Estimating Motor Fuel Demand in South Carolina

FY 2021-22 and FY 2022-23

August 2021

State of South Carolina
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INTRODUCTION

This report analyzes the history of South Carolina's motor fuel consumption and revenue and uses linear regression models to project the consumption levels and revenue for the next two fiscal years. The primary types of motor fuel used in South Carolina are gasoline and diesel fuel, although gasoline is consumed at a rate of over three times more than diesel in the state. For the purposes of this report, the term "gasoline" refers to both gasoline and gasohol, and the term "diesel" refers to diesel, biodiesel, and liquified petroleum gas.

HISTORICAL MOTOR FUEL CONSUMPTION AND REVENUE

Motor fuel demand in South Carolina has generally increased over time. However, in 2020, consumption significantly decreased due to the effects of the COVID-19 pandemic. Reduced travel and restrictions significantly impacted demand, particularly for gasoline in late FY 2019-20. However, traffic volumes as tracked by the South Carolina Department of Transportation (DOT) have already returned to historical levels. We anticipate that consumption will be much more consistent with historical trends in FY 2021-22 and FY 2022-23 than in recent years.

The following chart and table show the historical motor fuel gallons consumed in South Carolina since 1998.

Figure 1. Historical SC Motor Fuel Consumption
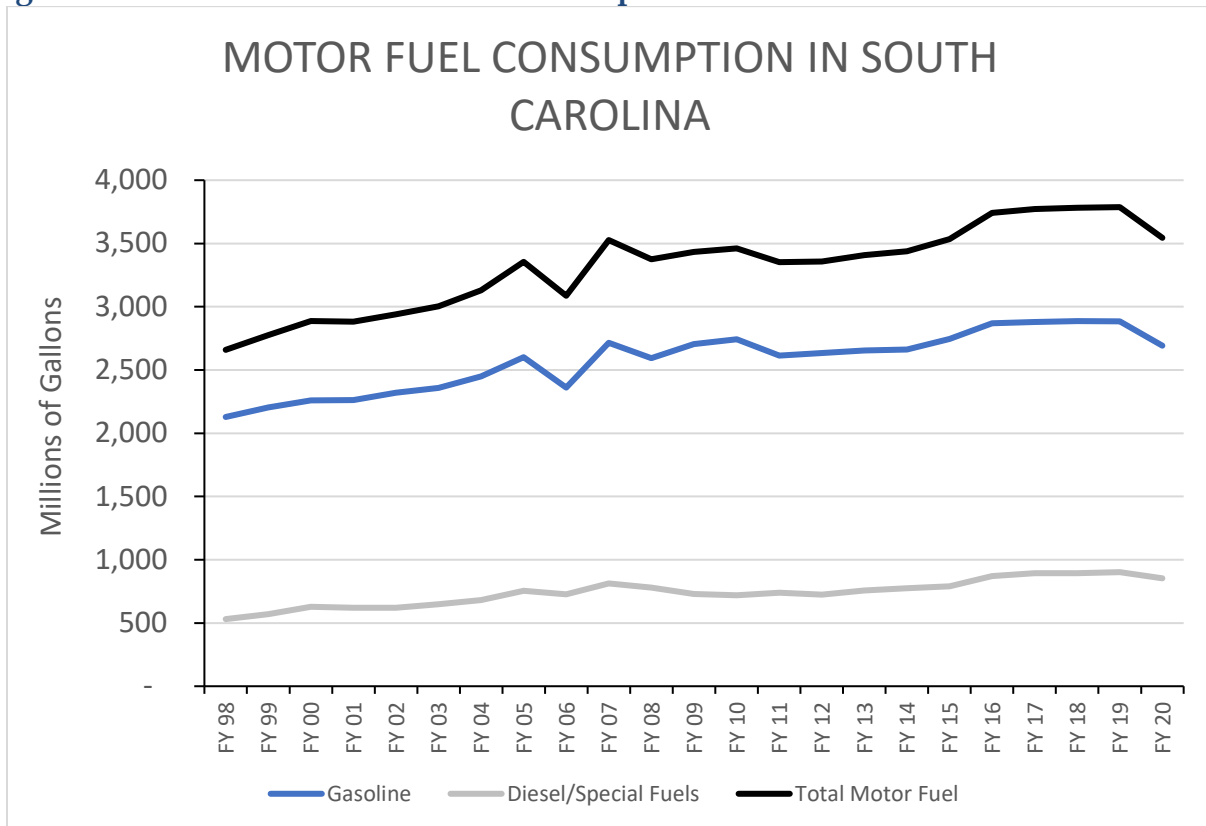
Table 1. Summary of Historical Motor Fuel Gallons

Fiscal Year	Gasoline (Billions of Gallons)	Diesel Fuel (Billions of Gallons)	Total Motor Fuel (Billions of Gallons)
1997-98	2.128	0.531	2.659
1998-99	2.204	0.571	2.774
1999-00	2.259	0.628	2.887
2000-01	2.262	0.619	2.881
2001-02	2.321	0.620	2.940
2002-03	2.357	0.647	3.004
2003-04	2.449	0.681	3.131
2004-05	2.601	0.754	3.355
2005-06	2.360	0.726	3.086
2006-07	2.714	0.813	3.526
2007-08	2.594	0.779	3.374
2008-09	2.705	0.728	3.433
2009-10	2.742	0.720	3.462
2010-11	2.615	0.739	3.353
2011-12	2.634	0.723	3.357
2012-13	2.653	0.756	3.409
2013-14	2.662	0.775	3.438
2014-15	2.745	0.790	3.535
2015-16	2.870	0.872	3.742
2016-17	2.878	0.893	3.771
2017-18	2.886	0.895	3.781
2018-19	2.885	0.902	3.787
2019-20	2.691	0.853	3.544

Due to changes in the fee over time, revenue is comprised of three main components in South Carolina:
- a 16 cents-per-gallon "base" fee,
- an additional fee component that increases by 2 cents each year from FY 2017-18 through FY 2022-23, and
- a 0.75 cents-per-gallon environmental and inspection fee.

The current total fee for FY 2021-22 is 26.75 cents per gallon. This amount will increase to 28.75 cents per gallon in FY 2022-23. Further discussion on these components, the allocations of fee revenue, and the tax rate schedule can be found in the Appendix. Figure 2 depicts the revenue collected from motor fuel user fees without the 0.75 cents component.

Figure 2. Total Revenue Collected from Motor Fuel User Fees

Note: Revenue does not include 0.75 cents environmental and inspection fees.
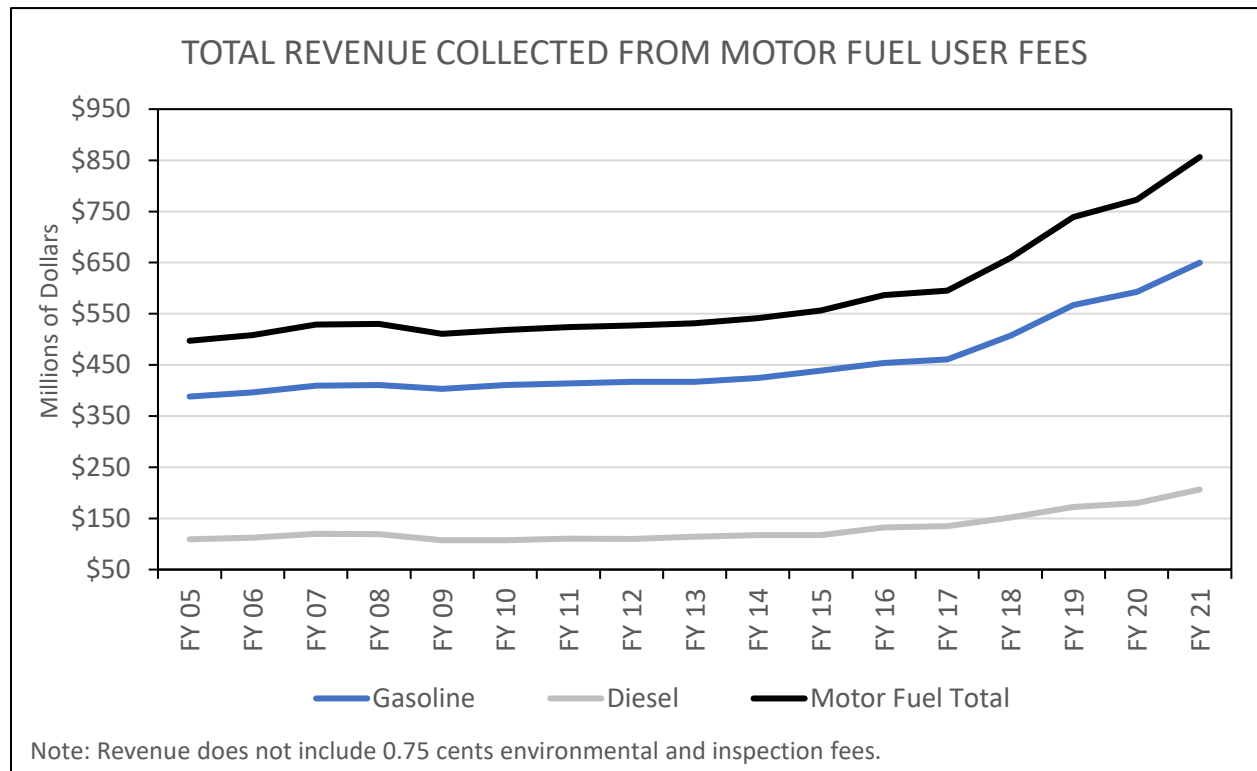
PROJECTIONS FOR FISCAL YEARS 2021-22 AND 2022-23

Projections for motor fuel consumption are based upon two models, one for gasoline and one for diesel fuel. Gasoline demand is predicted using the average price of gasoline, average per capita personal disposable income, the proportion of gasoline demand to total fuel demand, and Corporate Average Fuel Economy (CAFE) standard miles per gallon. Diesel demand is predicted using gross domestic product (GDP) and

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employment in the trade, transportation, and utilities sector.

Projections are separated into two categories: DOT's portion of the original 16 cents base fee and the amount of the increased fee for the Infrastructure Maintenance Trust Fund (IMTF). Due to the complexity of gasoline user fee distribution, projections are made for 13 cents per gallon of the 16 cents base fee. DOT actually receives 13.2366 cents per gallon of this part of the user fee.

Based upon the models, we estimate motor fuel demand for gasoline and the corresponding revenue for FY 2021-22 and FY 2022-23 as follows:

Table 2. Gasoline Demand and Revenue Projections

Fiscal Year	Gasoline Gallons (Billions)	Gasoline User Fee Revenue (13 Cents)	Gasoline IMTF Revenue
2021-22	3.021	$392,789,886	$261,960,640
2022-23	3.113	$404,144,488	$332,188,590

Figure 3. Gasoline User Fee Revenue in South Carolina (13 cents portion)

GASOLINE USER FEE REVENUE IN SOUTH CAROLINA
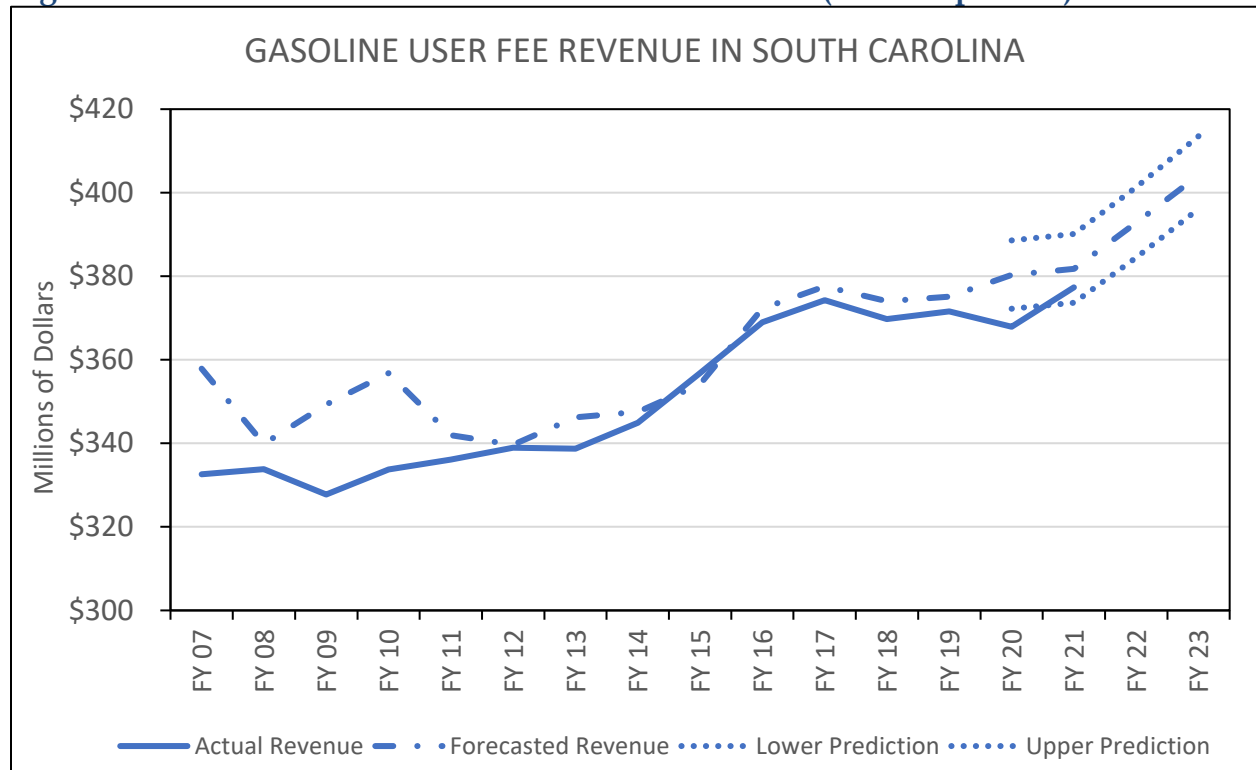
While DOT receives 13.2366 cents of the fee on gasoline, DOT receives 16 cents of the motor fuel user fee for diesel fuel. The following table provides our projections of the 16 cents component of the fee for diesel fuel and for the additional fee attributable to the IMTF.

Table 3. Diesel Fuel Demand and Revenue Projections

Fiscal Year	Diesel Fuel (Billions)	Diesel User Fee Revenue (16 cents)	Diesel IMTF Revenue
2021-22	0.979	$159,517,029	$97,861,597
2022-23	0.999	$163,034,504	$119,872,126

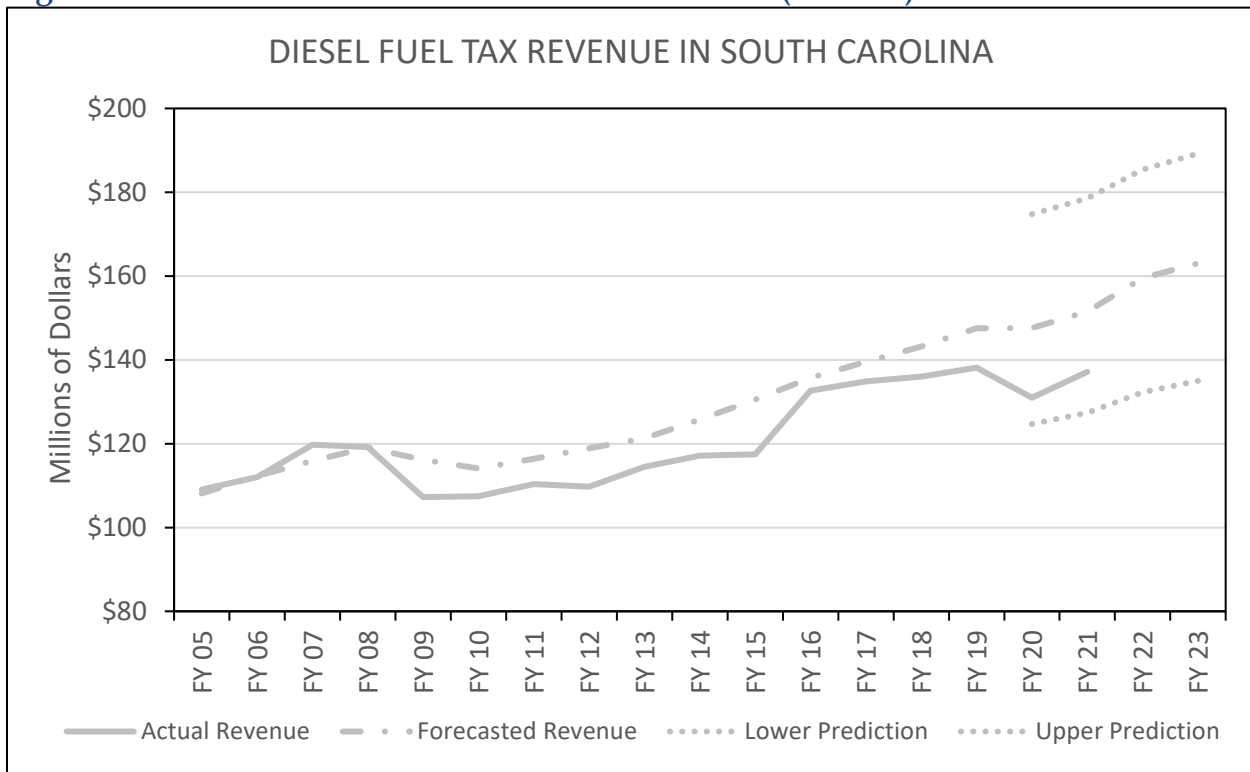**Figure 4. Diesel Fuel Tax Revenue in South Carolina (16 cents)**

Table 4. Motor Fuel User Fee Revenue History and Estimates

Fiscal Year	Fee Per Gallon	Gasoline		Diesel Revenue		Total Motor Fuel Revenue	
	Cents	Dollars	% Change	Dollars	% Change	Dollars	% Change
2004-05	16	$375,992,316	-	$109,058,099	-	$485,050,415	-
2005-06	16	$381,919,998	1.58%	$112,053,378	2.75%	$493,973,375	1.84%
2006-07	16	$395,517,686	3.56%	$119,766,794	6.88%	$515,284,480	4.31%
2007-08	16	$396,925,441	0.36%	$119,240,991	(0.44%)	$516,166,432	0.17%
2008-09	16	$389,497,510	(1.87%)	$107,267,436	(10.04%)	$496,764,946	(3.76%)
2009-10	16	$396,262,582	1.74%	$107,442,882	0.16%	$503,705,464	1.40%
2010-11	16	$399,487,621	0.81%	$110,325,004	2.68%	$509,812,625	1.21%
2011-12	16	$403,834,314	1.09%	$109,744,365	(0.53%)	$513,578,679	0.74%
2012-13	16	$402,667,179	(0.29%)	$114,511,278	4.34%	$517,178,457	0.70%
2013-14	16	$410,108,790	1.85%	$117,137,065	2.29%	$527,245,855	1.95%
2014-15	16	$424,754,788	3.57%	$117,457,502	0.27%	$542,212,290	2.84%
2015-16	16	$440,218,179	3.64%	$132,645,553	12.93%	$572,863,733	5.65%
2016-17	16	$446,608,833	1.45%	$134,870,908	1.68%	$581,479,741	1.50%
2017-18	18	$494,128,760	10.64%	$151,935,565	12.65%	$646,064,325	11.11%
2018-19	20	$553,345,125	11.98%	$172,225,934	13.35%	$725,571,058	12.31%
2019-20	22	$574,486,486	3.82%	$180,172,095	4.61%	$754,658,582	4.01%
2020-21	24	$630,855,710	9.81%	$206,466,083	14.59%	$837,321,793	10.95%
2021-22e	26	$785,579,773	24.53%	$254,440,152	23.24%	$1,040,019,925	24.21%
2022-23e	28	$871,722,724	10.97%	$279,701,628	9.93%	$1,065,281,401	10.71%

e-Estimates

Note: Revenues in Table 4 do not include the 0.75 cents per gallon environmental and inspection fees.

ASSUMPTIONS AND RISK

Projecting motor fuel consumption for FY 2021-22 and FY 2022-23 required projections for most of the input variables for the two models for either one or both forecast years. For the gasoline model, only the CAFE standards are available for the forecast periods. RFA utilized projections for gasoline prices, personal income, and fuel demand proportions to forecast gasoline gallons. For the diesel fuel model, RFA used national projections for GDP growth to estimate SC GDP and estimates for employment growth in the Trade, Transportation, and Utilities sector.

The accuracy of the forecasts of these variables affects the ability of the models to forecast motor fuel consumption. The projections for gasoline prices, personal income, and fuel demand proportions assume a return to the historical trends over the next two fiscal years. However, a deviation from historical growth for either personal income or fuel demand proportions would have the largest effects on the consumption projections. Both of the forecast inputs for the diesel model are also consistent with historical growth, and because the model gives almost equal weight to each variable, deviation from historical trends for either of these two inputs would significantly change the forecasted outcomes.

Table 5 summarizes the data sources used for both actual data and forecast data and the time periods those sources provide.

Table 5. Variable Data Sources and Time Periods

Variable	Actual Data Time Periods Available	Actual Data Source	Forecast Data Source
SC Gasoline and Diesel Gallons Consumed	January 1997 – May 2021	SC Department of Revenue	Gasoline and Diesel Demand Models
SC Population	CY 2000 - 2019	US Census Bureau	SC Revenue and Fiscal Affairs Office
SC Average Gasoline Price	CY 1970 - 2019	US Energy Information Administration's State Energy Data System	US Energy Information Administration's Short-Term Energy Outlook
SC Per Capita Personal Disposable Income	CY 1948 – 2020	US Census Bureau	SC Revenue and Fiscal Affairs Office
Proportion of Gasoline Demand to Total Fuel Demand	CY 1960 - 2019	US Energy Information Administration's State Energy Data System	Average Growth Rate from 2010-2019
Corporate Average Fuel Economy Standards	CY 1978 - 2014	National Highway Traffic Safety Administration	CFR Title 49, Section 531.5
SC Gross Domestic Product	CY 1997 - 2020	US Bureau of Economic Analysis	Federal Reserve System, Federal Open Market Committee
SC Employment in the Trade, Transportation, and Utilities Sector	January 1997 – May 2021	Federal Reserve Economic Data	Average Growth Rate from 2015-2021
SC Motor Fuel Revenue	FY 2005 - 2021	SC Department of Transportation	Gasoline and Diesel Demand Models

PREDICTION RANGES

The following tables provide prediction intervals for expected gasoline and diesel demand, expected DOT revenue, and expected IMTF revenue.

Table 6. Gasoline Demand and Revenue Forecast Ranges

Fiscal Year	Gasoline Gallons (Billions)	Gasoline Fee Revenue Forecast Range (13 cents)	Gasoline IMTF Fee Revenue Forecast Range
2021-22	2.957 – 3.087	$384,434,038 – 401,327,353	$256,387,931 – 267,654,473
2022-23	3.047 – 3.181	$396,118,590 – 413,525,363	$325,121,950 – 339,408,894

(95% Prediction Intervals)

Table 7. Diesel Demand and Revenue Forecast Ranges

Fiscal Year	Diesel Fuel Gallons (Billions)	Diesel Fee Revenue Forecast Range (16 cents)	Diesel IMTF Fee Revenue Forecast Range
2021-22	0.827 – 1.159	$132,252,214 – 185,379,460	$82,657,634 – 115,862,162
2022-23	0.844 – 1.183	$134,998,087 – 189,228,382	$101,248,565 – 141,921,287

(95% Prediction Intervals)

APPENDIX

I. SOUTH CAROLINA MOTOR FUEL TAX RATES

The following table gives an overview of how the motor fuel tax rate has changed since it was first enacted. The rate increased to 26 cents on July 1, 2021 and is set to increase to 28 cents on July 1, 2022.

Table A1. South Carolina Motor Fuel Tax Rate Schedule

Year	Tax	Legislative Enactment
1922	2 cents	Act 494 of 1922
1923	3 cents	Act 146 of 1923
1925	5 cents	Act 34 of 1925
1929	6 cents	Act 102 of 1929
1958	7 cents	Act 855 of 1958
1972	8 cents	Act 1575 of 1972
1977	9 cents	Act 141 of 1977
1979	10 cents	Act 197 of 1979
1980	11 cents	Act 506 of 1980
1981	13 cents	Act 177 of 1981
1987	15 cents	Act 197 of 1987
1995	16 cents	Act 136 of 1995
2017	18 cents	Act 40 of 2017
2018	20 cents	Act 40 of 2017
2019	22 cents	Act 40 of 2017
2020	24 cents	Act 40 of 2017
2021	26 cents	Act 40 of 2017
2022	28 cents	Act 40 of 2017

II. SOUTH CAROLINA MOTOR FUEL FEE DISTRIBUTION

Funds collected from the motor fuel user fees are distributed among various agencies and funds. Act 40 of 2017 set a yearly increase of the fees through FY 2022-23 and restructured the way those fees are allocated. Table A2 shows a breakdown of the current distributions.

Table A2. Motor Fuel User Fee Distribution as of July 1, 2021

Gasoline Revenue Distribution	Code of Laws Section
$18 million of the first 3¢ to the State Non-Federal Aid Highway Fund	§12-28-2910
13¢ component	-
0.13¢ (1% of 13¢) to DNR	§12-28-2730 (A)
12.87¢	-
2.6334¢ to "C" Funds	§12-28-2740 (A)
10.2366¢ to DOT	§12-28-2720
0.25¢ of this amount to Mass Transit	§12-28-2725
10¢ component[1]	-
1.33¢ to "C" Funds[2]	§12-28-2740 (A)
8.67¢ to Infrastructure Maintenance Trust Fund[3]	§12-28-310 (D)
Remaining 3¢ to the State Highway Fund	§12-28-2750

Diesel Revenue Distribution	Code of Laws Section
10¢ to Infrastructure Maintenance Trust Fund[1]	§12-28-310 (D)
Remaining 16¢ to the State Highway Fund	§12-28-2750

Total Motor Fuel User Fee[3]: 26¢	**§12-28-310 (Act 40 of 2017)**
Total Environmental and Inspection Fee: 0.75¢	**§12-28-2355**
0.25¢ Inspection Fee to DOT State Non-Federal Aid Highway Fund	§12-28-2355 (C) (Act 40 of 2017)
0.50¢ Environmental Impact Fee to DHEC	§12-28-2355 (B)

1 – Motor fuel user fee increases by 2¢ per year for six years beginning July 1, 2017, for a total increase of 12¢ by July 1, 2022.

2 - Pursuant to Proviso 86.1 of the FY 2019-20 Appropriations Act, the increase in "C" Funds is taken from the 2¢ increase per year of the gasoline user fee.

3 - Pursuant to Proviso 86.1 of the FY 2019-20 Appropriations Act, the Motor Fuel User Fee increase pursuant to §12-28-310 on gasoline is reduced by the increase in the allocation to "C" Funds. (See footnote 1)

III. MODELS AND STATISTICS

GASOLINE

The general equation for the demand for gasoline may be written as

$$\ln G_t = f(\ln P_t, \ln Yd_t, Prop_t, lagMPG_t),$$

where

G_t is the amount of per capita gasoline consumption in gallons at fiscal year t,

P_t is the average price of gasoline at fiscal year t,

Yd_t is the level of per capita personal disposable income at fiscal year t,

$Prop_t$ is the proportion of gasoline demand to total fuel demand at fiscal year t, and

$lagMPG_t$ is the Corporate Average Fuel Economy standard miles per gallon at fiscal year t.

After running the model using fiscal year data from the years 1978-2019, the following model was produced:

$$\ln G_t = 13.88 - 0.14 \ln P_t - 0.78 \ln Yd_t + 0.93\, Prop_t + 0.01\, lagMPG.$$

Table A3. Gasoline Demand Model Statistics and Fit

Regression Statistics	
Multiple R	0.980
R Square	0.961
Adjusted R Square	0.941
Standard Error	0.00710
Observations	13

ANOVA

	df	SS	MS	F	Significance F
Regression	4	0.0099	0.0024	49.032	1.143E-05
Residual	8	0.0004	5.05E-05		
Total	12	0.0103			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	13.879	1.501	9.245	1.52E-05	10.417	17.341
SC avg price	-0.145	0.025	-5.843	0.00039	-0.202	-0.088
SC per capita PDI	-0.781	0.154	-5.057	0.00098	-1.137149504	-0.4249
Petro Prop	0.9346	0.373	2.508	0.037	0.075	1.794
CAFÉ Standards	0.013	0.004	3.575	0.007	0.005	0.022

DIESEL

The general equation for the demand for diesel fuel may be written as

$$\ln D_t = f(\ln SCGDP_t, \ln TTU_t),$$

where

D_t is the amount of diesel fuel consumption in gallons at quarter t,
$SCGDP_t$ is the level of gross domestic product in South Carolina at quarter t, and
TTU_t is the level of employment in the trade, transportation, and utilities sector in South Carolina at quarter t.

After running the model using quarterly data from the Quarter 1 of 1997 to Quarter 1 of 2021, the following model was produced:

$$\ln D_t = 10.42 + 0.46 \ln SCGDP_t + 0.45 \ln TTU_t.$$

Table A4. Diesel Demand Model Statistics and Fit

Regression Statistics	
Multiple R	0.910
R Square	0.827
Adjusted R Square	0.824
Standard Error	0.0678
Observations	97

ANOVA

	df	SS	MS	F	Significance F
Regression	2	2.068	1.034	225.138	1.424E-36
Residual	94	0.432	0.00459		
Total	96	2.4996			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	10.418	1.097	9.493	2.20E-15	8.239	12.597
ln(gdp)	0.458	0.043	10.549	1.26E-17	0.372	0.544
ln(employment)	0.445	0.211	2.111	0.037	0.027	0.864

IV. OTHER MODELS CONSIDERED

Various scenarios with a combination of variables and time periods were considered in developing these motor fuel demand models.

For the gasoline model, we considered all the historical data we could obtain (1978-2019) with the same variables as the final gasoline model. However, the main concern was that the forecast indicated decreasing gallons each year through FY 2022-23. We believe this model was putting too much emphasis on increasing gasoline prices and increasing CAFE Standards.

Another time period considered used a twenty-year time frame instead of over forty years. The model did not include CAFE Standards as a variable, and while this model came closest to forecasts based on historical growth rates, the model did not fit as well as the final gasoline model.

Other variables included without success were personal income (as a quarterly variable in a quarterly model), the square of gasoline price, the square of personal disposable income, and the lag change in price relative to the lag change in gasoline gallons consumed. None of these variables created a "better" model or forecasts that seemed on track with historical growth.

For the diesel model, we added a variable to account for the effects of the COVID-19 pandemic, but this did not improve the model. This variable was not significant to the model, meaning the variable did not help predict diesel fuel consumption. Additionally, we considered the effects of port activities and transportation of goods by adding a variable into the model that measured the volume of shipping containers entering and leaving the state's ports.

V. DATA SOURCES

Motor Fuel Gallons Sold in SC: SC Department of Revenue

Motor Fuel Revenue: SC Department of Transportation

Population Estimates:
> https://www.census.gov/data/tables/time-series/demo/popest/2010s-state-total.html
> https://www.census.gov/data/tables/time-series/demo/popest/intercensal-2000-2010-state.html

Average Gasoline Prices: State Energy Data System of the US Energy Information Administration and US EIA's PADD1C data
> https://www.eia.gov/state/seds/seds-data-complete.php?sid=US
> https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_r1z_w.htm

Per Capita Personal Disposable Income: US Bureau of Economic Analysis, Table SAGDP2
> https://apps.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=3#reqid=70&step=1&isuri=1&acrdn=3

Proportion of Petroleum to Total Fuel Consumed:
> https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_use/tx/use_tx_SC.html&sid=SC

Corporate Average Fuel Economy (CAFE) Standards:
> https://one.nhtsa.gov/cafe_pic/CAFE_PIC_fleet_LIVE.html

Employment in Trade, Transportation, and Utilities:
> https://fred.stlouisfed.org/series/SCTRAD

SC GDP:
> https://apps.bea.gov/itable/iTable.cfm?ReqID=70&step=1&acrdn=1

> 1997-2004: SAGDP2 Table; 2005-2020: SQGDP2 Table

Gasoline Price Forecasts:
> https://www.eia.gov/outlooks/steo/pdf/steo_full.pdf
> Table 2

Personal Income Forecasts:
SC Revenue and Fiscal Affairs Office, Fiscal Analysis Division

CAFE Standards Forecasts:
    https://www.nhtsa.gov/laws-regulations/corporate-average-fuel-economy

GDP Forecasts:
    https://www.federalreserve.gov/monetarypolicy/fomcprojtabl20210616.htm

Population Forecasts:
    SC Revenue and Fiscal Affairs Office, Health and Demographics Division