

**The**

**2018**

**EPA Automotive  
Trends Report: \_\_\_\_\_**

Greenhouse Gas Emissions,  
Fuel Economy, and  
Technology since 1975

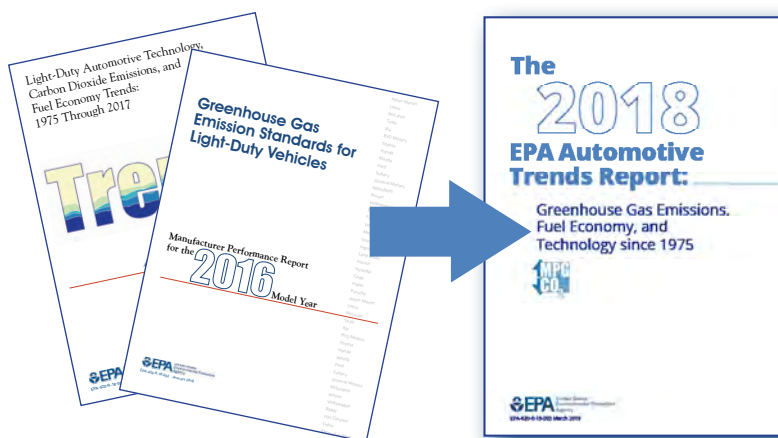


**Executive Summary**

## Executive Summary

This new annual report is part of the U.S. Environmental Protection Agency's (EPA) commitment to provide the public with information about new light-duty vehicle greenhouse gas (GHG) emissions, fuel economy, technology data, and auto manufacturers' performance in meeting the agency's GHG emissions standards. This report includes content previously published in two separate reports, the *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends Report*, and the *GHG Manufacturer Performance Report*. These reports have now been combined to provide a more comprehensive analysis.

EPA has collected data on every new light-duty vehicle model sold in the United States since 1975, either from testing performed by EPA at the National Vehicle and Fuel Emissions Laboratory in Ann Arbor, Michigan, or directly from manufacturers using official EPA test procedures. These data are collected to support several important national programs, including EPA criteria pollutant and GHG standards, the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA) Corporate Average Fuel Economy (CAFE) standards, and vehicle Fuel Economy and Environment labels.



This report presents current and historic data that provide a comprehensive overview of the automotive industry. The report does not examine future model years, and past performance does not necessarily predict future industry trends. All data for model years 1975 through 2017 are **final** and based on official data submitted to EPA and NHTSA as part of the regulatory process. In some cases (not for manufacturer compliance), this report will show data for model year 2018, which are **preliminary** and based on data provided to EPA by automakers prior to the model year.

The carbon dioxide (CO<sub>2</sub>) emissions and fuel economy data in this report fall into one of two categories. The first is **compliance** data, which is measured using laboratory tests required by law for CAFE and adopted by EPA for GHG compliance. The second is **estimated real-world** data, which is measured using additional laboratory tests to capture a wider range of operating conditions (including hot/cold weather and higher acceleration) that an average driver will encounter. This report will show estimated real-world data except for the discussion specific to the GHG regulations around Figures ES-6 through ES-8 and in Section 5.

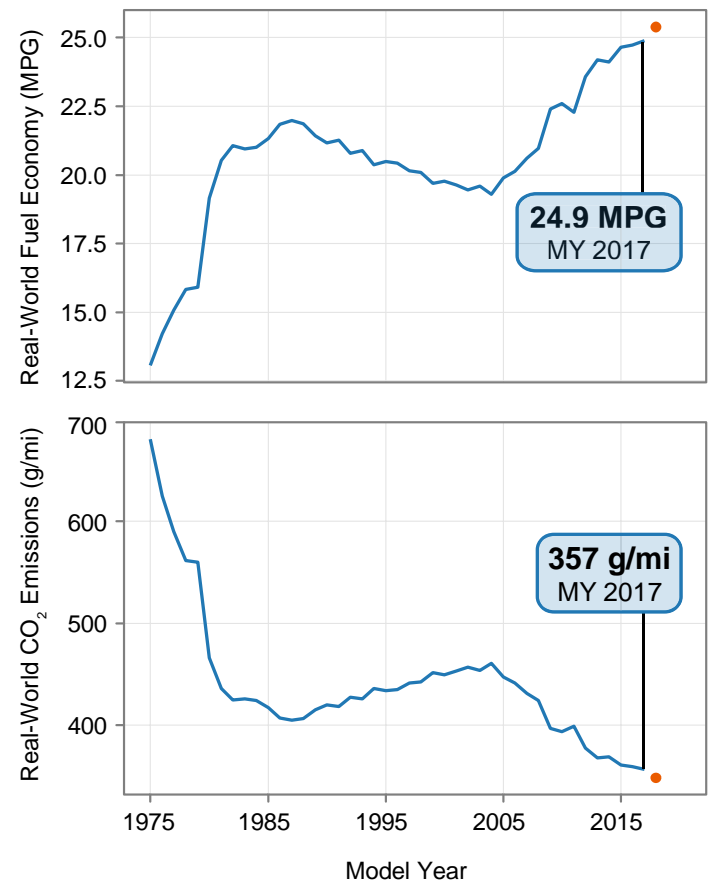
## New vehicle estimated real-world CO<sub>2</sub> emissions are at a record low and fuel economy is at a record high

In model year 2017, the average estimated real-world CO<sub>2</sub> emission rate for all new vehicles fell by 3 grams per mile (g/mi) to 357 g/mi, the lowest level ever measured. Fuel economy increased by 0.2 miles per gallon to 24.9 mpg, achieving a record high.

Since 2004, CO<sub>2</sub> emissions have decreased 23%, or 104 g/mi, and fuel economy has increased 29%, or 5.6 mpg. Over that time, CO<sub>2</sub> emissions and fuel economy have improved in eleven out of thirteen years and have repeatedly achieved new records. The trends in CO<sub>2</sub> emissions and fuel economy since 1975 are shown in Figure ES-1.

Preliminary data suggest further improvements in model year 2018. Average estimated real-world CO<sub>2</sub> emissions are projected to fall 8 g/mi to 348 g/mi and fuel economy is projected to increase 0.5 mpg to 25.4 mpg. Projected data are shown in Figure ES-1 as a red dot because the values are based on manufacturer projections rather than final data.

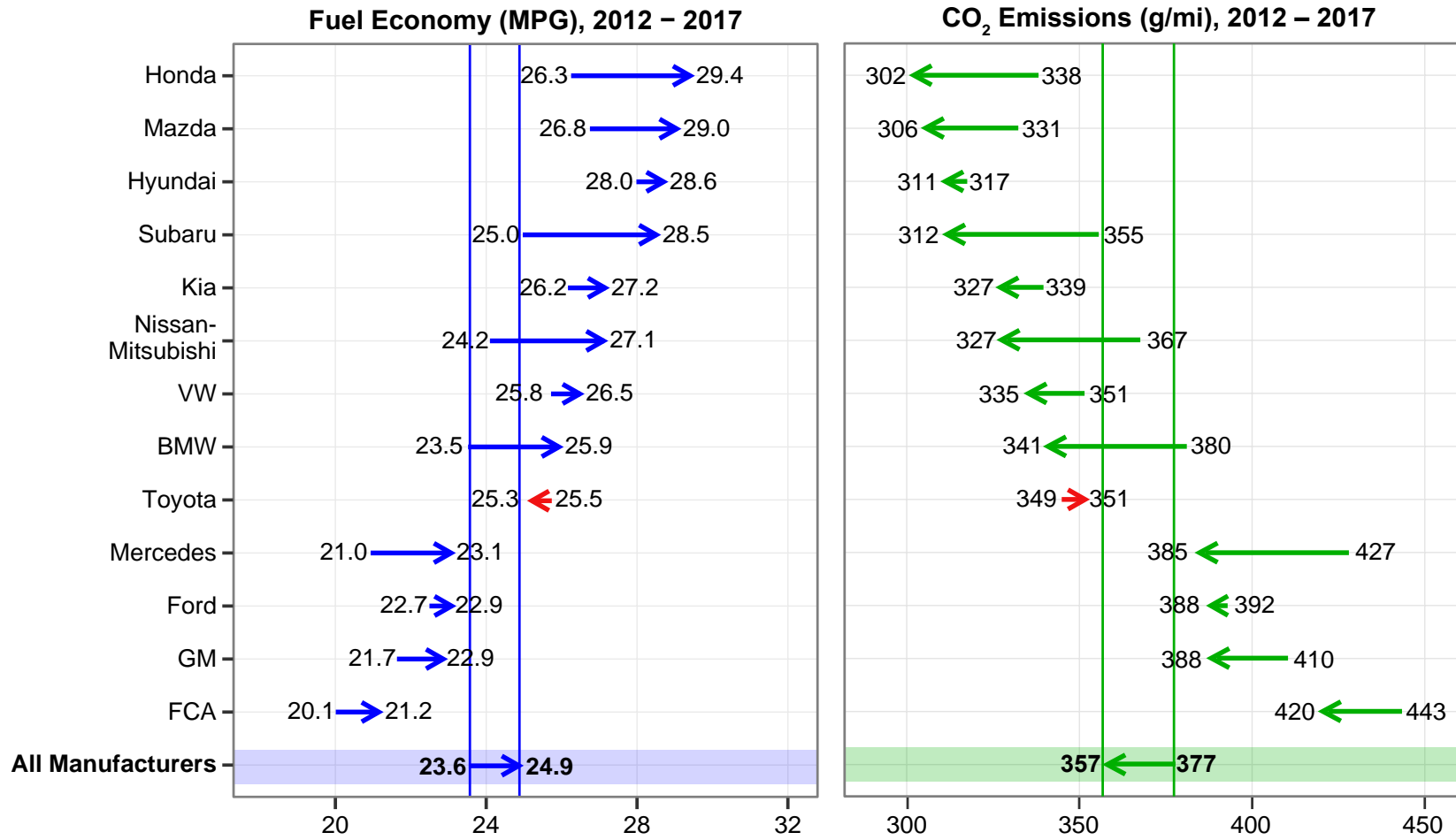
**Figure ES-1. Estimated Real-World CO<sub>2</sub> and Fuel Economy**



## Manufacturers have made significant improvements in fuel economy and CO<sub>2</sub> emissions over the last 5 years

Twelve of the thirteen largest manufacturers selling vehicles in the U.S. market improved estimated real-world CO<sub>2</sub> emissions and fuel economy between model year 2012 and 2017. This five-year span, shown in Figure ES-2, covers the model years for which the coordinated EPA GHG and NHTSA CAFE programs have been in place. Five years also represents the average length of a vehicle redesign cycle, so it is likely that most vehicles have undergone design changes in this period.

Figure ES-2. Changes in Estimated Real-World Fuel Economy and CO<sub>2</sub> for Large Manufacturers



Overall, the industry improved CO<sub>2</sub> emissions by 21 g/mi and fuel economy by 1.3 mpg between model year 2012 and 2017 (the apparent discrepancy with figure ES-2 is due to rounding). Subaru had the largest decrease in CO<sub>2</sub> emissions during this period, reducing emissions by 43 g/mi. Mercedes had the next largest reduction at 42 g/mi, followed by Nissan-Mitsubishi at 40 g/mi. Subaru also had the largest improvement in fuel economy at 3.5 mpg, followed by Honda at 3.1 mpg and Nissan-Mitsubishi at 2.9 mpg.

In model year 2017, Honda led the industry with the lowest CO<sub>2</sub> emissions and highest fuel economy. Mazda and Hyundai had the second and third lowest CO<sub>2</sub> emissions, respectively. FCA had the highest new vehicle average CO<sub>2</sub> emissions and lowest fuel economy of the large manufacturers, followed by GM and Ford.

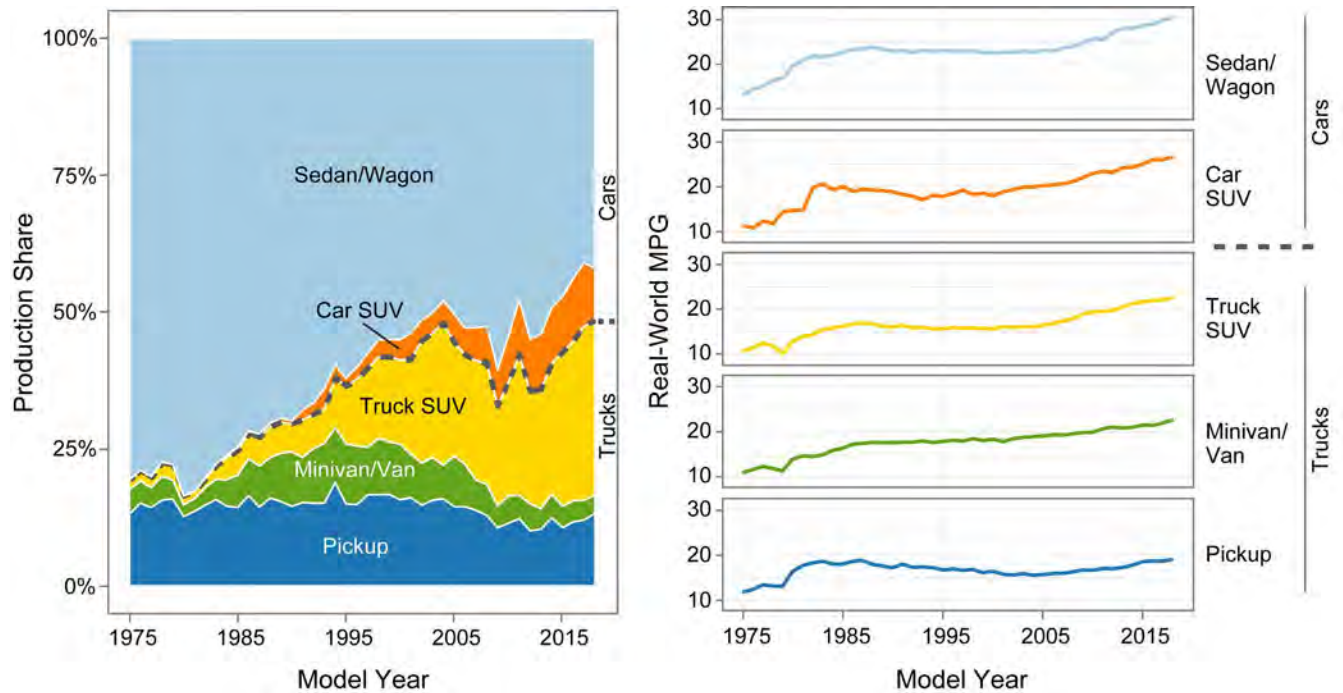
## Sport utility vehicles continue to gain market share, with truck SUVs achieving record low CO<sub>2</sub> emissions and record high fuel economy

In this report, vehicles are disaggregated into five vehicle types: sedan/wagon, car SUV, truck SUV, pickup truck, and minivan/van. Car SUVs are generally smaller 2WD SUVs while truck SUVs are larger or 4WD vehicles. The distinction between car and truck SUVs is based on regulatory definitions and is important because cars and trucks are subject to different GHG and fuel economy standards. Sedan/wagons and car SUVs are subject to the car regulatory standards while truck SUVs, pickups, and minivans/vans are subject to the truck standards. Note that media reports generally consider all SUVs as trucks, which is different from the regulatory distinctions used in this report.

The overall market continues to move towards both car SUVs and truck SUVs. Combined, car and truck SUVs captured a record high 43% market share in model year 2017. Truck SUVs improved fuel economy by 0.1 mpg and CO<sub>2</sub> emissions by 3 g/mile in model year 2017, while car SUVs essentially remained flat with no change in fuel economy and a slight increase in CO<sub>2</sub> emissions of less than 1 g/mi. Sedan/wagons fell to 41% of the market, or almost half of the market share they held in model year 1975, even as their fuel economy increased by 1 mpg.

All five vehicle types are at or near record low CO<sub>2</sub> emissions and record high fuel economy and have steadily improved in recent years. However, the market shift towards SUVs and away from sedan/wagons has offset some of the fleetwide benefits that otherwise would have been achieved from the increased fuel economy within each vehicle type.

**Figure ES-3. Production Share and Fuel Economy by Vehicle Type**



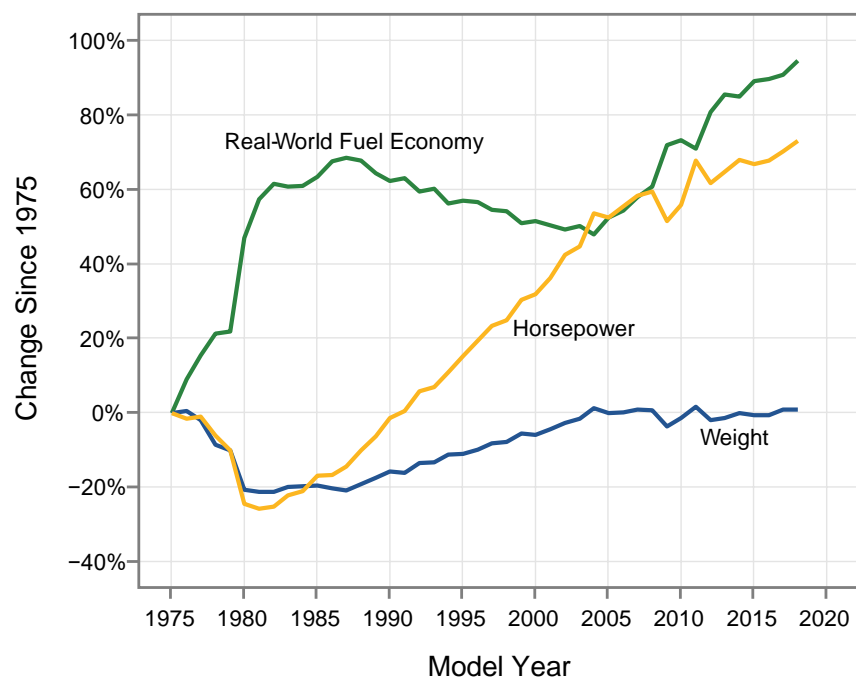
## Average new vehicle fuel economy and horsepower continue to increase, while weight remains constant

Vehicle weight and horsepower are two fundamental vehicle attributes that influence a vehicle's CO<sub>2</sub> emissions and fuel economy. Vehicles with higher weight, or more power, will generally have higher CO<sub>2</sub> emissions and lower fuel economy. Over time, automotive technology innovation has been applied to vehicle design with differing emphasis between vehicle weight, power, CO<sub>2</sub> emissions and fuel economy (Figure ES-4).

In the two decades before model year 2004, technology innovation was generally used to increase vehicle power, and weight increased due to changing vehicle design, increased vehicle size, and increased content. During this period, average new vehicle fuel economy steadily decreased and CO<sub>2</sub> emissions correspondingly increased. However, since model year 2004 technology has been used to increase fuel economy (up 29%) and power (up 11%), while maintaining vehicle weight and reducing CO<sub>2</sub> emissions (down 23%). The improvement in CO<sub>2</sub> emissions and fuel economy since 2004 is due to many factors, including gasoline prices, consumer preference, and increasing stringency of NHTSA light-duty car and truck CAFE standards.

One additional vehicle metric not shown in Figure ES-4 is vehicle footprint, or the area enclosed by the four tires. Footprint is important because it is the basis for determining regulatory standards under the GHG and CAFE regulations. Since EPA began tracking footprint in model year 2008, average footprint has increased slightly, up about 2%.

**Figure ES-4. Estimated Real-World Fuel Economy, Horsepower, and Weight Since Model Year 1975**



## Manufacturers continue to adopt a wide array of advanced technologies

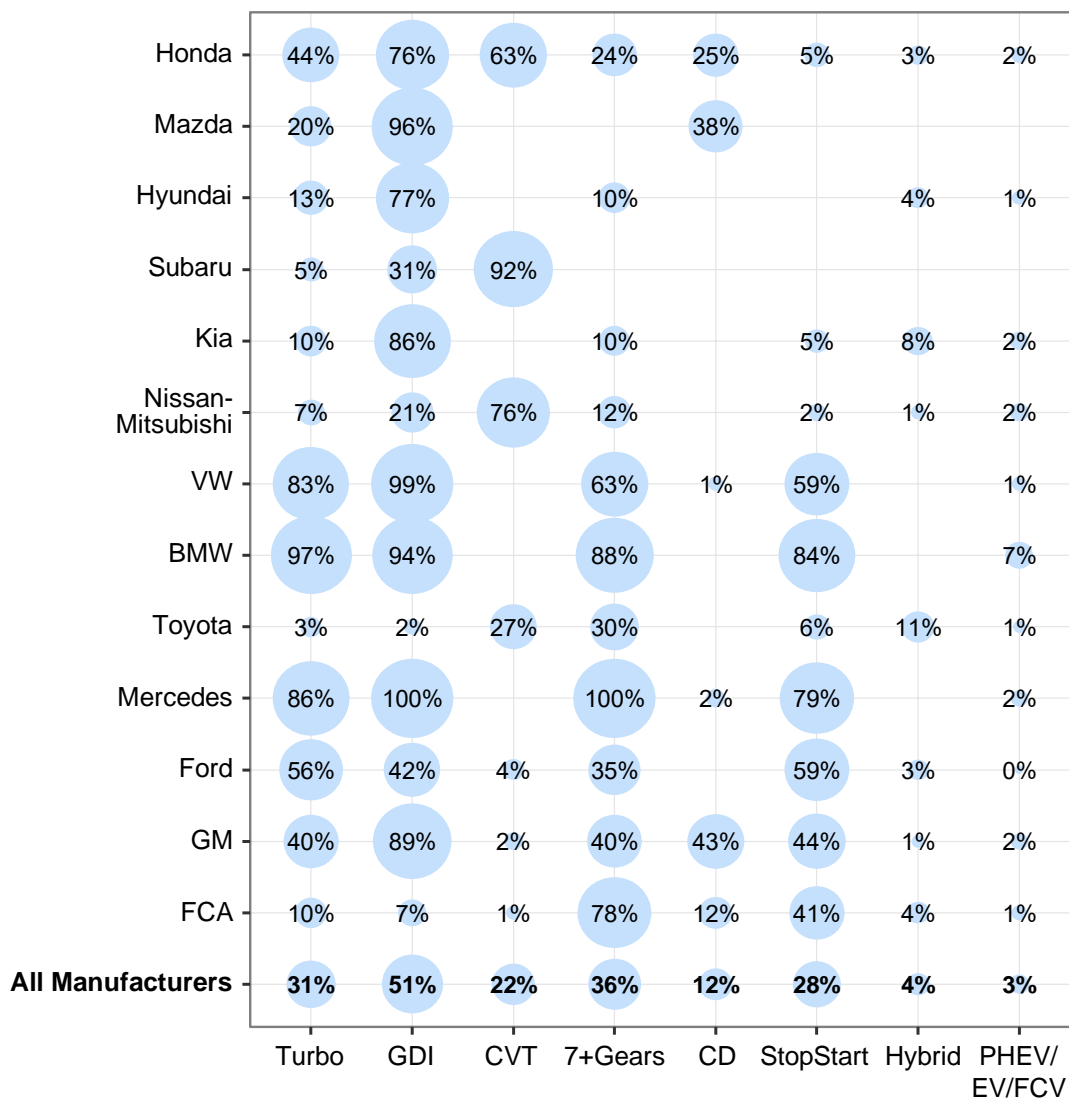
Technological innovation in the automobile industry has led to a wide array of technology available to manufacturers to achieve CO<sub>2</sub> emissions, fuel economy, and performance goals. Figure ES-5 illustrates projected manufacturer-specific technology adoption, with larger circles representing higher adoption rates, for model year 2018. The figure shows preliminary model year 2018 technology projections to provide insight on a quickly changing industry, even though there is some uncertainty in the preliminary data.

Engine technologies such as turbocharged engines (Turbo) and gasoline direct injection (GDI) allow for more efficient engine design and operation. Cylinder deactivation (CD)

allows for use of only a portion of the engine when less power is needed and stop/start systems can turn off the engine entirely at idle to save fuel. Hybrid vehicles use a larger battery to recapture braking energy and provide power when necessary, allowing for a smaller, more efficiently-operated engine. Transmissions that have seven or more gears, or continuously variable transmissions (CVTs), transfer power to the wheels more efficiently and allow for more efficient engine operation.

The technologies in Figure ES-5 are all being adopted by manufacturers to reduce CO<sub>2</sub> emissions and increase fuel economy, in some cases quite rapidly. For example, GDI was used in fewer than 3% of vehicles as recently as model year 2008 but is projected to be in about 50% of vehicles in model year 2018. Electric vehicles (EVs), plug-in hybrid vehicles (PHEVs), and fuel cell vehicles (FCVs) are a small but growing percentage of new vehicles.

**Figure ES-5. Technology Share for Large Manufacturers, Model Year 2018**



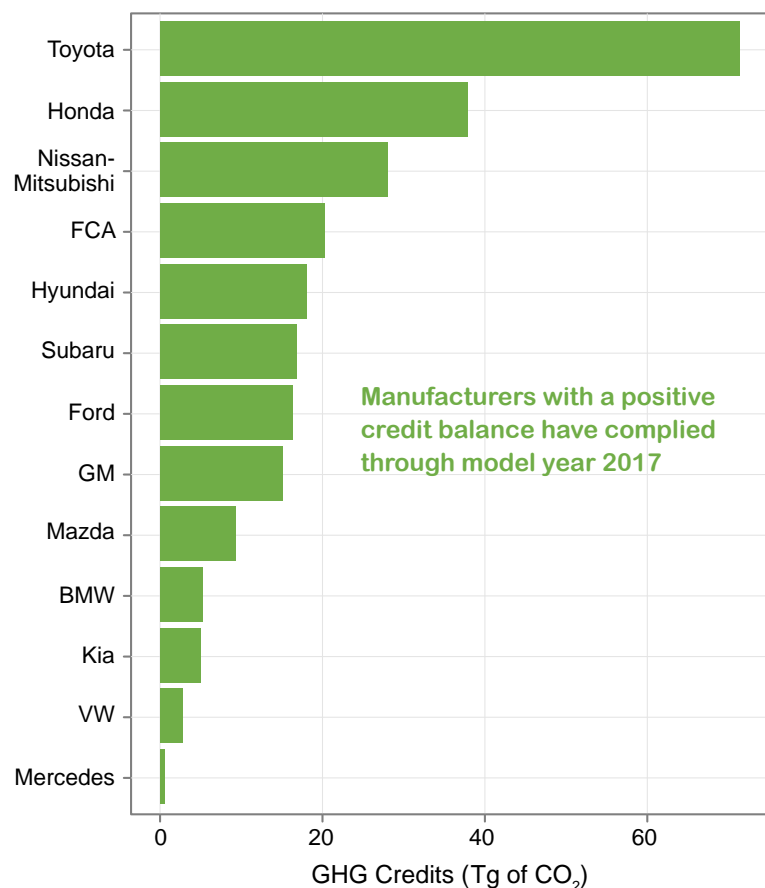


## All large manufacturers are in compliance with the GHG standards through the 2017 model year

EPA's GHG program is an averaging, banking, and trading (ABT) program. An ABT program means that the standards may be met on a fleet **average** basis, manufacturers may earn and **bank** credits to use later, and manufacturers may **trade** credits with other manufacturers. This provides manufacturers flexibility in meeting the standards while accounting for vehicle design cycles, introduction rates of new technologies and emission improvements, and fluctuating consumer preferences.

Manufacturers with average fleet emissions lower than the emissions standard generate credits by over complying with the standards. Because credits may not be carried forward unless deficits from all prior model years have been resolved, a positive credit balance means compliance with the current and all previous model years of the program. Any manufacturer with a deficit at the end of the model year has up to three years to offset the deficit with credits generated by future improvements beyond the standards or credits purchased from another manufacturer.

**Figure ES-6. GHG Credit Balance for Large Manufacturers, After 2017 Model Year**



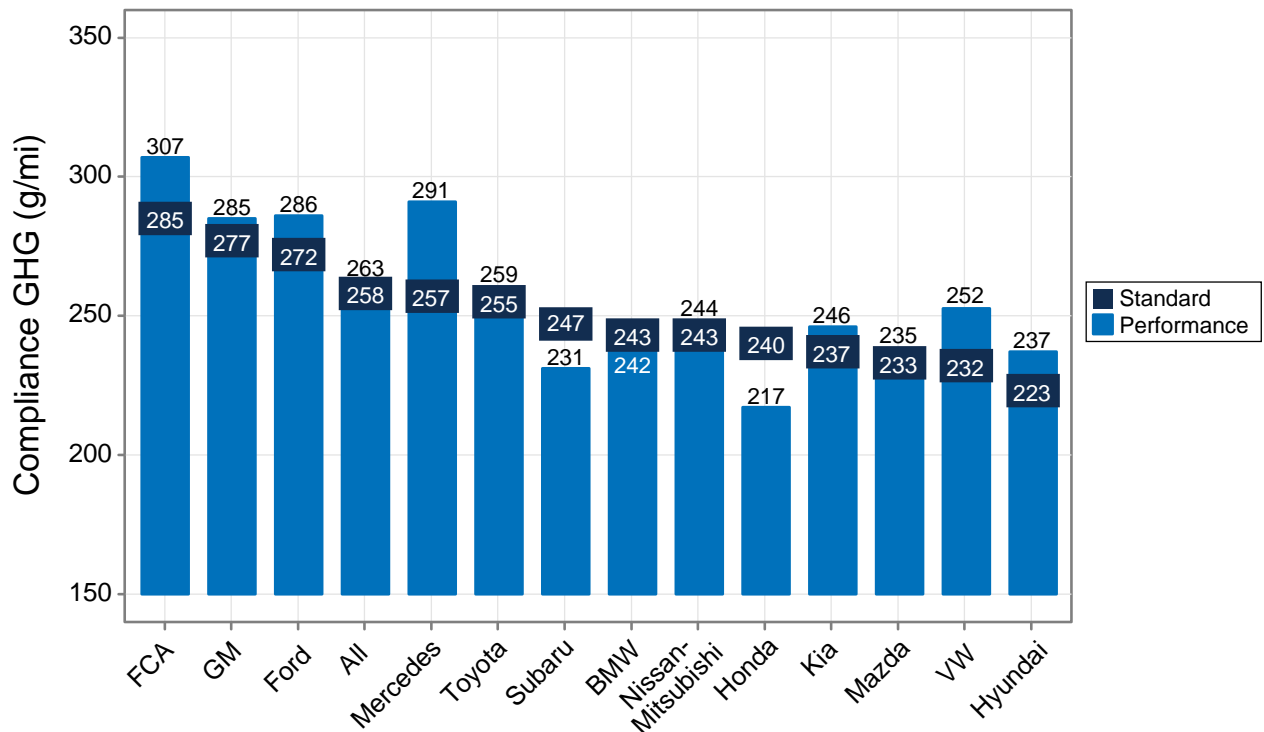
All large manufacturers (with production of more than 150,000 in model year 2017) ended the 2017 model year with a positive credit balance and are thus in compliance with model year 2017 and all previous years of the GHG program. The total credits accumulated, as shown in Figure ES-6, will be carried forward for use in future model years. Total credits are shown in **teragrams** (one billion kilograms), which accounts for manufacturer performance compared to their standards, expected vehicle lifetime miles driven, and the number of vehicles produced by each manufacturer, for all years of the GHG program.

## The industry used a combination of technology and credits to achieve compliance in 2017

Most large manufacturers used banked credits, along with technology improvements, to maintain compliance in model year 2017. Three large manufacturers achieved compliance based on the emission performance of their vehicles, without utilizing additional banked credits. Figure ES-7 illustrates the performance of individual large manufacturers in model year 2017 compared to their overall standard, in terms of an average vehicle grams per mile emission rate. This “snapshot” provides insight into how the large manufacturers performed against the standards in model year 2017, but it does not account for banked credits or credit transactions between companies. Figure ES-7 also does not portray whether these manufacturers ultimately complied with the model year 2017 standards (they did).

The manufacturers with emissions above their standards used banked or purchased credits in model year 2017. All of these manufacturers had credits available from previous years, and/or they were able to purchase credits to ensure their credit balance remained positive after model year 2017.

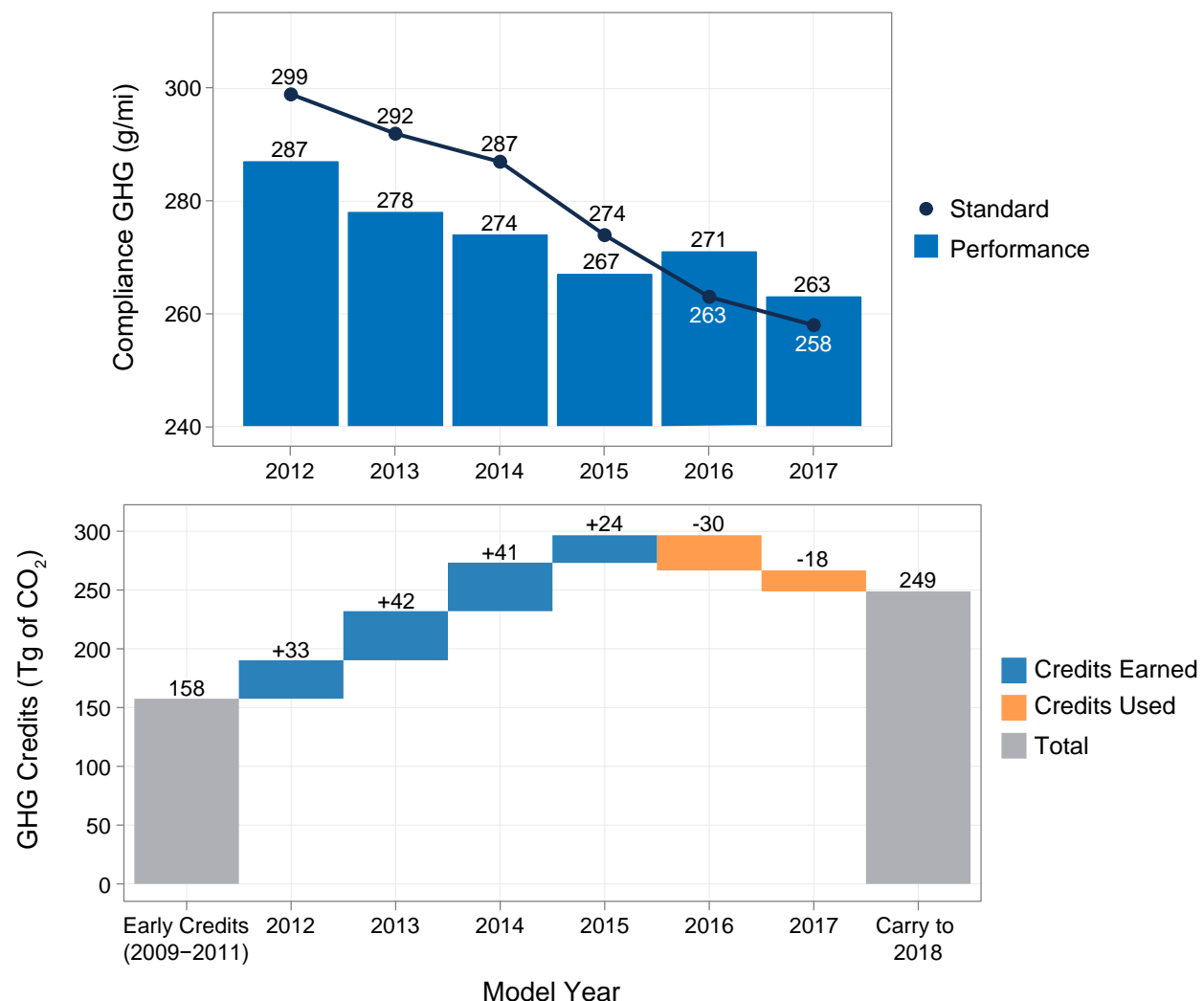
**Figure ES-7. Performance and Standards by Manufacturer, 2017 Model Year**



## A large bank of credits remains for the industry to use in future model years

The industry emerges from model year 2017 with a bank of almost 250 teragrams (Tg) of GHG credits, as seen in Figure ES-8. Based on their compliance strategy, many manufacturers used credits in model year 2017. As a result, the industry depleted their collective credit bank by about 18 Tg, or about 7% of the total credit balance, to maintain compliance. In addition to the balance of the industry-wide bank, the expiration date and distribution of credits are also important factors. Credits earned in model year 2017 or beyond have a five-year life, while all prior credits (92% of the current bank) will expire at the end of model year 2021. Additionally, more than half of the current balance is held by three manufacturers, and the availability of these or future credits is inherently uncertain.

**Figure ES-8. Industry Performance and Standards, Credit Generation and Use**



The industry was able to accrue credits before the standards took effect in model year 2012 for early deployment of efficient vehicles and technology (the “early credit” program). The industry generated additional credits the first four years of the program, as the industry GHG performance was below the standards. In the last two years, the industry GHG performance has been above the standards, resulting in withdrawals from the bank of credits to maintain compliance.

In model year 2017, the industry improved overall compliance GHG performance by 8 g/mi. While this was not enough to meet the standard, the gap between the standard and GHG performance narrowed to 5 g/mi from 9 g/mi. One factor that contributed meaningfully to this improvement was that production multipliers (e.g. one electric vehicle may be counted as two for compliance) took effect in model year 2017. These incentives are in place through model year 2019 before phasing out in 2021.

## The automobile industry continues to innovate, improve, and meet the GHG standards

The analysis here is a snapshot of the data collected by EPA in support of several important regulatory programs and is presented with the intent of providing as much transparency to the public as possible. The data show the change and innovation in the industry since model year 1975, and the manufacturers’ performance under EPA’s GHG standards.

To download the full report, or to explore the data using EPA’s new interactive data tools, visit the report webpage at [www.epa.gov/automotive-trends](http://www.epa.gov/automotive-trends).

*NOTICE: This technical report does not necessarily represent final EPA decisions, positions, or approval or validation of compliance data reported to EPA by manufacturers. It is intended to present technical analysis of issues using data that are currently available and that may be subject to change. The purpose of the release of such reports is to facilitate the exchange of technical information and to inform the public of technical developments.*

*The Department of Justice and EPA have reached settlements with Volkswagen and Fiat Chrysler Automobiles based on the sale of certain diesel vehicles equipped with devices to defeat the vehicles’ emission control systems. This report includes the original fuel economy and GHG certification values of these vehicles, as EPA believes this is a reasonable representation of how these vehicles were expected to perform. The affected vehicles are certain model year 2009 to 2016 diesel vehicles from Volkswagen and 2014 to 2016 diesel vehicles from Fiat Chrysler Automobiles, and account for less than 1% of production in all affected years. For more information about these investigations, please see [www.epa.gov/vw](http://www.epa.gov/vw) or [www.epa.gov/fca](http://www.epa.gov/fca).*