Union of Concerned Scientists

FACT SHEET

Tomorrow's Clean Vehicles, Today

Cars and trucks are already meeting—and beating—future fuel economy standards

HIGHLIGHTS

Federal fuel economy and global warming emissions standards for 2012–2025 passenger vehicles are one of the most important steps America has taken to address global warming and cut oil use. And thanks to forward-thinking investments in fuel efficiency technologies, manufacturers are producing cleaner cars and trucks faster than required, saving consumers millions of dollars at the pump every day. Today's vehicles are, on average, about one mile per gallon ahead of the standards, and 10 percent of vehicles sold today already meet the regulatory targets for 2020 and beyond.

These vehicles of the future are making real reductions today, and these benefits will only continue to grow as automakers deploy fuel-saving technologies across their fleets.

In 2010, the Environmental Protection Agency (EPA) and National Highway Traffic Safety Administration (NHTSA) issued joint standards for passenger cars and trucks sold in model years 2012 to 2016, regulating both global warming emissions and fuel economy for the first time ever. Two years later, the agencies extended the program to cover model years 2017 to 2025, setting a long-term regulatory guideline that would **cut global warming emissions from the average new car or truck by nearly 50 percent and boost on-road fuel economy from just 20 miles per gallon (mpg) in 2010 to an estimated 37 mpg.**[1]

Already, automakers are demonstrating that they have the technology to not only meet these standards, but also exceed them. Today, consumers have a greater number of fuel-efficient, lower-emission choices across all vehicle classes, and these vehicles can save drivers thousands of dollars at the pump compared with vehicles sold just a few years ago. **Ten percent of new vehicles sold today already meet the regulatory targets for 2020 and beyond.** Automakers are well positioned to meet requirements over the next 10 years by expanding the use of fuel-saving and emissions-cutting technologies across their fleets.

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Today, consumers can choose from a wide array of cars and trucks that save money at the pump. Indeed, 10 percent of vehicles sold in 2015 will meet fuel economy and global warming emissions standards for 2020 and beyond, thanks to automakers employing efficient technologies across their fleets.

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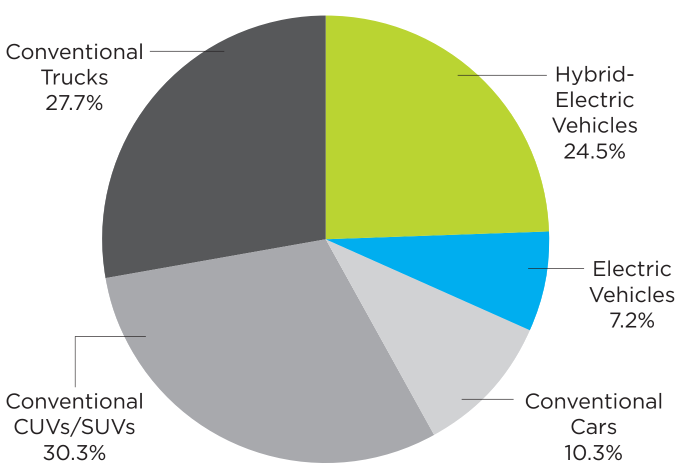
1 *The standards are commonly referred to as 54.5 mpg-equivalent standards. However, on-road fuel economy is different than the values used for regulatory compliance; see UCS 2011 for more information.*

The Growing Market for Clean Cars and Trucks

Regulations are not the only force pushing manufacturers to improve the fuel efficiency of their vehicles. Automobile dealers and consumer groups have found that **people consider fuel economy to be the most influential factor when purchasing a new vehicle** (J.D. Power 2015; NADA 2014). Fuel-efficient vehicles act as an insurance policy against the volatility of the oil market—an efficient vehicle saves consumers money at the pump, whether gas prices are $2 or $4 per gallon.

Manufacturers are responding to consumer demand in part by offering more efficient option packages for their models, whether that is an "eco" package, a hybrid model, or just a base engine configuration that gets great gas mileage. In total, **nearly 100 different model variants meet fuel economy standards for 2020 or beyond—including variants of six of the top 10 best-selling vehicles.**[2] These models span a range of vehicle classes and technologies—indeed, nearly 70 percent of those sold are powered exclusively by a conventional internal combustion engine, and about 60 percent are trucks, crossover-utility vehicles (CUVs), or sport-utility vehicles (SUVs) (see Figure 1).

FIGURE 1. Vehicles Sold Today That Meet or Exceed 2020 Standards, by Vehicle Type



The vehicles sold in 2015 that meet EPA and NHTSA standards for 2020 and beyond use a variety of technologies, ranging from efficient conventional engines to battery-electric vehicles that eliminate the engine altogether, and span every major class of vehicle. Based on vehicle sales, the majority of these vehicles are conventional gasoline- and diesel-powered cars and trucks.

NOTE: Percentages reflect projected 2015 sales based on analogous 2014 vehicle sales. It includes nearly 100 different vehicle subconfigurations from the 2015 model year.

> ***Nearly 100 different model variants meet fuel economy standards for 2020 or beyond—including variants of six of the top 10 best-selling vehicles.***

Included in the latter category is Ford, which began offering a turbocharged version of its popular F-150 pickup back in 2011 for customers who wanted the towing and payload capabilities of the larger V8 engine without giving up the fuel economy of the smaller V6. In 2014, this was the most popular version of the best-selling vehicle in the country. For 2015, Ford has added another variant with an even smaller engine made possible by a lighter aluminum body, and stop-start capability that can provide even better fuel economy. (These and other fuel-saving technologies are described in more detail in Box 1.)

Super-efficient hybrids are expanding their reach as well. The 50 mpg Toyota Prius is the most popular hybrid vehicle in the market, with more than 125,000 sold in 2014. It is so popular that it spawned three siblings: Prius c, a smaller city car; Prius V, a larger wagon; and Prius Plug-in, which can drive short distances on electricity from the grid. Toyota continues to expand its hybrid offerings to other classes of vehicles as well (for example, the Highlander SUV), working to ensure that consumers have efficient vehicle choices in every category.

Conventional Vehicles Go High-Tech

As noted above, an internal combustion engine exclusively powers the majority of model configurations that already satisfy future vehicle standards. In this fact sheet, we highlight 10 of these conventional vehicles that not only represent the breadth of options for consumers but also demonstrate the efficiency improvements that can still be made to the internal combustion engine using innovative technologies introduced to the market today (see pp. 4–5).

2 *Model variant of the top 10 best-selling vehicles (based on 2014 sales) that meet or exceed 2020 regulatory targets: Ford F-150 with 2.7L EcoBoost (#1); Ram 1500 EcoDiesel (#3); Honda CR-V 4WD (#7); Toyota Corolla LE ECO (#8); Honda Civic HF (#9); and Ford Fusion Hybrid and Ford Fusion Energi (#10).*

Smaller, turbocharged engines are one of the biggest technology trends, with deployments in every class of vehicle; Ford has been one of the greatest adopters of this technology and offers an "EcoBoost" engine option across most of its light-duty fleet. Transmission improvements—increasing the number of gears and/or improving operation of the gearbox and clutch—are another major trend across a broad range of vehicles.

These and other technologies translate into big savings across the fleet. Our analysis shows that, over their lifetimes, **the 10 vehicles we have highlighted are saving consumers more than $4,000 in fuel costs**, on average, compared with analogous 2010 vehicles.[3] And these fuel-saving technologies have been deployed in just a fraction of the U.S. vehicle fleet over the last five years; imagine the payoff to consumers and *(continued on p. 6)*

BOX 1.

Clean Technology, from A to Z

Below are just some of the technologies available to automakers today for cutting fuel use and curbing global warming emissions.

Active aerodynamics—These features respond in real time to a vehicle's needs, reducing aerodynamic drag and improving fuel economy. One example is *active grille shutters*, which close at steady highway speeds when the engine is at relatively low power and needs less air intake.

Diesel—Diesel vehicles use a more energy-dense fuel and a different combustion cycle than a gasoline engine that, together, lead to improved fuel efficiency. New advances in pollution-control methods have made the pollution from diesel vehicles comparable with gasoline vehicles, and many manufacturers are now deploying diesel vehicles to reduce fuel use.

Direct injection—By injecting fuel directly into the cylinder of an engine at high pressure, direct injection can improve control of the combustion process; it also results in more efficient ignition of the fuel, improving fuel economy and reducing pollution.

Electrification—A motor is more efficient than an engine, and using electricity to either partially or fully propel the vehicle can result in significant improvements to efficiency. *Hybrid-electric vehicles* (e.g., Toyota Prius) combine an electric motor and gasoline engine; *plug-in hybrid-electric vehicles* (e.g., Chevy Volt) do as well, but also draw energy from the electric grid for longer electric-only driving. *Battery-electric vehicles* (e.g., Nissan Leaf) run exclusively on electricity, eliminating the engine altogether.

Lightweighting—Reducing the weight of a vehicle reduces the amount of energy (i.e., fuel) necessary to propel it. By replacing traditional steel with materials like *aluminum, carbon fiber*, and *high-strength steel* that can offer similar durability at reduced weight, manufacturers can provide greater fuel efficiency while maintaining safety and performance.

Regenerative braking—A lot of energy is wasted as heat when a driver brakes a vehicle; regenerative braking slows a vehicle by converting its kinetic energy to electricity that can be used later to either power accessories or aid in propulsion.

Solar-reflective glazing—By reflecting solar energy that would typically be transmitted to the vehicle's interior, solar-reflective glazes on the windows or paint reduce cabin temperature, thus reducing the amount of energy used by the air-conditioning system.

Stop-start—Fuel wasted by idling is virtually eliminated with stop-start technology, which turns off the engine while the vehicle is stopped and immediately turns the engine back on when the driver releases the brake.

Transmission improvements—Automatic transmissions are getting more efficient through reduced friction and improved clutch designs, including *dual-clutch transmissions* that allow for a more efficient transfer of torque. This can also be combined with a higher number of gears (e.g., *7-, 8-, 9-, 10-speed transmissions*) that allow for the engine to be operating more efficiently more frequently, or with *continuously variable transmissions* that keep the engine at its "sweet spot" at all times.

Turbocharging and engine downsizing—A turbocharger can provide a significant boost in power for each combustion event, allowing a smaller engine to provide power equivalent to a much larger engine. Smaller engines also lose less energy to friction, further reducing fuel use.

Variable valve control—The precise timing of the intake and exhaust valves helps determine the efficiency of the combustion process. There are numerous strategies available to manufacturers to optimize valve phasing, lift, and timing; some of these can also result in reduced pollution as well as reduced fuel use.

3 Looking across all conventional vehicles that meet or exceed 2020 standards, consumers save an average of $3,700 in fuel costs over the lifetime of these vehicles.

10 Conventional Cars and Trucks with

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Ford F-150

Model Specifications: 2.7L EcoBoost

Vehicle Type: Pickup truck

Technologies: Active grille shutters; aluminum lightweighting; stop-start; turbocharged, downsized engine

FUEL ECONOMY
2010: 16 mpg
2015:
21 mpg
Meets standards for 2020–2023

Lifetime Fuel Savings[a] (compared with 2010):
$4,700

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Ram 1500

Model Specifications: EcoDiesel

Vehicle Type: Pickup truck

Technologies: 8-speed automatic transmission; active grille shutters; diesel

FUEL ECONOMY
2010: 15 mpg[b]
2015:
23 mpg
Meets standards for 2020–2023

Lifetime Fuel Savings (compared with 2010):
$6,500

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Mercedes GLA250

Model Specifications: 4MATIC with 2.0L Turbo

Vehicle Type: Luxury crossover utility vehicle

Technologies: 7-speed dual-clutch transmission; solar-glazed glass; stop-start; turbocharged, downsized engine

FUEL ECONOMY
2010: 18 mpg[c]
2015:
27 mpg
Meets standards for 2020

Lifetime Fuel Savings (compared with 2010):
$8,100

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Subaru Outback

Model Specifications: 2.5i with CVT

Vehicle Type: Crossover utility vehicle

Technologies: Continuously variable transmission

FUEL ECONOMY
2010: 24 mpg
2015:
28 mpg
Meets standards for 2020–2021

Lifetime Fuel Savings (compared with 2010):
$2,350

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Honda CR-V

Model Specifications: 4WD

Vehicle Type: Crossover utility vehicle

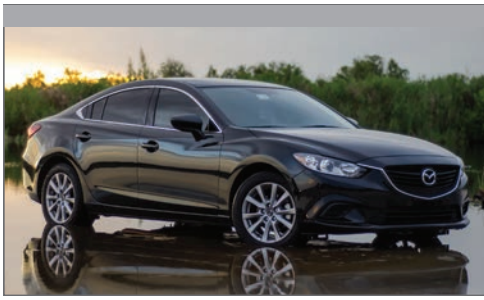
Technologies: Continuously variable transmission; high-compression direct injection; variable valve control

FUEL ECONOMY
2010: 23 mpg
2015:
28 mpg
Meets standards for 2020–2021

Lifetime Fuel Savings (compared with 2010):
$3,250

NOTES: a. Lifetime fuel savings for all vehicles shown are discounted at 5 percent annually; b. 2010 model is gasoline-powered; c. 2010 analog vehicle is the Mercedes GLK350.

Unconventional Fuel Economy



Mazda6

Model Specifications: Grand Touring with Technology Package

Vehicle Type: Midsize sedan

Technologies: Active grille shutters; high-compression direct injection; regenerative braking; variable valve timing

FUEL ECONOMY
2010: 24 mpg
2015:
32 mpg
Meets standards for 2020–2021

Lifetime Fuel Savings (compared with 2010):
$3,950

Hyundai Sonata

Model Specifications: 1.6L Eco

Vehicle Type: Midsize sedan

Technologies: 7-speed dual-clutch transmission; solar-glazed glass; turbocharged, downsized engine

FUEL ECONOMY
2010: 25 mpg
2015:
32 mpg
Meets standards for 2020

Lifetime Fuel Savings (compared with 2010):
$3,050

Chevy Cruze

Model Specifications: ECO (Manual)

Vehicle Type: Compact sedan

Technologies: Solar-glazed glass; turbocharged, downsized engine

FUEL ECONOMY
2010: 29 mpg
2015:
33 mpg
Meets standards for 2020

Lifetime Fuel Savings (compared with 2010):
$1,550

BMW 3 Series

Model Specifications: 328d

Vehicle Type: Luxury sedan

Technologies: 8-speed automatic transmission; diesel; stop-start

FUEL ECONOMY
2010: 27 mpg
2015:
36 mpg
Meets standards for 2020–2022

Lifetime Fuel Savings (compared with 2010):
$4,050

Mitsubishi Mirage

Model Specifications: None (All variants)

Vehicle Type: Subcompact

Technologies: Aerodynamics; continuously variable valve timing; lightweighting

FUEL ECONOMY
2010: 28 mpg[d]
2015:
40 mpg
Meets standards for 2020–2023

Lifetime Fuel Savings (compared with 2010):
$3,900

NOTE: d. 2010 analog vehicle is the Chevrolet Aveo5.

(continued from page 3)

the environment over the next 10 years as automakers continue to increase their investments in innovative fuel-saving technology.

Advanced-technology Vehicles Are Helping Automakers Meet the Standards

The internal combustion engine will continue to power the vast majority of cars and trucks sold over the next decade. However, advanced-technology vehicles that run partially or fully on electricity, such as the hybrid Toyota Prius and battery-electric Nissan Leaf, will also play an important role in reducing oil use and cutting global warming emissions in the years ahead.

State and federal incentives and infrastructure investments have enabled consumers to purchase more electric vehicles (EVs); in turn, getting more EVs on the road is helping automakers meet fuel economy and global warming emissions standards. They are also saving consumers money on fuel; on a per-mile basis, driving on electricity is cheaper than gasoline in every region of the country. Indeed, **the average EV owner will save more than $7,500 in fuel costs** over the lifetime of the vehicle compared with a similar 2015 conventional vehicle.[4]

Hybrid-electric vehicles and plug-in electric vehicles already make up more than 3 percent of the market. While meeting federal standards does not require widespread deployment of EVs by 2025, the growing EV market will help manufacturers lower the global warming emissions from their fleets.

Staying on Track for 2025

Despite the growing number of innovative, fuel-efficient vehicles available to consumers, the average vehicle sold today gets only 24 mpg on the road (EPA 2014a). This is a significant improvement over the previous decade, however, and the standards are helping to push even stronger progress—**the average new vehicle in 2025 will achieve an estimated 37 mpg on the road** (see Figure 2),[4] and many vehicles will far exceed this target.

Over the next two years, the EPA and NHTSA will evaluate how well the manufacturers are meeting the standards and review whether the targets for 2022–2025 need to be revised. The availability of numerous vehicles already meeting targets well into the future indicates that automakers are up to the challenge. **The latest scorecard for the EPA/NHTSA regulations shows that manufacturers, on average, are about 1 mpg, or one year, ahead of where the regulations require them to be** (EPA 2015).

In addition to making their vehicles more fuel-efficient, manufacturers are encouraged to reduce global warming emissions from their fleets by reducing refrigerant leakage from air-conditioning (A/C) systems and making A/C systems operate more efficiently. Because the refrigerants used in most vehicles' A/C systems are potent global warming gases, reducing refrigerant use helps get automakers closer to the 2025 targets. **Manufacturers are currently reducing global warming emissions from vehicle climate control systems faster than required.**

Because they have been implementing technologies ahead of the regulatory requirements, manufacturers, on avaerage, have earned more flexibility in meeting future targets, due to earning credits for overcompliance that can be used in later years. This effectively gives industry extended lead times to get new technology investments out of the labs and into showrooms. As a result of this credit-banking system, the standards will approximately result in the expected level of total emissions savings in the end, but some of **the benefits to the climate and our pocketbooks will be reaped sooner than expected.**

Standards Provide Flexibility and Deliver Efficiency in Every Class

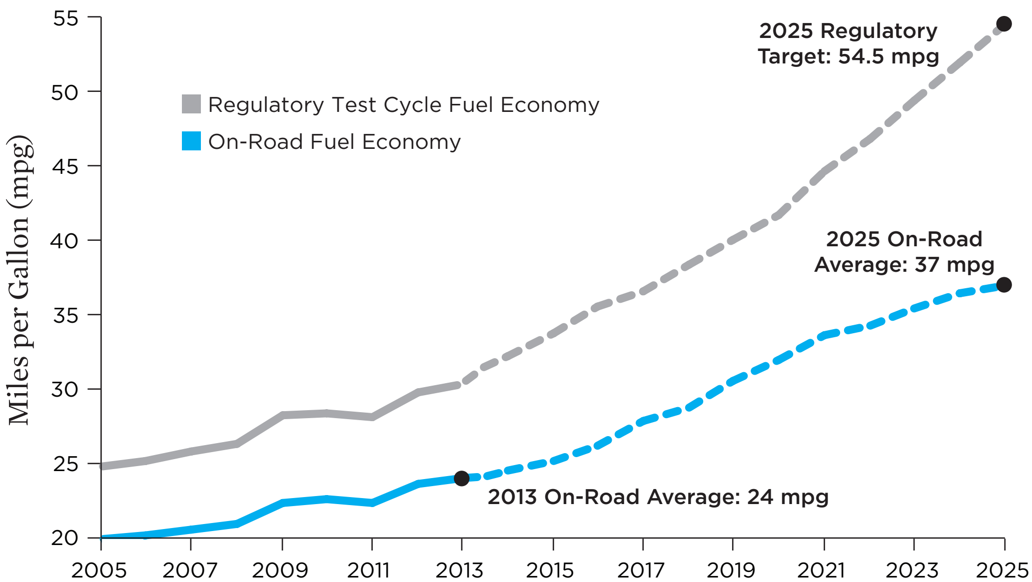
The current fuel economy and global warming emissions standards are strong but also flexible. The rule is designed to respond to changes in the market, including the types of vehicles manufacturers might sell in the future. This is one of the major reasons why shifts in consumer preferences or the mix of vehicles a manufacturer chooses to sell do not mean that the standards need to be revised.

Vehicle standards depend on the size and type of a vehicle—a small car will have a higher fuel economy target than a small truck or a large car. They are designed that way to ensure that all sizes and types of vehicles become more efficient, not to put everyone in tiny economy cars.

For an example of how this works, consider the Mitsubishi Mirage and Ford F-150 (both highlighted on pp. 4–5). The Mirage has an average on-road fuel economy target for 2015 of 31 mpg; the F-150 is a much larger vehicle and, subsequently,

4 *Sales-weighted savings that include both plug-in electric hybrid vehicles ($5,750 in lifetime savings) and battery-electric vehicles ($9,300 in lifetime savings). Savings are based on projected electricity and fuel prices by the Energy Information Administration (EIA 2015) and discounts future cost savings by 5 percent annually.*

FIGURE 2. Fuel Economy of New Cars and Trucks, 2005–2025



Today's average new vehicle gets 24 mpg on the road; by 2025 this will improve to around 37 mpg. This is much lower than the well-publicized 54.5 mpg-equivalent regulatory standard, which is based on laboratory tests that do not accurately reflect real-world usage and considers emissions credits earned from air-conditioning system improvements.

SOURCES: EPA 2014A; EPA AND NHTSA 2012A, 2010.

has a lower 2015 target of about 19 mpg.[5] In 2010, these vehicles' respective fuel economies were 28 mpg and 16 mpg, meaning that both manufacturers needed to improve the vehicles' efficiency in order to meet the future standard. And they did: in a five-year span, Mitsubishi improved the Mirage's fuel economy to an impressive 40 mpg, and Ford increased the efficiency of the F-150 to as much as 21 mpg. In both cases, federal regulations helped drive the manufacturers' progress, and the vehicles well exceeded their 2015 standards thanks to investment in efficiency technologies.

Because the regulations consider the size of vehicles sold, **selling more large vehicles does not hurt a manufacturer's ability to meet fuel economy standards.** Each vehicle has its own target, as described above. A manufacturer's annual fuel economy target is then based on the sales-weighted average of the targets of all vehicles sold. For example, if Ford sold only the most efficient version of the F-150, the company would already be in compliance with standards out to 2023. Manufacturers are thus driven to try to make each vehicle, on average, meet its target—and are particularly driven to do so with high-volume models—but the standards allow each manufacturer the flexibility to consider which strategies best correspond to its own product offerings and customers.

Conclusions

Automakers are having no trouble meeting the challenge of making cleaner cars and trucks for consumers—indeed, 10 percent of new vehicles sold today already meet fuel economy and global warming emissions standards for 2020 and beyond. By deploying a wide array of technologies into vehicles today, automakers are well on their way to meeting the federal government's goal of cutting global warming emissions from the average new passenger vehicle in half by 2025.

5 *The regulatory target in 2015 for the F-150, based on the sales-weighted average cab and bed, is 362 g/mile, as measured on the city and highway test cycles used for regulatory purposes. This translates to approximately 19 mpg in real-world, on-road driving conditions after considering air-conditioning credits.*

Our analysis shows that **the vehicles sold already under these standards are saving more than 5 million gallons of fuel a day compared with vehicles sold just five years ago, and have avoided 29 million metric tons of global warming emissions.** Not only has that saved more than $9 billion in fuel so far (and continues to save more than $12.3 million a day), but it would be equivalent to shutting down five coal-fired power plants *permanently*. If these standards reain in place, these economic and environmental benefits will only continue to grow as more fuel-efficient, low-emission vehicles hit our nation's roads.

BOX 2.

Methodology

Our analysis uses fuel economy data published by the EPA: 2-cycle test data are used for comparison to the regulatory targets, and 5-cycle adjusted label data are used to represent real-world fuel economy. By combining this with the values in the regulations of carbon content for gasoline (8,887 grams per gallon) and diesel (10,180 grams per gallon), we are able to estimate the tailpipe emissions for each vehicle (EPA and NHTSA 2012a). From this total, we subtract the projected contribution of emissions reductions from the air-conditioning system as provided by the EPA in its Rule Impact Assessment (EPA 2012). For appropriate technologies (e.g., stop-start) we include off-cycle credits for both fuel economy and global warming emissions commensurate with those given in the technical documentation of the regulation (EPA and NHTSA 2012b), with the exception of Mercedes vehicles, whose off-cycle credits were approved separately (EPA 2014b).

The physical footprint of each vehicle was calculated with publicly available data on wheelbase and front and rear track width; most often this was available directly from the manufacturers' websites. These values were then used to calculate the regulatory targets for both fuel economy and global warming emissions by using the target curves defined in the regulations for passenger cars and light trucks (EPA and NHTSA 2012a).

Sales data were estimated for the 2015 model year based on sales data from October 2013 through September 2014, which we use to estimate the 2014 model year (WardsAuto 2015a, 2015b, 2015c; Cobb 2015, 2014). For those models with no 2014 analog, the sales fraction of the particular submodel configuration was estimated based on the most similar 2014 configuration, company press releases, or inventory data from Edmunds.com.

TEN CONVENTIONAL CARS AND TRUCKS WITH UNCONVENTIONAL FUEL ECONOMY

The 10 vehicles highlighted in this analysis are representative of the breadth of conventional vehicles that meet future standards, and are not exhaustive. More than 40 conventional vehicle configurations were identified that meet 2020 standards or better, in addition to nearly 60 hybrid-electric or plug-in electric vehicles.

The lifetime savings for each of the 10 highlighted vehicles are based on the best available analog—in most cases, the baseline 2010 model of the same model line. Projected fuel prices were used to calculate savings (EIA 2015): the regular gasoline price is projected to rise from $2.31 per gallon in 2015 to $3.20 per gallon in 2030. Lifetime mileage considered for each vehicle is 185,953 miles for cars and 200,284 miles for trucks and SUVs, based on scrappage-weighted National Highway Traffic Survey data and a 0.6 percent annual increase, similar to the regulations (EPA and NHTSA 2012b). Future fuel savings were discounted 5 percent annually.

The years listed for each vehicle represent the range of fuel economy and global warming emissions standards that different subconfigurations of the specified vehicle may meet.

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NATIONAL HEADQUARTERS
Two Brattle Square
Cambridge, MA 02138-3780
Phone: (617) 547-5552
Fax: (617) 864-9405

WASHINGTON, DC, OFFICE
1825 K St. NW, Suite 800
Washington, DC 20006-1232
Phone: (202) 223-6133
Fax: (202) 223-6162

WEST COAST OFFICE
500 12th St., Suite 340
Oakland, CA 94607-4087
Phone: (510) 843-1872
Fax: (510) 843-3785

MIDWEST OFFICE
One N. LaSalle St., Suite 1904
Chicago, IL 60602-4064
Phone: (312) 578-1750
Fax: (312) 578-1751

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