Short-Term Energy Outlook: Motor Gasoline Consumption Forecasts

Concepts, Data Sources, and Techniques
Handbook of Energy Modeling Methods

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1. Introduction

Gasoline is the most widely used petroleum product in the United States. In 2022, gasoline accounted for 44% of total U.S. liquid fuels consumption, and gasoline consumed in the United States accounted for nearly 10% of global liquid fuels consumption. U.S. gasoline consumption peaked in 2018 at more than 9.3 million barrels per day (b/d), but by 2022, it had fallen by 6% to 8.8 million b/d. The drop in consumption was the result of rising vehicle fuel efficiency and changes to driving patterns after the onset of the COVID-19 pandemic. These factors continue to create uncertainty in EIA's gasoline consumption forecasts. Electric vehicles sales have been increasing, and fuel efficiency of new internal combustion engine vehicles continues to rise.

The *Short-Term Energy Outlook* (STEO) Motor Gasoline Consumption Module provides forecasts of vehicle miles traveled and vehicle fuel efficiency in the United States. From these forecasts, we derive forecasts of motor gasoline consumption in the United States. Gasoline *consumption* refers to deliveries of gasoline out of the primary supply chain (including from refineries, blenders, pipelines, and bulk terminals) and is referred to as *product supplied* in our weekly data from the *Weekly Petroleum Status Report* (WPSR) and in our monthly data from the *Petroleum Supply Monthly* (PSM). Forecast gasoline consumption in our STEO, therefore, reflects gasoline leaving the primary supply chain, not retail sales.

The Motor Gasoline Consumption Module contains eight equations and identities, of which two are estimated regression models. Some input variables of the Motor Gasoline Consumption Module come from outside the model (exogenous variables), which includes variables from other modules in the STEO modeling system and from other organizations.

2. Data Sources

The data sources for motor gasoline consumption include:

- EIA *Petroleum Supply Monthly* (PSM) for monthly product supplied data
- EIA *Weekly Petroleum Status Report* (WPSR) for estimated monthly product supplied volumes calculated from weekly data for the two most recent months

Gasoline consumption data reported in PSM and WPSR include ethanol blended into gasoline that is sold as finished gasoline.

We use data from the Federal Highway Administration (FHWA) on vehicle miles traveled (VMT). The FHWA reports total VMT in the monthly *Traffic Volume Trends* report, a monthly report based on hourly traffic-count data reported by each state. The states collect these data at approximately 5,000 continuous traffic-counting locations nationwide, and the FHWA uses the data to estimate the percent change in traffic for the current month compared with the same month in the previous year. FHWA re-adjusts the estimates annually to match the VMT from the Highway Performance Monitoring System and continually updates the estimates with additional data. Because the sample sizes are limited and the states include both gasoline-fueled, diesel-fueled, and electric vehicles in the traffic counts, VMT should only be interpreted as a proxy for gasoline-fueled vehicle travel.

In our model, we estimate historical average gasoline-vehicle highway fuel efficiency, in miles per gallon (MPG, representing average fleet fuel efficiency), as total VMT divided by total gasoline consumption in gallons (1 barrel is equal to 42 gallons):

MPG = MVVMPUS / (MGTCPUS * 42),

where

MVVMPUS = vehicles miles traveled, million miles per day; and
MGTCPUS = total consumption of motor gasoline, million barrels per day.

In 2022, 96% of gasoline consumed in the United States was consumed for transportation. For our model, we assume that all gasoline consumed in the United States is used for transportation. So, when calculating historical MPG data, we use the total gasoline consumed, including that consumed for non-transportation purposes, which leads to an understating of the MPG in our model compared with the actual MPG of the U.S. gasoline-powered vehicle fleet.

3. Linear Regression Models

3.1 Motor gasoline consumption forecast

In our historical data, VMT and gasoline consumption are the variables for which we have actual data, and MPG is a derived variable. In contrast, our forecasting model contains two equations, one for MPG and one for VMT. We derive gasoline consumption by dividing the forecasts for VMT by forecasts for MPG. We set up the forecast this way because it allows us to isolate the two underlying factors that determine how much gasoline U.S. consumers use: (1) the number of miles we expect U.S. consumers will drive and (2) the efficiency of the vehicles they use for that driving.

As part of the gasoline consumption forecast, we create a variable called the inflation-adjusted cost per mile of driving (CPM). We calculate this variable by dividing the retail price for regular-grade gasoline by the Consumer Price Index to get the real price of gasoline. We then divide that number by MPG to arrive at CPM.

3.2 Vehicle miles traveled forecast

Data for our VMT series in the Short-Term Integrated Forecasting System (STIFS) model is in million miles per day. In 2022, U.S. drivers traveled about 8.8 billion miles each day. We use FHWA data as a proxy for VMT by gasoline-fueled cars. The FHWA data, however, are based on traffic count data and are not limited to gasoline-fueled vehicles. The FHWA data include diesel-fueled vehicles, electric vehicles, and hybrid vehicles. The effects of this difference on our consumption forecast, however, are difficult to estimate because the data do not capture VMT based on the type of fuel used by a vehicle.

Because the data include non-gasoline-fueled vehicles, VMT in our forecast overstates actual VMT by gasoline-fueled vehicles. Because VMT by solely gasoline-fueled vehicles is less than the FHWA estimate, our VMT forecast contributes to an overstatement efficiency (MPG). As noted above, however, some understatement to our MPG forecast exists because of gasoline used for non-transportation purposes.

To control for population growth, the dependent variable in our equation is VMT per person (VMT per capita) in the working age population (people ages 15 years through 64 years). Estimates for seasonally adjusted per-capita VMT are derived from a log-linear equation using the following independent variables:

- Non-farm employment as a share of working age population
- The share of people aged 65 years and over as a share of total population
- CPM
- Real disposable income per capita

We include non-farm employment as an independent variable because about 20% of VMT in the United States is commuting and work-related driving. The share of the population 65 years and over has a negative relationship with VMT, capturing the effect of decreased driving by people moving out of the working age cohort. We include CPM to reflect the price-elasticity of driving demand—the fact that people drive less as the cost of driving goes up. Real disposable income per capita captures the effects of increased disposable income on travel—for example, vacation driving and other discretionary driving increase with real disposable income.

The COVID-19 pandemic caused shifts in working and commuting patterns that resulted in the errors in the VMT equation being larger from 2020 through 2022 than before the pandemic. Shifts in commuting patterns during this period have often been difficult to forecast as businesses adapted to work-from-home and hybrid solutions. In addition, changes to commuting patterns have not been linear as COVID-19 cases have fluctuated up and down, and travel patterns have shifted accordingly. The degree to which commuting patterns will affect gasoline consumption moving forward remains unclear. More people working from home at least part-time would lead to decreased consumption from commuting. However, this trend may be offset to some degree if commuting modes shift from public transport to private vehicles or if commuting distances increase. Commuting will likely continue to drive a significant portion of gasoline consumption, but as commuting patterns continue to evolve, consumption may vary.

3.3 Seasonally adjusted motor-gasoline fuel efficiency

Data for our fuel efficiency series (MPG) in the STIFS model is in miles per gallon. In 2022, MPG in the United States averaged 23.5 miles per gallon. Estimates for seasonally adjusted motor gasoline-related fuel efficiency are derived from the MPG regression model using the following independent variables:

- Average regular retail motor gasoline price
- Consumer price index
- A simple trend variable

We use the average regular retail motor gasoline price and Consumer Price Index to calculate an inflation-adjusted gasoline price. The trend variable in the regression equation captures trends in increasing average fuel efficiency, such as those related to increasing corporate average fuel economy standards and the increasing use of electric vehicles.