adoption (modest increase), Vehicle Miles Traveled (modest increase) and population (stable).

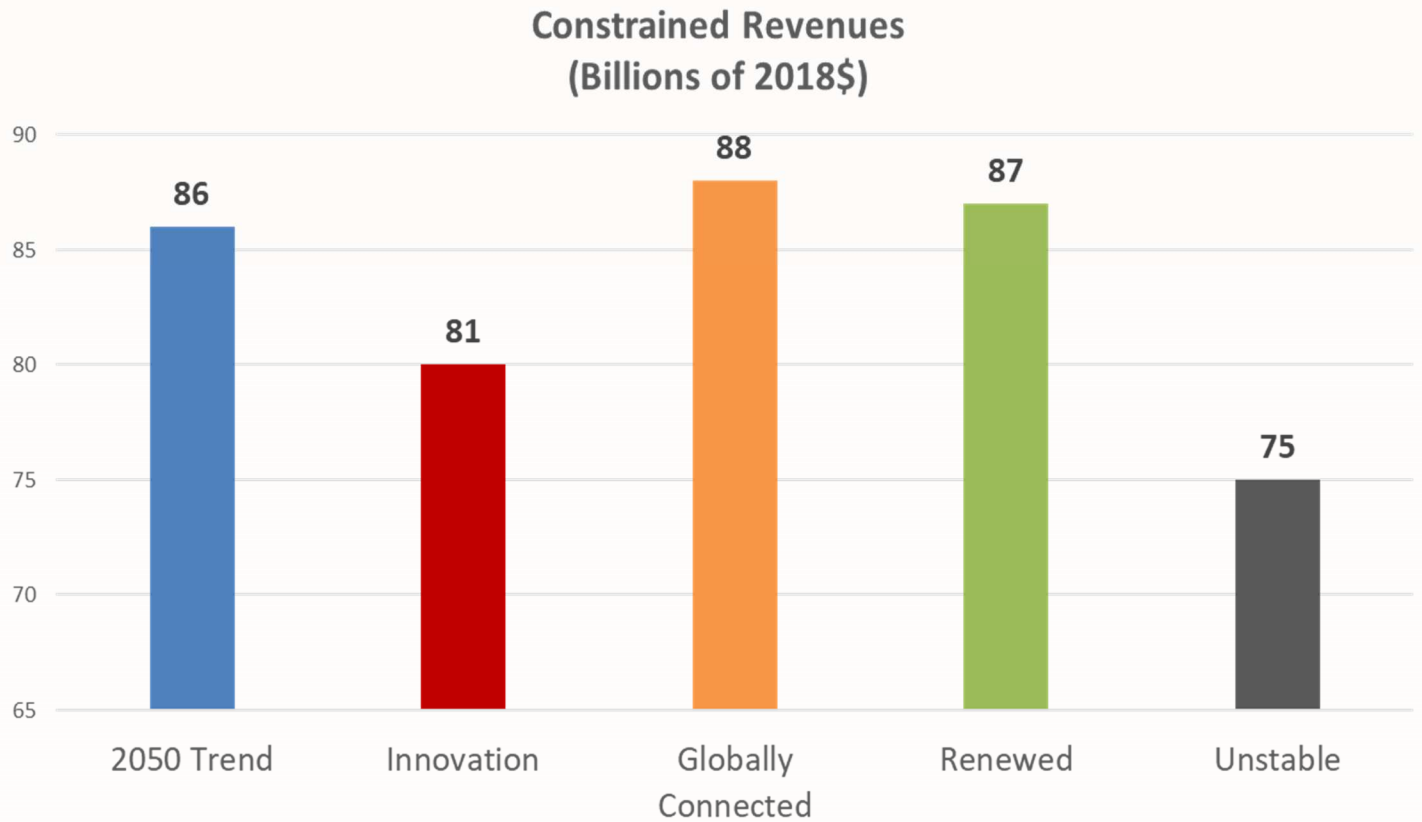
**Unstable:** This scenario envisions a more pessimistic future where funding instability, political and social events, environmental threats, and energy uncertainty stall tourism and stagnate the economy. This creates a transportation system where travel costs are high, and mobility is more unreliable. Under this scenario, transportation technology adoption is slow, Vehicle Miles Traveled (significant decrease) and population (significant decrease).

The approach to modeling potential revenue impacts associated with the scenarios is uncomplicated, focusing upon the key influencers of motor fuel tax, Highway Use Tax, and NCDMV fee levels. The resultant discounted, constrained revenue forecasts for the scenarios are presented in Figure 5-2.

The figure illustrates that the Innovation and Unstable scenarios are expected to have the most influence on revenues. This is primarily due to reductions to motor fuel receipts and NCDMV fees as greater fuel economies, adoption of electric vehicles and slow down or reduction in the growth of personal transportation occur under the scenarios. Under the Globally Connected and Renewed scenarios, increases in economic activity and transportation demand tend to offset the negative influences, resulting in increased revenues relative to the base forecast.

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<sup>12</sup> Vehicle Miles Traveled is adjusted through adjustment to the Real Gross Domestic Product variable. Vehicle Miles Traveled and Real Gross Domestic Product are near perfectly correlated (0.995 correlation), therefore a 1 percent reduction in Real Gross Domestic Product growth equates to a 1 percent decrease in Vehicle Miles Traveled.



*Figure 5.2 Discounted, Constrained Revenues*

## 6. CONCLUSIONS AND NEXT STEPS

The STREET model is based on current relationships and revenue assumptions, modified for changing future conditions. It allows the user to adjust the key assumptions that drive revenues so that forecasts can be custom developed to assess differing future conditions on NCDOT revenues.

The model in its current state is relatively easy to use, but future enhancements to make the model more useful may include:

- Front end interface to facilitate user-defined inputs
- Graphical displays and outputs of model runs and sensitivity analysis
- New variables/revenue sources
- Ability to import sourced economic and demographic data.