

# CUSTOMERS AND PRODUCTS

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Our core business is to produce high-quality, smart, safe vehicles that delight our customers.

We use life cycle assessments to understand and reduce the overall impacts of our products and the materials we use; we are developing sustainable technologies to improve fuel economy; and we're exploring alternative fuel and powertrain options across our portfolio.

As part of our plan, we have invested heavily in electric vehicles, providing customers with efficient, low-carbon alternatives. We are also leaders in the use of sustainable, bio-based and recycled materials, helping us to enhance fuel economy, performance and end-of-life options.

The quality and safety of our products remain priorities of the utmost importance. We are committed to designing and manufacturing vehicles and technologies that achieve high levels of safety across a wide range of real-world conditions. We continue to get high marks in key public and private crash-testing programs, as well as in customer satisfaction and quality surveys, while our global Ford Driving Skills for Life education program is seen as an equally important contribution to road safety.

*“Our customers are why we exist; their satisfaction is essential to our future success. Therefore, the quality of our products and services must be our number one priority, today and tomorrow.”*

**Bill Ford**  
Executive Chairman, Ford Motor Company

## How We've Gone Further

 **Delivering Our Electrification Plans**  
13 new electric vehicles to be launched by 2020 Globally, more than 40% of our nameplates will be electrified

 **Recycling Reaches New Heights**  
We recycle 5 million pounds of aluminum scrap a week through our closed-loop recycling system Enough to build 51 jumbo jets every month

 **Growth in Sustainable Materials**  
Annual CO<sub>2</sub> emissions cut by more than 20 million pounds by using soy foam in our new U.S. vehicles In seat cushions, backs and headrests

 **Keeping Customers Satisfied**  
Customer satisfaction in North America was a best-ever 81% Global Quality Research System (GQRS), 2016

 **5-Star Safety Ratings**  
Ford has seven Advanced Awards for innovative technologies, and six Best in Class Awards, from Euro NCAP More than any other OEM

 **Safer Behavior Behind the Wheel**  
Ford Driving Skills for Life has now reached 1 million newly licensed drivers Program active in 35 countries

## Reducing Vehicle Emissions

We are committed to making vehicles and technologies accessible to millions of people to help improve lives. But we also acknowledge that climate change is real and that we share a responsibility to address this global challenge.

In our products, as well as in [our operations](#), we are working to reduce greenhouse gas (GHG) emissions – including investing in powertrain technology and electrification, aerodynamics and weight reduction – to provide our customers with more efficient, lower-impact alternatives.

### Cutting Emissions Across Our Portfolio

Responding to the risks and opportunities presented by climate change, our [science-based global strategy](#) aims to reduce GHG emissions from our vehicles. It encompasses our Sustainable Technologies and Alternative Fuels Plan to deliver high-quality products that meet consumer demand while also helping to limit future climate change. Our climate change stabilization commitment also aims to reduce GHGs from [operational processes](#).

Through this plan, and working closely with policy makers around the world, we continue to reduce GHG emissions from our vehicles in line with regional “glide paths.” These trajectories define the industry-wide emissions reductions needed to support stabilizing climate change.

We recognize that there's no single way to improve fuel efficiency and cut vehicle CO<sub>2</sub> emissions. That's why we take a portfolio approach across three areas:

-  **Vehicle**
- Offering customers the “power of choice” through affordable, accessible lower-carbon options:
- New engine/transmission technologies
  - Electrical system improvements
  - Aerodynamic improvements
  - Weight reductions
  - Advanced powertrain options
  - Electric vehicles
  - Vehicles powered by alternative fuels

-  **Fuel**
- Evaluating, developing and introducing vehicles that use fuels with lower fossil-carbon content:
- Biofuels
  - Electricity
  - Compressed natural gas (CNG)
  - Liquefied petroleum gas (LPG)
  - Hydrogen



**Customer**

Customers decide which vehicles and fuels to purchase and how those vehicles will be driven and maintained.

We promote “eco-driving,” providing training, information and vehicle technology to help customers use the least fuel possible.

**Our Plan for a More Sustainable Future**

For the past nine years, Ford has been following an ambitious plan of vehicle technology and alternative powertrain and fuel actions. By implementing this consistently, we are improving fuel economy and reducing CO<sub>2</sub> emissions across our product portfolio.

No one predicted the direction fuel prices would take over recent years. As fuel prices declined, so too has the demand for fuel efficiency, and customers are prioritizing other vehicle attributes such as performance and infotainment. When fuel prices are low, customers tend to be less interested in purchasing vehicles with advanced powertrain technologies that are more fuel-efficient but also more expensive.

**Global Technology Migration Path – CO<sub>2</sub> Reduction**

**In Place (2017)**

 **Internal Combustion Engine (ICE)**

- EcoBoost® engines widely available
- Diesel/after-treatment technology to reduce emissions

 **Alternative Fuels**

- Vehicle and powertrain capability to leverage renewable fuels
- Flex Fuel Vehicles
- CNG prepared engines available where demand exists

 **Energy Management, Electrical Architecture and Efficiency**

- Electric power steering widely available
- Global migration of battery management systems ongoing
- Aerodynamic improvements

 **Transmission and Driveline**

- 6-speed replaces 4- and 5-speed automatic transmissions

 **Weight Reduction**

- Significant weight reduction programs using conventional materials

 **Electrification**

- Start-Stop systems introduced
- Hybrids/Plug-In Hybrids available in >10% of nameplates
- 20 mile PHEV
- 76 mile BEV

 **Fuel Cells**

- First generation automotive fuel cell system complete

**Near Term (2020)**

**Existing Technologies at High Volume**

 **Policy/Mobility**

- Initiate cross-sector GHG mitigation discussions
- Engage in dialogue with technical and regulatory community on the “end-game” for future local air quality vehicle tailpipe emission standards

 **Internal Combustion Engine (ICE)**

- Advanced technologies to improve gasoline engine/EcoBoost® powertrain efficiency and performance
- Innovation in diesel technology
- Innovation to meet future local air quality vehicle tailpipe emission standards

 **Alternative Fuels**

- Expand product capability for renewable fuels

 **Energy Management, Electrical Architecture and Efficiency**

- Additional aerodynamic improvements

 **Transmission and Driveline**

- 8+ speed automatic transmissions and advanced driveline technologies widely available

 **Weight Reduction**

- Significant weight reduction programs using conventional and advanced materials

 **Electrification**

- Electrification solutions applied to manual transmissions
- Start-Stop widely available
- Hybrids/Plug-In Hybrids available in >25% of nameplates
- 30+ mile PHEV
- 200+ mile BEV

 **Fuel Cells**

- Develop second generation fuel cell technologies

**Mid Term (2025)**

**Reduce Weight and Expand Electrification**

 **Policy/Mobility**

- Introduction of autonomous vehicle (AV) technologies
- Introduction of commercial vehicle (CV) advanced technologies
- Introduction of smart mobility technologies

 **Internal Combustion Engine (ICE)**

- Expand and optimize gasoline engine/EcoBoost® technologies in conjunction with electrified and alternative fuel applications and improved fuel properties
- Further develop diesel technology to enhance capability and affordability in key vehicle segments

 **Alternative Fuels**

- Develop diesel/gasoline technologies compatible with low-carbon/renewable fuels

 **Energy Management, Electrical Architecture and Efficiency**

- Develop intelligent energy management technologies, e.g., waste heat recovery

 **Transmission and Driveline**

- Further develop electrified transmission and driveline technologies

 **Weight Reduction**

- Continued weight reduction using advanced materials

**⚡ Electrification**

- More efficient hybrid-specific engines
- Expand electrified driveline and transmission technologies
- Hybrids/Plug-In Hybrids available in >50% of nameplates
- Expand BEV volume

**🔋 Fuel Cells**

- Develop affordable fuel cell powertrain solutions for high-volume applications

**Long Term (2030+)**

**Electrification/Alternative Fuels at High Volume**

**📶 Policy/Mobility**

- Improve sustainability by integrating vehicle technologies, low-carbon/renewable fuels and Smart Mobility solutions
- Engage in cross-sector GHG mitigation projects

**🚗 Internal Combustion Engine (ICE)**

- Continue optimizing engine technologies for electrified applications
- Identify and incorporate advanced technologies that are compatible and synergistic with low-carbon/renewable fuels

**💧 Alternative Fuels**

- Evolve technologies in response to progress in low-carbon/renewable fuels

**⚙️ Transmission and Driveline**

- Expand functionality of transmission and driveline technologies in support of next-generation electric vehicles

**📦 Weight Reduction**

- Lightweight material models applied to global platforms

**⚡ Electrification**

- Next-generation Hybrid, Plug-in Hybrid and BEV technologies (lighter, smaller, reduced cost, improved functionality)
- Continued expansion of all-electric vehicles across portfolio

**🔋 Fuel Cells**

- Align fuel cell migration with fuels/infrastructure availability
- > [See our detailed vehicle fuel economy and carbon emissions performance](#)

**Taking a Life Cycle Approach**

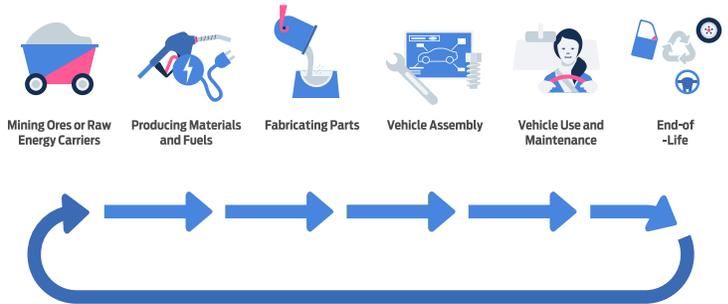
**A life cycle assessment (LCA) is an analytical tool that helps identify and measure the potential environmental impacts of products or services. We use LCAs to understand and reduce the materials and energy used, and emissions generated, over the entire life cycle of our products.**

**Quantifying Vehicle and Fuel Impacts**

As our product portfolio includes an ever-widening range of engines and fuels, LCAs become increasingly complex and all the more important. We are continuing to develop a portfolio of LCA tools to gain a more holistic understanding of the impacts of our products over their life cycle. In 2016, Ford researchers published a [physics-based LCA model](#) to quantify the energy and GHG emission benefits of lightweighting electric vehicles.<sup>1</sup>

The life cycle of a vehicle spans the environmental impacts associated with everything from the mining of the ores and metals used in its manufacture, through the production of materials, fuels and components, and the assembly, use and maintenance of the vehicle to, finally, its disposal.

**Our Product Life Cycle**



Historically, much of our work to improve the life cycle performance of our products has focused on their tailpipe or tank-to-wheels (TTW) greenhouse gas (GHG) and other emissions. However, we are now also working to understand the well-to-wheels (WTW) impacts of our products and the fuels they use. Estimates of WTW emissions vary with the specifics of the vehicle, engine and fuel type:

**At what life cycle stage are most GHG emissions released?**

- In gasoline- and diesel-powered vehicles (including hybrids)... **it is during the vehicle's use**
- In plug-in hybrids,<sup>2</sup> battery- and hydrogen-powered vehicles... **it is during production of the fuel (electricity or hydrogen)**

When comparing gasoline- and diesel-powered vehicles, diesels generally have lower lifetime GHG emissions than gasoline equivalents. And in vehicles with other powertrains, overall CO<sub>2</sub> emissions depend on the carbon intensity of the electricity or hydrogen production. The emission benefits of battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) are maximized when the electricity is generated from low-CO<sub>2</sub> sources such as wind or solar power.

> [Read more about our work to develop alternative fuel and powertrain options](#)

Regardless of the fuel used, GHG impacts from fuel production are part of the total vehicle life cycle impacts. They are not within the control of the vehicle manufacturer, and need to be addressed under a separate framework. To achieve the desired GHG reductions in this stage, other stakeholders such as fuel producers, infrastructure developers and government are essential participants in the development of a solution.

**How We Apply LCA**

We are applying our LCA knowledge in research and development using, for example, our Product Sustainability Index (PSI) in Europe. This tool assesses a range of attributes, from life cycle global-warming potential and air-quality potential to the use of sustainable materials, external noise, safety, capacity relative to vehicle size and ownership costs over the first three years. Through the PSI, several European vehicles have demonstrated improved environmental, social and/or economic performance over their life cycle when compared with previous models.

We use LCA to help us assess the environmental and cost impacts of different materials. We are currently studying the energy and GHG emissions from producing carbon fiber automotive parts and comparing these impacts to the fuel savings these parts can help generate.

## Driving the Science of Sustainability

Ford researchers have played a leading role in an industry-government cradle-to-grave LCA, which explored the costs and GHG emissions of current and future technology for light-duty vehicles. Compared to a conventional gasoline vehicle, CO<sub>2</sub> abatement costs were estimated to be around \$100s per metric ton, increasing to \$1,000s per metric ton for alternative vehicle-fuel pathways. The [data, assumptions and methodology have been made available publicly](#) to inform technical discussions about cost-effective strategies to reduce CO<sub>2</sub> emissions.

We believe that addressing climate change requires a multi-sector approach, in which the cost-effectiveness of CO<sub>2</sub> abatement options will be of critical importance. We are conducting research to compare the cost-effectiveness of actions intended to achieve emission reduction targets in sectors facing high abatement costs (such as transport) with those in other sectors.

> [Read about how we're addressing non-CO<sub>2</sub> emissions](#)

1. H.C. Kim, T.J. Wallington, "Life cycle assessment of vehicle lightweighting: A physics-based model to estimate use-phase fuel consumption of electrified vehicles," Environ. Sci. Technol., 50, 11226 (2016).
2. Plug-in hybrids that travel long distances or use renewable electricity can incur more GHG emissions from vehicle use than fuel production.

## Improving Fuel Economy

**Through our Sustainable Technologies and Alternative Fuels Plan, we use a variety of approaches to improve the fuel economy of our conventional gasoline- and diesel-powered vehicles.**

### Engine and Transmission Technologies

#### Gasoline Engines

Our EcoBoost® engines use turbocharging and direct fuel injection to deliver significant fuel-efficiency gains and reduced CO<sub>2</sub> emissions in gasoline-powered vehicles. So far, we've brought this fuel-saving technology to more than 8 million engines worldwide, ranging in size from 1.0L to 3.5L, and there are more than 1 million Ford EcoBoost®-equipped trucks on the road today.

Ford's 1.0L EcoBoost® engine has been voted best in class at the International Engine of the Year Awards for the fifth year in a row. Judges praised the combination of drivability, performance, economy, refinement and technology that continues to set the standard.

Thanks to its all-new 3.5-liter EcoBoost® engine, paired exclusively with our new 10-speed automatic transmission, the 2017 Ford F-150 lineup has shown improvements in its EPA-estimated fuel economy ratings. The 2017 Ford F-150 truck was named the American Council for an Energy-Efficient Economy (ACEEE) Greener Choice award winner, the only full-size truck in the list.

**Thanks to EcoBoost®, F-150 owners alone will save more than 110 million gallons of gas during 2017; that's the equivalent of 13 oil supertankers.**

Ford continues to innovate, building on the strong EcoBoost® engine foundation, while understanding that specific applications and markets may dictate different solutions. New technologies are being investigated and developed to improve performance, fuel economy and emissions for multiple powertrain options, including hybridization. Major areas of focus include advanced boosting, reduced friction, and advanced fuel injection and ignition.

Moving forward, we will continue to assess the importance of low-carbon renewable fuels on CO<sub>2</sub> reduction and their impact on future powertrain designs.

## Advanced Transmissions and Drivelines

The all-new 10-speed automatic transmission available for 2017 F-150 4x2 and 4x4 models – our first volume-production 10-speed automatic – improves powertrain efficiency by maximizing engine operation within its optimal range. Along with the new EcoBoost® engine, this new powertrain combination provides better low-end and peak performance, which is ideal for hauling heavy payloads and towing trailers.

We continue to progress both front- and rear-wheel-drive transmissions to optimize the overall powertrain, including the development of advanced torque converters to enable aggressive lock-up operation and improved hydraulics to reduce oil pumping losses, all aiming to increase efficiency and performance while enabling quick, smooth shifts.

Additionally, we are developing driveline technologies to reduce parasitic losses while enhancing function and drivability, including low-drag all-wheel-drive systems.

### Diesel Engines

Diesel engines operate lean and unthrottled, and at a higher compression ratio than gasoline engines, and diesel fuel has approximately 10 percent more energy by volume than gasoline.

As a result of these factors, modern diesel engines consume 25–30 percent less fuel by volume (15–20 percent less by energy) than gasoline engines and, on a well-to-wheels (WTW) basis, emit up to 20 percent less CO<sub>2</sub> per kilometer. Thanks to technologies such as diesel oxidation catalysts, diesel particulate filters, selective catalytic reduction systems and lean nitrous oxide (NO<sub>x</sub>) traps, non-CO<sub>2</sub> emissions such as NO<sub>x</sub> and particulate matter have been greatly reduced relative to past models. Our research and development activities continuously pursue innovative solutions for even cleaner and more efficient propulsion systems.

In Europe, we have enhanced our lineup of 1.5L and 2.0L TDCi engines with the all-new 2.0L EcoBlue engine: a new generation of clean, efficient, refined and high-performance diesel engines that are already available in Ford's light-duty commercial vehicles. In North America, we offer two advanced diesel engines: the 6.7L Power Stroke V8 available in our SuperDuty and Medium Duty commercial trucks, and a new 3.2L Power Stroke turbo diesel in the Transit Van. Diesel engines continue to be a popular option, due to their excellent drivability, CO<sub>2</sub> emissions and fuel consumption characteristics when carrying heavy loads.

As our plans develop further, we are maintaining a special focus on sustainable fuels, and already today, our advanced diesel engines are compatible with biodiesel.

> [See our detailed vehicle fuel economy and carbon emissions performance](#)

### Reducing Vehicle Weight

We are adopting advanced lightweight materials to help reduce fuel consumption wherever practicable. For example, our F-Series trucks feature advanced aluminum alloy bodies, allowing us to save weight and deliver even more capability. Later in 2017, we also plan to release an Expedition featuring an aluminum body.

Together with Magna International, we have developed a prototype carbon fiber composite subframe that reduces mass by 34 percent compared to the stamped steel equivalent. This lightweight subframe will help reduce CO<sub>2</sub> emissions and improve fuel efficiency, helping automakers meet [federal clean car standards](#). The subframe also replaces 45 steel parts with two molded and four metallic parts: an 87 percent reduction.

We have also developed an incredibly light but strong cargo floorboard in the all-new Ford EcoSport, made of high-strength 100 percent recycled paper and water-based glue. The honeycomb design, inspired by beehives, is able to handle more than 100 times its six-pound weight in cargo.

> [Find out more about our use of sustainable materials](#)

## What's Next in Fuel Economy?

To help us meet consumers' growing appetite for vehicles with greater fuel efficiency, we have invested \$200 million in a new aerodynamic testing complex. The new facility, to be located next to our Driveability Test Facility in Allen Park, Michigan, will feature innovative technology that simulates real-world driving conditions, including a next-generation rolling road wind tunnel and state-of-the-art climatic chamber, to advance improvements in fuel economy.

We're also exploring how 3D printing could help produce lighter-weight parts that lead to better overall vehicle fuel efficiency. Ford is the first automaker to pilot the Stratasys Infinite Build 3D system, capable of printing large-scale, single-piece automotive parts like spoilers. Housed at the Ford Research and Innovation Center in Dearborn, it could provide a more efficient, affordable way to create low-volume prototype parts, personalized items or specialized race car components.

› [Watch a short video of the printer in action.](#)

## Alternative Fuels and Powertrains

**Our Sustainable Technologies and Alternative Fuels Plan includes the research and development of alternative powertrains and fuel options across all our vehicles, helping us go further through new capabilities.**

### Our Pathway to Lower-Carbon Options

Delivering on our promise to give customers the power of choice, we offer a range of powertrain and fueling options designed to reduce vehicle CO<sub>2</sub> emissions, as well as improve fuel efficiency.

As part of our strategy to support global [climate stabilization goals](#) and a more sustainable product portfolio, we have developed a roadmap for migrating our vehicle technologies toward the use of lower-carbon fuel options (see graphic below).

### Our Global Fuels Migration Path

#### In Place (2017)

##### Gasoline and Diesel

- Growth of fossil fuel continues with developments in extraction technologies

##### Electricity (HEV, PHEV, BEV)

- Electricity grids start to transition to low-fossil CO<sub>2</sub> future

##### Renewable Biofuels

- First generation biofuel production increases

##### CNG and LPG

- CNG and LPG available in limited markets

#### Near Term (2020)

##### Electricity (HEV, PHEV, BEV)

- Electricity grids continue to transition to low-CO<sub>2</sub> future
- Fleet programs confirm grid/infrastructure readiness for plug-in HEVs and BEVs

##### Renewable Biofuels

- Second generation biomass-based fuels introduced at low volume
- Renewable fuel capacity expands in select markets

##### CNG and LPG

- CNG expands in commercial fleets and available in limited markets

##### Hydrogen Fuel Cell

- Limited hydrogen fueling site Limited hydrogen fueling sites

#### Mid Term (2025)

##### Gasoline and Diesel

- Gasoline/diesel fuel quality improvements

##### Electricity (HEV, PHEV, BEV)

- Electricity grids continue to transition to low-CO<sub>2</sub> future
- Grid/infrastructure and standardization support expansion of plug-in HEVs and BEVs

##### Renewable Biofuels

- Second generation biomass-based fuel production expands

##### CNG and LPG

- CNG availability increases with demand and production capacity

##### Hydrogen Fuel Cell

- Limited hydrogen fueling sites

#### Long Term (2030+)

##### Gasoline and Diesel

- Further gasoline/diesel fuel quality improvements to support advanced vehicle technologies

##### Electricity (HEV, PHEV, BEV)

- Clean electricity further enhances the benefit of plug-in HEVs and BEVs

##### Renewable Biofuels

- Renewable fuel capacity expands in all markets

##### CNG and LPG

- CNG from alternative/renewable sources
- Increasing fraction of liquid renewable hydrocarbons in fuel portfolio

##### Hydrogen Fuel Cell

- Potential to begin ramp-up of hydrogen/infrastructure

#### ELECTRIC VEHICLES

### Extending Our Electrification Plans

Leading in electrification, as well as [autonomy and connectivity](#), is critical to our expansion to both an automotive and a mobility company. Our extended electric vehicle strategy aligns with increasing calls for cleaner, more efficient vehicles, and we remain focused on delivering affordable electric vehicles at scale.

We already have nearly two decades of experience in electrification – vehicles that run on a battery-powered electric motor or a combination of electric and gasoline powertrains – and infrastructure to support this. And at the end of 2016, we were the top seller of plug-in hybrid vehicles and second largest seller of electric vehicles<sup>1</sup> in the United States, having sold 560,000 electric vehicles globally.

Our \$4.5 billion investment in electrification will support the introduction of 13 new electric vehicles; these include hybrid versions of the F-150 and Mustang, a Transit Custom [plug-in hybrid](#), two hybrid police vehicles and a fully electric small SUV by 2020, along with an autonomous hybrid vehicle designed for commercial ride-hailing or sharing by 2021. Globally, more than 40 percent of our nameplates will offer electric versions by 2020.

In expanding our electric vehicle efforts, we are also:

- Testing hybrid taxi and van prototypes in a number of U.S. cities
- Investing \$700 million in the production of electric and autonomous vehicles, and creating 700 jobs, in our Flat Rock assembly plant in Michigan
- Expanding our battery development program into Europe and Asia
- Using insights from 33,000 Ford electric vehicle owners to better understand how they use their vehicles

As well as focusing our efforts on areas of strength, such as commercial vehicles, trucks, utility and performance vehicles, we are looking at electric vehicle fleet management, route planning and telematics solutions, and piloting wireless recharging technology.



### Hybrid Electric Vehicles (HEVs)

HEVs are powered by both an internal combustion engine (ICE) and an electric motor with a battery system. When using the electric motor and battery system only – at low speeds and for short distances, for example – they don’t consume gasoline. All our hybrid vehicles can run on battery power, on ICE power or a combination of both to optimize fuel efficiency. They have a regenerative braking system that captures energy, otherwise lost to braking, to recharge the battery. We are currently increasing our hybrid capability across our highest-volume global product platforms, including the Ford C-MAX, Ford Fusion, Ford Mondeo and Lincoln MKZ.



### Plug-in Hybrid Electric Vehicles (PHEVs)

PHEVs are powered by an ICE and a high-voltage electric battery that, unlike HEVs, can be charged from a household or public electric outlet. When the battery is depleted, the vehicle functions as a standard HEV. PHEVs also accrue charge through regenerative braking and discharge it during use. This provides additional fuel savings and can reduce direct tailpipe emissions to zero when running on battery power. Our two PHEVs are the Fusion Energi and the Ford C-MAX Energi.



### Battery Electric Vehicles (BEVs)

BEVs use a high-voltage electric motor, powered by a battery pack. Their primary benefit is their lack of tailpipe CO<sub>2</sub> and other emissions during use; however, they are not necessarily totally zero-emission over their entire life cycle, as this depends on the source of electricity used for charging. Our electric vehicles use lithium-ion batteries, offering better performance than the nickel-metal-hydride batteries they replaced. The new Focus Electric offers a projected 115-mile range on a single charge, and DC fast-charging capability able to deliver an 80 percent charge in around 30 minutes.

> [Read our front page story for more information about how we’re delivering our electrification plans](#)

## VEHICLES POWERED BY ALTERNATIVE FUELS Renewable Biofuel Vehicles

Biofuels made from renewable resources offer a relatively affordable way to reduce CO<sub>2</sub> emissions. Two types are widely used:

- **Ethanol**, primarily made from fermented corn sugars or sugar cane, is usually blended with gasoline. In the U.S., most retail market gasoline already contains up to 10 percent ethanol (E10), while E85 (U.S. and Europe) and E22/E100 (Brazil) are also common

- **Biodiesel**, made from soy, canola, rapeseed, corn or palm oil, or animal fats, is primarily mixed with fossil diesel. The most common blends are B5 and B20 (in the U.S.) and B7 (in Europe)

We also support the further development and expanded production of next-generation biofuels made from plant cellulose. These can cut GHG emissions significantly, and using stems and leaves from crops such as corn also reduces competition with food crops.

## Compressed Natural Gas (CNG) and Liquefied Petroleum Gas (LPG) Vehicles

We offer engine packages specially prepared by qualified vehicle modifiers for conversion to compressed CNG and LPG on many vehicles. Typically, CNG and LPG vehicles have lower CO<sub>2</sub> and life cycle GHG emissions than gasoline or diesel vehicles; they also have lower [non-CO<sub>2</sub> emissions](#). Vehicles with gaseous-prepped engines can be converted to CNG, LPG or to a bi-fuel system capable of running on either fuel or on conventional gasoline. We offer a wide range of commercial vehicles with CNG and LPG.

## Hydrogen Fuel Cell Vehicles (FCVs)

FCVs are zero-emission electric-drive vehicles. The fuel cell system converts stored hydrogen to electricity, leaving only water and low-temperature heat as by-products. Through the Automotive Fuel Cell Cooperation (AFCC) in Vancouver, a joint venture with Daimler AG, we conduct research to overcome key barriers to commercialization including cost, durability and fuel infrastructure.

## CO<sub>2</sub> Savings vs. Gasoline (E10) in the U.S.

Powertrain/Fuel	“Tank-to-wheels” <sup>6</sup> CO <sub>2</sub> emissions	“Well-to-wheels” <sup>7</sup> CO <sub>2</sub> emissions
HEV	28%	28%
PHEV <sup>2,8</sup>	45%	36%
BEV <sup>2</sup>	100%	51%
E85 <sup>3</sup>	2%	27%
CNG	25%	19%
LPG	11%	13%
FCV <sup>4</sup>	100%	41%
Diesel	15%	14%
B7 <sup>5</sup>	15%	17%
B20 <sup>5</sup>	15%	24%

## What’s Next in Alternative Fuels and Powertrains?

One of the electronic vehicles we’re adding to our portfolio, the PHEV Ford Transit Custom van, is the centerpiece of a multimillion-pound project designed to help improve air quality in London. The 12-month trial, featuring 20 vans running mainly on electric power for the majority of urban trips, will explore how PHEVs can contribute to cleaner air targets and address local transportation challenges.

To help facilitate the adoption of mass-market BEVs, we’ve also signed a Memorandum of Understanding with BMW Group, Daimler AG, Volkswagen Group, Audi and Porsche to create the highest-powered charging network in Europe. Starting in 2017, we aim to build a sizable number of ultra-fast charging stations to enable long-range travel for BEV drivers.

> [Learn about our electrification strategy in China](#)

1. HEVs, PHEVs and BEVs.
2. Average grid electricity mix.
3. Ethanol from corn.
4. Hydrogen from steam methane reforming of NG at central plant.
5. Biodiesel from rapeseed (RME).
6. 2015 US Vehicle efficiency from Elgowainy, A. et al. (2016) Argonne National Lab report number ANL/ESD-16/7.
7. Well-to-tank from GREET 2015.
8. PHEV has c.20 km all-electric range.

## Addressing Non-CO<sub>2</sub> Emissions

**We take the impacts on air quality and the related health risks from vehicle tailpipe emissions very seriously, and are working hard to address emissions beyond CO<sub>2</sub> in our research, product development and operations.**

Smog-forming vehicle tailpipe emissions result from the incomplete combustion of fuels, impurities in fuels and the high-temperature oxidation of atmospheric nitrogen during the fuel combustion process. Regulated smog-forming tailpipe emissions include hydrocarbons, nitrogen oxides (NO<sub>x</sub>), carbon monoxide and particulate matter. We recognize that these pollutants increase with vehicle congestion.

### Meeting Regional Tailpipe Emissions Standards

#### United States

Currently, the U.S. Environmental Protection Agency (EPA) requires vehicles to be certified to its Tier 2 regulations, which have helped reduce smog-forming emissions since 2004. The EPA's more stringent Tier 3 standards are being phased in from the 2017 model year. California has its own Low Emission Vehicle II (LEV II) program for light-duty vehicles, with different requirements from the federal Tier 2 program; LEV III requirements, which began to be implemented with the 2015 model year, closely align with the EPA's Tier 3 program. We plan to comply with both Tier 3 and LEV III standards as they are phased in.

#### Europe

All new passenger cars registered since September 1, 2015 comply with the Euro 6 tailpipe emissions standard Phase I. The more stringent Euro 6d Real Driving Emissions (RDE) standard will apply from September 2017. For our light-duty segment, the Transit Connect and Transit Courier already comply with Euro 6 Phase II.

In recent years, concerns in Europe that real-world emissions are higher than tested emissions led to the development of the RDE protocol, which will involve testing vehicles on the road using portable emissions analyzers. In 2015, these concerns were reinforced by reports that a competitor OEM deliberately utilized different calibrations for test conditions and for on-road use, defeating the purpose of the emission tests.

Ford supports efforts to ensure that test procedures more closely match the real-world conditions that customers experience under normal driving. Ford has supported the inclusion of the RDE initiative in the Euro 6 standards, and we have also been involved in the development of the Worldwide Harmonized Light Vehicles Test Procedure (WLTP). These efforts will help to ensure that improvements in vehicle emission control systems will translate to improvements in urban air quality.

Ford will measure and publish RDE results, including NO<sub>x</sub> emissions, according to Euro 6.2 emission regulation from 2016 onward. Ford complies with regulatory requirements worldwide, and we have processes and controls in place to ensure that compliance is ongoing.

#### China

The China Ministry of Environmental Protection released the national stage-6 emission standard for light-duty vehicles in December 2016. The standard is based on the Euro 6 framework, adopting the WLTP for tailpipe emission tests, US EPA Tier 2 fuel evaporation and onboard refueling vapor recovery (EVAP/ORVR) requirements, and California onboard diagnostics requirements (OBD II). Tailpipe emission limits are set as follows:

- 6a, which equates to Euro 6 limits, will come into effect in July 2020
- 6b, which is approximately 40–50 percent lower than 6a (depending on pollutants), will come into effect from July 2023

### Other Regions

In other regions, Ford meets the required tailpipe emissions regulations. These are generally based on the European non-CO<sub>2</sub> tailpipe emissions regulations system, but vary by country. For example:

- In India, we meet the current regulations, based on Euro 4 and Euro 5 standards, and will meet Bharat Stage VI (BS VI) standards from April 2020 based on Euro 6
- In Brazil and Argentina, we meet new regulations based on Euro 5
- In the Middle East, where emission limits are largely constrained by fuel quality, we meet the current standards based on Euro 2, and 2018MY vehicles will meet standards based on Euro 4 gasoline (Euro 3 diesel)

> [See our tailpipe emissions data in detail](#)

### Beyond the Tailpipe

With the decreasing trend in vehicle tailpipe emissions, other emissions assume a larger proportional importance.

Through our Restricted Substance Management Standard, we have:

- Prohibited GHGs such as perfluorocarbons (PFCs) and sulfur hexafluoride (SF<sub>6</sub>)
- Replaced all chlorofluorocarbons (CFC) refrigerants with hydrofluorocarbons (HFCs), which do not contribute to ozone depletion and have significantly lower global warming impacts

Globally, we continue to lower non-CO<sub>2</sub> GHG emissions. We have replaced HFC-134a with HFC-1234yf, a compound with a lower global warming potential, in passenger cars registered starting in 2017 in Europe; in the 2017MY Escape, Fusion, MKZ, F-150 (except Phantom), GT and Focus in the United States and Canada; and in the 2017MY Focus, Kuga, Mondeo and MKZ in South Korea.

The lack of servicing infrastructure and substantially higher costs limit the use of HFC-1234yf in other markets, but we remain committed to further reducing non-CO<sub>2</sub> emissions wherever practical and cost-effective.

We are exploring current and likely future particulate matter emissions associated with brake and tire wear and from different vehicle powertrain technologies, comparing these with current and future tailpipe emissions. We will discuss our findings in a future report.

## Using Sustainable Materials

**Through our global materials strategy, we are increasingly using materials that are more sustainable from a total life cycle perspective, including recycled, renewable and recyclable materials, and working to decrease or eliminate less sustainable materials.**

### Our Sustainable Materials Strategy

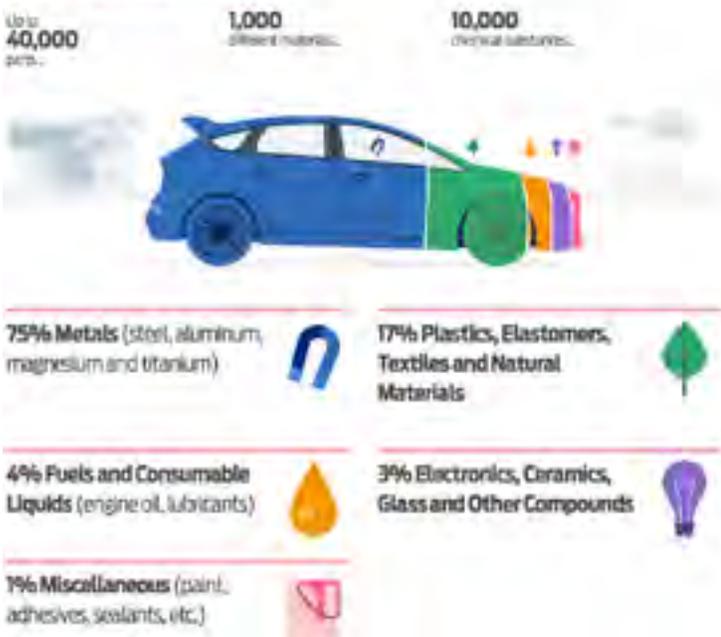
Ford continues to be a leader in the research, development and integration of more sustainable, bio-based and recycled content in our vehicles. We aspire to choose materials that have been obtained by socially sustainable means, that have lower environmental impacts and that provide equivalent or superior performance to existing materials. Aspects to consider include a material's origin (virgin, renewable or recycled), the methods used to source and process it, the emissions generated throughout its life cycle and its application.

The choice of materials is an important factor in a vehicle's sustainability, across all life cycle stages and throughout our value chain. It can influence vehicle safety, fuel economy and performance, as well as the options for recycling or reusing components at the end of a vehicle's life. We continue to reduce the number of materials we use, and prioritize locally sourced materials where we can to reduce their carbon footprint.

Our holistic view of the materials used in our vehicles involves:

- Increasing use of recycled materials
- Continuing to develop and implement plant-based renewable materials
- Eliminating substances of concern
- Addressing any health impacts of some materials
- Addressing end-of-life impacts (i.e., landfilling) through improved recyclability
- Working with environmentally and socially responsible suppliers
- Continuing research on closed-loop recycling and second life use of components
- Partnering with other industries and the farming community to utilize their by-products

**What's in a Typical Vehicle?**



**Recycled Materials**

Using recycled content in materials diverts consumer and industrial waste from landfill, reduces the depletion of natural resources, and can lower both energy consumption and costs. However, these materials must deliver the same quality, appearance and performance as virgin materials. We are now concentrating our efforts on nonmetallic materials, which are often composed of virgin content.

**Closed-Loop Recycling**

In some cases, we recycle the materials from our auto parts back into the same use, a process known as “closed-loop recycling.” For example, aluminum can be reused many times without loss of quality, and recycling aluminum requires 95 percent less energy than refining raw aluminum from bauxite, as well as avoiding the environmental impacts of mining.

**Ford recycles 5 million pounds of high-strength, military-grade aluminum scrap a week through the closed-loop recycling system now in use at three Ford factories. That's enough to build more than 37,000 new F-Series truck bodies a month.**

We work closely with our suppliers to recycle aluminum scraps, or “chips,” from the production of the 2017 Ford F-150 to make more vehicles. These chips, most of which come from stamping windows into body panels, can comprise 40 percent of the original metal used. To achieve the level of purity required for auto bodies, we have invested \$60 million in equipment that separates, cleans and shreds aluminum, and transfers it straight into designated trucks.

[Watch how we recycle tons of aluminum, one chip at a time.](#)

**Nonvisible Applications**

Where viable, we also “upcycle” materials into uses with higher material and performance requirements. In line with our global sustainable materials strategy, certain nonvisible plastic parts must be made out of plastics from post-consumer recycled waste, such as nylon, tires and battery casings. For example:

- We are working on transforming post-consumer laundry detergent containers and milk bottles into blow-molded automotive components
- We are also investigating how post-consumer drinks bottles may be used to make energy-absorbing materials

**Visible Applications**

Using recycled materials for interior parts such as seat fabrics, components and carpets requires us to achieve the necessary appearance as well as performance. To date, we have developed 50 seat fabrics made from at least 25 percent post-industrial or post-consumer recycled content, and currently use recycled seat fabrics in 12 vehicles.

**Renewable Materials**

**We continue to use more plant-based materials to reduce our carbon footprint and our dependence on petroleum.**

The environmental, economic and performance benefits of durable, plant-based materials include reductions in greenhouse gas (GHG) emissions, vehicle weight and fuel consumption; lower manufacturing energy use and costs; reduced use of petroleum and non-sustainable resources; diverting waste from landfill; and the creation of new markets and revenue opportunities for farmers.

*“Someday, you and I will see the day when auto bodies will be grown down on the farm.”*

Henry Ford, 1934

**Why Renewable Materials Matter to Ford**

Around 8 percent of all the petroleum oil used in the world each year goes to making plastic. Once used, up to half of all plastic is dumped into landfills. Much of the rest is burned, and millions of tons are dumped into our oceans; relatively little is recycled. In response to the ocean waste problem, our research team has recently initiated an effort to investigate automotive uses for ocean plastic.

**The average Ford vehicle uses around 20–40 pounds of renewable materials.**

Driven by concerns around cost, supply and environmental protection, Ford scientists are researching ways to replace petroleum oil as the main ingredient in plastic. We began researching the use of sustainable materials to rival and replace petroleum-based plastics in our vehicles in 2000. Having introduced the industry’s first soy-based foam in seat cushions and seat backs in 2006, our renewable materials program has now expanded to include a number of different renewable material applications, all of which meet strict performance and durability specifications.

We have implemented many world- and industry-first renewable materials, including wheat-straw storage bins, rice hull wiring harnesses and tree-based cellulose. These materials are lighter in weight, meet all durability and performance requirements, and provide new revenue streams for North American farmers. We have achieved all this while lowering GHG emissions and reducing petroleum consumption.

> [Watch a video about Ford's renewable materials program.](#)

### From Bluejeans to Rice Hulls



See the recycled and bio-based materials used on the new F-150.

- **Truck body:** All the weight-saving aluminum used is recyclable
- **Seat backs, cushions and head restraints:** Use soy-based polyurethane foam
- **Sound insulation:** Padding made from recycled cotton and bluejean production scrap
- **Wiring harness:** Made using rice hulls
- **Fuel lines:** Contain castor oil-based nylon
- **Underbody cover:** Contains recycled rubber from post-consumer tires and polypropylene
- **Exterior mirror gaskets:** Contain post-consumer recycled tires and soybean oil

### Our Current Technology

- Coconut fibers are used in the trunk liners of the Ford Focus Electric.
- Seat cushions, storage bins and door panels are just a few of the many items we make with renewable materials.
- We're working on making sustainable car parts out of tomato peel and other by-products from the farm.

Scientists at our research centers in the U.S., Germany, China and Brazil are developing foams, plastics and composites derived from renewable resources for use in millions of vehicles every year.

In our North American vehicles, all seat cushions, backs and headrests contain soy foam. Castor oil is used in all vehicles for fuel lines and in several vehicles for instrument panel foam. We are also developing applications that use locally sourced and plentiful plant oils – such as soy oil in the U.S., mustard seed oil in Canada, castor oil in tropical regions, and palm oil in Asia, Africa and South America – in instrument panels, seals and gaskets.

**Almost 300 vehicle parts are derived from renewable sources such as soybeans, cotton, wood, flax, jute and natural rubber.**

We use renewable, plant-based natural fibers to reinforce plastic in our vehicles:

- Cellulose-reinforced plastic, using fibers from sustainably grown trees, has been used to replace fiberglass in center console armrests
- Wheat-straw-reinforced plastic is used in storage bins

- Kenaf, a tropical plant, is used in compression-molded plastic door parts
- Rice hulls are used to reinforce electrical brackets

**Almost 300 vehicle parts are derived from renewable sources such as soybeans, cotton, wood, flax, jute and natural rubber.**

We are also looking at ways to utilize other waste streams and by-products, such as recycled tires, recycled T-shirts and denim, recycled plastic bottles and even shredded U.S. currency. Ford researchers in Asia Pacific recently announced their work to reinforce plastics with bamboo fiber, which is strong, plentiful and aesthetically pleasing.

Meanwhile, Dearborn researchers are focused on agave fiber, grown for tequila production in Mexico ([see below](#)). This fiber is exceedingly tough and available in large quantities locally. Instead of burning the fiber, utilizing it as a plastics reinforcement will reduce CO<sub>2</sub> emissions, improve fuel economy and provide farmers with additional revenue.

### CASE STUDY

#### Agave By-Products Get a Second Chance

In tequila production, once the heart of the agave plant is harvested and roasted, and its juices extracted for distillation, a portion of the remaining fibers can be used as compost for local farms, or used by local artisans to make crafts. However, there is a huge surplus of fiber, and much of it is burned in the field, producing greenhouse gas. Now, as part of a broader sustainability plan, Jose Cuervo® has joined forces with Ford to develop a new way to use its remnant fibers.

Together, we're exploring the use of its by-products to develop sustainable bioplastics for our vehicles, and testing them for use in components such as wiring harnesses, heating and air-conditioning units, and storage bins.

Initial assessments highlight the potential for success, given the composite's durability and aesthetic qualities. It could reduce vehicle weight and improve fuel economy, while reducing our reliance on petrochemical-based plastics.

*"There are about 400 pounds of plastic on a typical car. Our job is to optimize the material properties of a natural fiber composite such as agave, and then find the appropriate place for it on our vehicles. This will help Ford to reduce our impact on the planet. It is work that we're really proud of, and it could certainly have broad impact across numerous industries."*

**Debbie Mielewski**

Senior Technical Leader, Sustainable Materials Research, Ford Motor Company

> [See the route agave takes to get a second life in a Ford vehicle.](#)

### Our Research Partnerships

We continue to research renewable materials and potential applications at our research centers around the world, and through partnerships with suppliers and nonautomotive partners.

Along with Coca-Cola, Nike and Procter & Gamble, we co-founded the plant-based PET Technology Collaborative (PTC), a strategic working group focused on accelerating the development and use of 100 percent plant-based PET materials and fibers. Collaborations with these companies to further our sustainability efforts include:

- The first automotive use of Coca-Cola's PlantBottle plastic, used in the seat fabric, trim, carpets and headliner in a Focus battery electric demonstration vehicle
- Partnering with Procter & Gamble to use biomimicry, inspired by nature's solutions, to solve some of the most challenging material issues facing our industries

We are also part of WWF's [Bioplastic Feedstock Alliance \(BFA\)](#), working to support the responsible development of plastics made from plant material, and helping build a more sustainable future for the bioplastics industry.

And we were excited about recent laboratory success in generating polyurethane foams that meet general durability and performance requirements, which utilize CO<sub>2</sub> as a feedstock.

› [See how we're sequestering excess CO<sub>2</sub> to make durable plastics and foams for use in our vehicles](#)

## Eliminating Substances of Concern

**Through a range of processes and tools for monitoring and managing materials and substances, we ensure our products meet all relevant local and global regulations. We have also managed to eliminate or reduce substances of concern where economically and technically feasible, well ahead of regulatory requirements.**

### How We Monitor and Manage Materials

Our Restricted Substance Management Standard (RSMS) designates the substances to be restricted or eliminated from our operations and our vehicles. The first of its kind in the industry, the RSMS process is embedded in our Global Product Development System (GPDS).

We also monitor and manage materials through the following systems and tools:

- **International Material Data System (IMDS):** An industrial web-based tool sponsored by around 40 original equipment manufacturers (OEMs) and used by more than 100,000 automotive supplier companies to track, review and report vehicle components, materials and substances
- **Global Materials Management (GMM):** Ford's materials and substances tracking and reporting tool used by Ford engineers and suppliers
- **Global Material Approval Process (GMAP):** System for reviewing and approving materials used in Ford plants and facilities, for both production and non-production materials (e.g., vehicle and plant floor paints, steel, plastics and adhesives)
- **Materials and Toxicology System (MATS):** Ford's internal database for managing specifications, Material Safety Data Sheets and Approved Source List, and generating compliance reports

### Continuing Our Progress

- We were one of the first automotive companies working to eliminate a number of chemicals<sup>1</sup> being monitored by governments around the world, including the E.U., U.S., Canada, Japan and China
- We phased out "hex chrome" (hexavalent chromium) across our operations and products before it was banned. Hex chrome is a corrosion coating used on nuts, bolts and brackets that the U.S. Occupational Safety and Health Administration lists as a potential lung carcinogen and is banned by End of Life Vehicle Directives issued by the E.U., Japan and South Korea
- Globally, we have transitioned from lead to steel wheel weights
- The Alliance of Automobile Manufacturers has a Memorandum of Understanding with the U.S. Environmental Protection Agency committing to phase copper out of brake friction material, because it degrades on use and can end up in the water cycle through urban drainage systems. We already offer vehicles with copper-free brake pads
- We eliminated mercury from all components, and we're working to address end-of-life impacts associated with [mercury-based components](#) in older vehicles

- We have a phase-out requirement for all E.U. REACH-restricted substances that have reached or are approaching their sunset dates<sup>2</sup>
- We monitor, and provide advice to relevant governmental agencies about, ongoing developments in other global substance restrictions such as the [Stockholm Convention](#)

Taking a leadership role in our efforts to eliminate less desirable chemicals, we lead or chair several industrial association working groups. These include:

- The U.S. Council for Automotive Research's North America Automotive Substances of Concern Committee
- The Automotive Industry Action Group's Chemical Management and Reporting Group
- The Global Automotive Declarable Substance List (GADSL) Steering Group
- ACEA's (E.U. car manufacturer association) working group on Materials and Substances

### Rare Earth Elements

Small quantities of the 17 "rare earth elements" (REEs) are used in internal combustion engine vehicles, and the motors and battery systems of electric vehicles contain neodymium and dysprosium, yet REEs are hard to extract, both economically and sustainably. Having assessed the (albeit small) amount of REEs our vehicles contain, we have focused on reducing their use in our electrified vehicle battery systems. Compared to its predecessors, our third-generation hybrid battery system is expected to save up to 500,000 pounds of REEs annually.

› [Read more about our approach to managing human rights issues associated with conflict minerals](#)

### Ensuring Occupant Health

Ford is working to provide healthy vehicle interiors and use information technology to improve occupant health and wellness.

#### Air Quality

Under specific conditions, the properties that make nanoscale materials useful may also pose risks to human health and the environment. Current research largely focuses on exposure during manufacturing and processing, but we want to prevent any unwanted consequences that might occur during the entire life cycle of nanoparticles, due to environmental factors (moisture, temperature, etc.) or mechanical actions (vibrations, abrasion, etc.). The Ford Plastic Research group has developed guidelines to ensure that research involving nanotechnology is conducted safely and responsibly, and that environmental considerations are incorporated into our technical innovations and product development.

Our vehicle interior air quality specifications consider the air quality in our vehicles, and our engineers also test the materials that come into direct contact with passengers for any allergen impacts. Many of our vehicles feature high-performance filters that keep out allergenic pollens. Having applied these specifications in our European vehicles, we are now phasing them in across other regions, starting with the United States.

#### In-Car Health and Wellness

We're exploring ways to use in-vehicle communication systems and other technology to help drivers to monitor their own health and wellness. For example:

- The Allergy Alert® app enables drivers to check pollen and other health-risk conditions with simple voice commands
- We are exploring how wearable devices, including smart watches and fitness bands, can measure indicators of driver stress such as heart rate, perspiration and skin temperature
- We are engaging with medical companies and auto insurers to see whether monitoring in-vehicle driver wellness could result in lower insurance premiums
- We are partnering with the Henry Ford Health System on a health and wellness app challenge

- Ford research teams in Dearborn, Aachen and Nanjing are partnering with university collaborators at the University of California, Berkeley, Peking University; and Tsinghua University to better understand the sources of emissions near roads and how to quantify them

1. Including hexabromocyclododecane (HBCDD) and decabromodiphenyl ether (decaBDE).
2. The date after which a substance of concern cannot be used in the E.U. without authorization from the European Chemicals Agency (ECHA).

## Reducing End-of-Life Impacts

**Automobiles are some of the most highly recycled consumer products in the world. The majority of materials contained in vehicles – particularly metals, polymers and fluids – can be recovered at the end of their useful lives.**

In theory, end-of-life vehicles are 95 percent recoverable, but in practice, the cost in energy and labor to recover the final fractions manually often exceeds their value and the environmental benefits of doing so. We try to achieve the highest level of economically and environmentally viable recovery through the careful selection of materials, and by providing dismantlers with information on materials used and the best methods for treatment.

### Take-Back Schemes

We've long been at the forefront of providing cost-free take-back networks for end-of-life vehicles (ELVs). There are currently networks for Ford vehicles in 19 E.U. markets, and we participate in a further 10. In the U.K., Ford was the first major manufacturer to establish a comprehensive plan that met the E.U. Directive, working with cartakeback.com to create a network of 190 facilities.

### Alternative End-of-Life Treatments

Addressing end-of-life issues associated with mercury in older vehicles, we helped to forge a collaboration among the U.S. Environmental Protection Agency, state authorities, dismantlers, steelmakers and environmental groups to recycle mercury switches. With more than 10,000 participants in the scheme, over 7.1 tons of mercury had been recovered by the end of 2016. With this agreement set to end in 2017, we have forged a new agreement with the steelmakers to collectively manage mercury switch recovery through to the end of 2021.

To help divert plastic, foam and other nonmetal materials (known collectively as "automotive shredder residue" or ASR) from landfill, we support the development and implementation of treatment technologies that make the actual recycling of ELVs more economically and ecologically viable. We've also co-sponsored a [life cycle assessment](#) that showed the environmental benefits of using ASR for energy recovery.

### Recycling During Servicing

At our U.S. dealership service centers, we recycle, reuse and reprocess the parts removed during servicing, such as headlights, bumpers and windshield-wiper motors. Dealers are charged for new parts, but are reimbursed if they are recycled through our Core Recovery Program. Parts that can be remanufactured are cleaned, machined and tested before being used in new vehicles; otherwise, they are broken down into small pellets and used to make new parts.

The scheme forms part of our voluntary Go Green Dealer Sustainability Program, to which around half of our U.S. Ford and Lincoln Mercury dealers have signed up.

> [Read more about our dealers](#)

## Product Quality and Customer Satisfaction

**Ford customers expect high-quality products and exceptional experiences that make their lives better. Our culture of collaboration and continuous improvement means that we can deliver great experiences as well as address any quality and satisfaction concerns quickly and effectively, and learn from every quality issue.**

### Our product quality vision

*is to achieve best-in-world quality and productivity by driving the disciplined execution of common processes and standards.*

### Our product quality mission

*is to deliver continuous quality and productivity improvements across all functions while delivering high-quality vehicles our customers want and value.*

### Exceeding Expectations, Every Step of the Way

We start thinking about people's lives and experiences years before a new model or service becomes available. Observing customers in their environments and daily lives, as well as imagining our future world, shapes our awareness of the mobility needs of people globally. Understanding our customers deeply over time points to the right products and services to offer. Focusing on the right experiences to offer provides us with criteria we can measure against, to gauge beyond how well things function to how well they serve people and make their lives better.

### Managing Product Development

Our product development process always starts with the customer: understanding who they are, how they live and what they value in a vehicle. Then we identify and implement the technologies that will meet their evolving needs and expectations.

Engineers, designers and product marketing teams work together to finalize a vehicle concept and, once approved, it is brought to market using our Global Product Development System (GPDS), which combines the best production methods from across our global operations. GPDS also provides common metrics to increase efficiency and quality. Each vehicle must meet specific competitive and performance targets at every milestone in its development, including criteria for fuel economy, emissions and substances of concern.

We continually work to improve the quality of our products, using our quality policy ([Policy Letter 1](#)) to ensure that quality lies at the heart of everything we do, and our extensive global Quality Operating System (QOS) to manage the development and measurement of our manufacturing processes. This helps ensure that our vehicles meet or exceed customer expectations at every stage of vehicle development and manufacture.

### Tracking Progress on Quality

We monitor product quality through a combination of internal and external measurements that assess how we are doing and where we can improve. The Global Quality Research System (GQRS), our primary quality survey, tracks customer satisfaction and "Things Gone Wrong." It is implemented on our behalf every quarter by the market research and consulting firm Ipsos RDA Group. We also subscribe to J.D. Power and Associates' annual Initial Quality Study, Vehicle Dependability Study, and Automotive Performance, Execution and Layout (APEAL) Study, and track warranty claims and costs internally.

> [Look at our product quality and customer satisfaction data in more detail](#)

## Enhancing the User Experience

Building on what we observe and understand from our customers, we use our User Experience (UX) Everyday Framework to help us develop new experiences that meet their needs and exceed their expectations.

### A Warm Welcome

Lincoln has applied what it knows about its customers to develop the Embrace experience. Embrace automatically detects, welcomes and anticipates the driver's needs, with subtle and focused lighting where it's needed (from all-round lighting to a targeted "floormat"), seamless unlocking when entering the vehicle and ambient internal lighting set to individual preferences.

### Are You Sitting Comfortably?

Inspired by private jets and high-end office furniture, we've introduced new Perfect Position Seats to the Lincoln Continental. The patented design allows the seat to be adjusted up to 30 ways, matching individual body shapes and weights for optimal comfort. High cushions extend and adjust independently – allowing one leg to remain at rest while the other engages the pedals – and a massage functionality helps reduce muscle fatigue in the upper legs and lower back.

### Simple but Effective

Using what they learned about Lincoln customers, the team responsible for the drive mode control for the Navigator simplified its terrain management system. By defining "ideal" drive control behaviors – offering fine-grain control for occasional use by "experts" and a more intuitive, integrated control for everyday drivers – engineering and design teams were able to provide a solution that met the needs of both groups.

## CASE STUDY

### A Breath of Fresh Air

One area in which we've worked hard to ensure ongoing customer satisfaction is interior odor. Our engineers create a complex bouquet of more than 100 different materials to ensure that "new-car smell" is pleasant to as many customers as possible. Ford's approved "odor assessors" then test how heat and wear affect the odor of a car's parts.

Parts deemed to have an unpleasant odor are eliminated or replaced, or their formula is modified to fix the problem.

> [Watch a short video about the work of our odor assessors.](#)

## Data Privacy and Security

**The information that customers provide enables us to deliver great products and a personalized experience. We are committed to respecting customer privacy and using customer data responsibly.**

### Anticipating Customer Needs

By investing in data science and analytics, we can harness the true potential of technology, helping us deliver great products and services, and ensure a personalized experience. In doing so, we commit to protect customers' privacy and handle their data securely and responsibly as we explore new ways to deliver innovative solutions.

To enable us to develop new customer experiences and mobility services – through FordPass®, for example – we leverage the technology of partners such as cloud-based software leader Pivotal. One of the first programs to emerge from this partnership is a Dynamic Shuttle pilot service for employees at our Dearborn campus. This features smart ride-hailing technology that analyzes real-time data to maximize route efficiency and meet users' requests for ride sharing in a timely manner.

> [Read how we're using FordPass to transform how we interact with our customers](#)

### Responsible Data Practices

Customers, employees and others care about the privacy and security of their data, and we take our responsibilities seriously. We have established a companywide governance infrastructure to drive a holistic approach to the privacy and security of data entrusted to us. This includes a number of policies and directives to ensure the continuing confidence of those who entrust us with their personal information. These policies require transparency, responsible data handling and use, and choice where appropriate.

We are also a founding member of the [Auto-ISAC](#) (Information Sharing and Analysis Center), established by the 12 members of the Auto Alliance to gather, analyze and share information about cyber-related threats and vulnerabilities.

## Improving Vehicle Safety

**Quality is critical to the safety of our customers and, therefore, to our responsibilities and success as a company. Safety continues to be one of the highest priorities in the design of our vehicles. We are committed to designing and manufacturing vehicles that achieve high levels of safety over a wide range of real-world conditions.**

### Our Approach to Vehicle Safety

*"Our team is committed to enhancing vehicle safety through ongoing research and development of crashworthiness and innovative crash avoidance features. We encourage safe driving, with features such as MyKey® and Forward Collision Warning, and continue to educate and improve the skills of new drivers with our Ford Driving Skills for Life program."*

**Wayne Bahr**

Global Director – Automotive Safety Office, Ford Motor Company

Our corporate safety policy, Policy Letter 7, outlines our commitment to design and build vehicles that meet or exceed applicable laws and regulations, while meeting the safety needs and expectations of our customers. In line with our policy letter, Ford is continuously working to enhance the safety of our products, a fundamental aspect of our [Quality Operating System \(QOS\)](#).

We conduct engineering analyses, computer simulations and crash testing to evaluate the performance of vehicles and components at a number of sites around the world.

We have state-of-the-art **crash-test facilities in Dearborn** in Michigan, Merkenich in Germany and Dunton in the U.K.

In Dearborn, we have a **motion-based driving simulator**, VIRTTEX (VIRtual Test Track Experiment), to research advanced driver assist features, human-machine interface (HMI) concepts, and other driving-related human factor topics such as drowsy driving and distracted driving.

We are also researching driver assist technologies, as well as looking at connectivity, mobility and autonomous vehicles, at our **Research and Innovation Centers** in Dearborn, Michigan, and Palo Alto, California.

In addition to meeting or exceeding regulatory requirements, our processes, tools and facilities confirm that our vehicles align with our own stringent internal guidelines on safety design, as well as Ford-specified levels of performance for Public Domain tests. We regularly re-evaluate and update these guidelines as appropriate.

## Public Domain Ratings

Public Domain rating programs vary around the world, each having unique testing protocols and evaluation criteria. Among other consumer advocacy groups, organizations such as New Car Assessment Programs (NCAPs) and insurance-sponsored organizations that rate vehicles for safety exist globally. NCAPs, which have traditionally included vehicle crashworthiness ratings, are increasingly introducing pedestrian protection assessments along with driver assist and crash avoidance technology evaluations.

NCAPs around the world are continually being updated and often use different evaluation procedures, making it increasingly difficult to achieve the highest ratings. This disparity in what is evaluated, and the procedure or method used, can lead to different ratings for the same vehicle across regions. These inconsistencies pose additional challenges for global automotive companies like Ford, and may even require us to implement unique vehicle designs in different markets.

Nonetheless, we continue to get high marks for vehicle safety in key public and private crash-testing programs (see below for latest data, and in [customer satisfaction and quality surveys](#)).

### Global Safety Public Domain Organizations

Global	<a href="#">Global NCAP</a>
North America	<a href="#">IIHS</a>
North America	<a href="#">NHTSA</a>
Latin and South America	<a href="#">Latin NCAP</a>
Europe	<a href="#">Euro NCAP</a>
Russia	ARCAP (website not available in English)
China	CNACP (website not available in English)
Japan	<a href="#">JNCAP</a>
Korea	<a href="#">KNCAP</a>
South East Asia	<a href="#">ASEAN NCAP</a>
Australia and New Zealand	<a href="#">ANCAP</a>
India	BNVSAP (expected to launch October 2017)

### Vehicle Safety Highlights

Ford continues to receive high marks and accolades for vehicle safety in a number of the industry's key third-party crash-testing programs. Our highlights include:

- As at March 2017, Ford leads all brands with 11 valid 5-Star ratings, the highest possible Overall Vehicle Score in the **New Car Assessment Program (NCAP)** of the U.S. National Highway Traffic Safety Administration (NHTSA)
- Ford has seven **Euro NCAP Advanced Awards** for innovative technologies, and six Best in Class Awards from Euro NCAP, more than any other OEM
- We received 5 Stars on all three vehicles tested for **CNCAP** ratings in 2016

› [Examine our vehicle safety performance in more detail](#)

## Driver Assist Technologies

Sixty years ago, we became the first automaker to offer factory-installed safety belts, and our legacy of safety innovation endures to this day. We continue to roll out a range of technologies designed to enhance vehicle safety and help customers drive more safely.

## Our Approach to Automotive Safety

Ford views automotive safety holistically, and actively works this approach into all areas of our business, from vehicle design and manufacturing to operator behavior and the motor vehicle environment.

We continue to implement innovations that enhance vehicle safety. We are also working on vehicles that communicate with each other and with the world around them, and share learnings with colleagues who are working toward our vision of an [integrated transportation ecosystem](#).

A variety of Ford technologies are available to help customers drive more safely and to alert them to a potential collision. These driver assist systems can also aid with routine driving tasks to reduce demands on the driver.

Our vehicles offer a range of driver assist features and semi-autonomous technologies that use radar, sonar and cameras to see, sense and interpret the environment. The very latest driver assist technologies, listed here, are available on specific vehicles in certain markets:

- **Speed Assist:** Adjustable Speed Limiter Device; Traffic Sign Recognition; Intelligent Speed Assist; Adaptive Cruise Control (ACC)
- **Braking and Collision Avoidance:** Active City Stop; Forward Collision Warning With Brake Support; Pre-Collision Assist With Pedestrian Detection
- **Lane Management:** Lane-Keeping System; Driver Alert System
- **Vision and Visibility:** Blind Spot Information System with Cross-Traffic Alert; Rearview Camera
- **Parking:** Active Park Assist; Enhanced Active Park Assist
- **Other Technologies:** Auto Hold; Hill Start Assist; Curve Control

## Our Latest Technology

Developing new systems is part of our commitment to triple our investment in developing driver assist technologies. New features that are now available include the following:

### Return to Park

Available on the 2017 Ford Fusion, the Return to Park feature uses data from a network of sensors to detect conditions that indicate a customer's intent to exit the vehicle. The smart technology can automatically shift to park, even if the driver forgets; for example, if the vehicle is turned off, or if the driver's safety belt is unlatched and the driver's door is opened when the vehicle is stationary.

### Pedestrian Detection

We have introduced new technology that enhances the current Pre-collision Assist with Pedestrian Detection that can automatically brake for pedestrians, both in daylight and at night. This advanced Pedestrian Detection system scans the road and pavement ahead for people already in, or about to step into, the road ahead, and can automatically apply the brakes if it detects an imminent collision and the driver doesn't respond to initial warnings. Later this year, the advanced Pedestrian Detection system will be introduced on the next-generation Fiesta in Europe, while in North America, it will debut on the 2018 Ford F-150 and 2018 Ford Mustang.

### ACC Stop and Go

ACC Stop and Go is a new semi-autonomous technology that "piggybacks" on the existing adaptive cruise control feature, and can help drivers experience less stress on the road. When activated, it automatically accelerates and brakes for the driver while maintaining a safe distance from the vehicle ahead. If the car stops for more than three seconds, the driver can tap the resume button or accelerator and the car returns to its preset speed. ACC Stop and Go has been added to the 2017MY Continental and Fusion/MKZ.

### BLIS (Blind Spot Information System)

To help change lanes when pulling a trailer, the 2017 F-150 Raptor offers the BLIS (Blind Spot Information System) with trailer coverage, which extends the blind spot zone range behind the vehicle to include the trailer. And our 2017 Super Duty features Trailer Reverse Guidance with cameras fitted in the front grille, tailgate and side view mirror.

### What's Next in Driver Assist Technology?

Ford's driver assist technologies have the potential to improve safety today, and form the building blocks for an autonomous future tomorrow. We are currently testing fully autonomous vehicle technology in real-world conditions, as well as implementing key semi-autonomous technologies across our entire portfolio.

#### Our Latest Technologies

**Evasive Steering Assist** helps drivers steer around stopped or slower vehicles to avoid collisions. Designed to operate at city and highway speeds, it uses radar and a camera to detect slower-moving and stationary vehicles ahead, and provides steering support to enable drivers to avoid a vehicle if a collision is imminent. The system is activated if there is insufficient space to avoid a collision by braking and the driver initiates evasive action.

> [Watch a short video about Evasive Steering Assist.](#)

**Wrong Way Alert** technology uses a windshield-mounted camera and information from the vehicle's navigation system to offer customers visual and audio warnings should they begin driving the wrong direction against traffic.

> [See how the Wrong Way Alert works.](#)

Another of our new technologies, **Traffic Jam Assist**, helps the driver keep the vehicle centered in a lane, plus it brakes and accelerates to keep pace with the vehicle in front.

> [Introducing Ford Traffic Jam Assist.](#)

We are also conducting research with a variety of public, private and academic entities to progress toward a future in which autonomous and connected vehicles communicate with one another, and with the road infrastructure, to help avoid collisions and reduce congestion:



#### Technical Challenges Surrounding Automated Driving

- Collaborating with the University of Michigan, Stanford University, Automated Driving Applications and Technologies (AdaptIVe)
- Lead contributor to the Crash Avoidance Metrics Partnership (CAMP) Automated Vehicle Research report, commissioned by NHTSA



#### Practical and Policy Challenges of Connected Vehicles

- Part of Vehicle Infrastructure Integration Consortium (VIIC), a group of 10 automakers and the U.S. Department of Transportation, looking at security and privacy, the allocation of risk and liability, and the funding of necessary infrastructure



#### Vehicle-to-Vehicle Safety Communication Systems

- Co-leading a group of eight automakers through CAMP



#### Vehicle-to-Infrastructure Applications

- Leading a separate consortium, working with the Federal Highway Administration



#### Cyber Security

- Developing Automotive Cyber Security Best Practices alongside members of the Auto Alliance and Global Automakers, and in conjunction with the Auto-ISAC



### Driver Distraction

- Ford continues to invest a significant amount of time and resources researching driver distraction. Through partnerships with universities and organizations such as the AAM, we have been focusing on analyzing data from large-scale naturalistic driving studies (NDS)

> [Read our front page story about how we're helping drivers make good decisions behind the wheel](#)

## Occupant Protection

**Our commitment to advancing vehicle safety includes conducting research and developing technologies that further protect occupants and other vulnerable road users in a variety of situations.**

### Our Current Technology

Many factors influence a vehicle's crash performance, including its ability to absorb energy on impact and the use of passive safety equipment such as safety belts and airbags.

Safety belts remain the most effective and important vehicle safety technology available. In addition to traditional safety belts, Ford offers rear seat inflatable safety belts, which incorporate airbag technology to help reduce the risk of head, neck and chest injuries for rear passengers. We have also patented technologies that allow airbags to be placed in other locations inside the vehicle, such as knee airbags for front passengers.

We are using more advanced and ultra-high-strength steels, aluminum, plastics and composites in vehicle structures to maintain high levels of safety crash performance while reducing vehicle weight and improving fuel economy.

### What's Next in Occupant Protection?

We collaborate with other automakers on precompetitive projects to enhance the safety of vehicle occupants. The results from these joint projects may have a broad impact and are often published in peer-reviewed journals and other scientific publications.

We collaborate with General Motors (GM) and Fiat Chrysler Automobiles (FCA) through the various safety-related working groups and committees of the U.S. Council for Automotive Research (USCAR). We also collaborate with other automotive manufacturers through the Alliance of Automobile Manufacturers (Auto Alliance), the Society of Automotive Engineers (SAE) International and the International Organization for Standardization (ISO).

We are also participating in joint projects on lithium-ion batteries and lightweight materials with the Department of Energy (DOE), software vendors and suppliers. We collaborate with universities in many areas through our Alliance partner universities<sup>1</sup> and by awarding grants through our University Research Program (URP).

### Research into Occupant Protection

Our ongoing vehicle safety and occupant protection research includes the following examples:

- Using real-world crash data and developing computer models to estimate the effects of demographic trends (e.g., occupant age and weight) and vehicle characteristics (e.g., size and weight) on future vehicle safety
- Developing and using advanced human body computer models that reflect changing global demographics to investigate the specific needs of elderly and obese occupants, and to research possible countermeasures

## STRATEGY AND GOVERNANCE

## CUSTOMERS AND PRODUCTS

## OPERATIONS

## PEOPLE AND COMMUNITIES

## PERFORMANCE AND DATA

- Working with industry to evaluate the biofidelity, repeatability, reproducibility and durability of next-generation anthropomorphic test devices (ATDs) – including two mid-sized ATDs for testing front and side impacts – so that they more closely simulate the responses of human occupants in crashes
- Ensuring emerging [alternative fuel technology systems](#) perform as intended during a vehicle crash
- Under the USCAR partnership and in collaboration with GM and FCA, we conducted a literature research and meta-analysis project on crash avoidance technologies, including but not limited to advanced driver assist technologies such as autonomous emergency braking (AEB), lane departure, night vision and advanced lighting
- Along with USCAR, we have continued the collaboration with Sandia National Laboratories (SNL) and the National Renewable Energy Laboratory (NREL) to conduct research and crash testing of live lithium-ion batteries to evaluate their safety performance
- With the DOE, we are evaluating the lightweighting of materials used in traditional automotive manufacturing to improve fuel economy while maintaining crashworthiness. Different commercial CAE (computer-aided engineering) crash codes are being evaluated for materials such as boron, carbon fiber and magnesium, while considering the implementation of new crash modes such as the proposed frontal oblique impact test being considered by NHTSA
- We are researching nano-liquid foam technology and its potential future applications in collaboration with Michigan State University
- We are developing new state-of-the-art CAE and safety methods for process improvements, enhancement of computer simulation capabilities and to support virtual testing

### Research into Autonomous Vehicle Safety

We have also initiated research projects with universities related to future autonomous vehicle (AV) safety. These include:

- Assessing occupant use cases and occupant sensing technologies with Purdue University
- Evaluating how AV technologies may affect the real-world crash scenarios and occupant protection with the University of Michigan
- Evaluating how driver assist features will affect the safety of the occupant and accident scenarios in the field with Virginia Tech
- Developing potential out-of-position situations for the new deployable restraints and seating configurations that AVs may enable with Virginia Tech

› [Read more about our work with connected and autonomous vehicles](#)

### CASE STUDY

#### Enhancing Safety in Autonomous Vehicles

With 29 years' experience developing safety-related electronics for automobiles, Colm Boran manages Ford's Autonomous Vehicle (AV) Systems Engineering team. His current role involves specifying the company's SAE Level 4 AV system architecture, which Ford plans to introduce in 2021 in a commercial fleet offering ride-sharing, ride-hailing or package delivery services.

*“Our development processes, test facilities and decades of launching various driving automation systems in millions of vehicles around the world are all being brought together to develop the Ford SAE Level 4 AV. This is designed to operate autonomously without a steering wheel or pedals, within a geo-fenced area.*

*To enhance driving safety, the development vehicle has a range of sensors to exploit different portions of the electromagnetic spectrum, helping the system operate in a variety of driving and climatic conditions, such as low sun, for example. Some go beyond human capability and can “see” equally well in complete darkness, beyond the range of the vehicle’s headlights. And unlike humans, the sensing system never gets distracted or tired.*

*These sensors are arranged to provide 360° coverage, scanning round the vehicle several times per second. This creates a highly detailed map of the roads and surrounding structures, helping the system determine its location with precision.*

*In addition, we are in the process of investigating various redundant sub-systems that maintain functionality during abnormal situations.”*

**Colm Boran**

Manager – Autonomous Vehicle Systems Engineering, Ford Motor Company

1. University of Michigan, Massachusetts Institute of Technology, Stanford University and Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen University, Northwestern, Ohio State, Michigan State, Virginia Tech, Purdue, Katholieke Universiteit (KU) Leuven.

## Post-Crash Response

**Post-crash notification technology assists occupants in summoning assistance in an urgent situation through in-vehicle emergency call systems and can give first responders potentially life-saving information.**

### Automated Emergency Calls

Vehicles equipped with SYNC® in-car connectivity, which enables drivers to use cell phones and MP3 players through voice commands, also come with a call-for-help system called SYNC 911 Assist (in the U.S.) or Emergency Assistance (in other markets).

In the event of a severe crash where an airbag is deployed or the fuel pump is shut off, SYNC 911 Assist can make an emergency call using a paired/connected cell phone. This call can be initiated automatically, although a vehicle occupant can opt to cancel the call.

As well as providing the emergency operator with a GPS location, SYNC Enhanced 911 Assist can also provide data such as impact velocity, crash type, whether multiple impacts were sustained, safety belt usage for seating positions with belt reminders, and whether airbags were deployed. Such information could help emergency responders understand the severity of the incident and dispatch the most appropriate response. Enhanced 911 Assist is currently available on vehicles in the U.S. and China that are equipped with SYNC Gen 1.1 or Gen 3, and the offering has recently expanded to include Brazil.

### Alerting Passers-By

The SOS-Post Crash Alert System™, available on most Ford and Lincoln vehicles, alerts passers-by and first responders to a vehicle's location. In the event of airbag or safety belt pre-tensioner activation, it automatically starts the hazard lights and, in non-European vehicles, sounds the horn. The system also sends a signal to unlock the vehicle doors to aid exit or access to first responders.

## Encouraging Safer Driving

**To us, driver safety is not just about making safer vehicles. We're also encouraging safer behavior behind the wheel through a range of programs around the world, including our flagship Driving Skills for Life (DSFL) initiative.**

### Ford Driving Skills for Life

[Ford Driving Skills for Life \(Ford DSFL\)](#) was established in 2003 by Ford Fund, in partnership with the Governors Highway Safety Association (GHSA) and a panel of experts, to teach newly licensed drivers the

necessary skills for safer driving, and the importance of making good decisions behind the wheel. The core curriculum – vehicle handling, hazard recognition, driver distraction, and speed and space management – is delivered through hands-on courses, classroom material and the Ford DSFL website, which includes an interactive training center (“The Academy”).

As we expand the program, we adapt it to suit different regions. In North America and Europe, the Ford DSFL programs help teenagers – the primary age group of first-time drivers – drive more safely. For example, the Ford DSFL National Tour delivered free hands-on training sessions in 20 U.S. states during 2016. Meanwhile, in many Asian, Middle Eastern and African markets, where the number of new drivers is increasing rapidly as more people are able to afford vehicles, Ford DSFL is aimed at novice drivers of all ages.

› [See how we're delivering Ford's DSFL program around the globe](#)

## Progress in 2016

Our global reach spread further in 2016 to 150 markets around the world, with first-time programs in Finland, Poland, Korea, Kenya, Nigeria and Uganda; Hungary and Norway will be added in 2017.

**In 2016, we delivered free hands-on, online and classroom-based safety training to 160,000 participants around the world.**

Now in its 14th year, Ford DSFL had reached more than 1 million young people and newly licensed drivers in 35 countries at the close of 2016. This includes 200,000 people attending free, behind-the-wheel training and 800,000 people taking The Academy's online training modules, and equates to an investment of nearly \$60 million in promoting safety on the road.

## Addressing Driver Distraction

Ford conducts a significant amount of research into driver distraction, both on our own and through partnerships with universities and organizations such as the Alliance of Automobile Manufacturers (Auto Alliance), to help make driving safer for everyone. Studies have demonstrated the importance of having drivers keep their hands on the wheel and their eyes on the road, informing the development of some [driver assist technologies](#) such as Forward Collision Warning, Automatic Emergency Braking, lane-keeping systems and SYNC®, which permits hands-free, voice actuation of several phone, navigation and audio features.

**According to the U.S. National Highway Traffic Safety Administration (NHTSA), approximately 18 percent of all motor vehicle driver deaths involve drugs other than alcohol, such as cannabis and cocaine.**

### Driving Under the Influence...

To educate teens and new adult drivers about the dangers of driving while under the influence of alcohol or drugs, we have worked with the Meyer-Hentschel Institute in Germany to produce tailor-made “Drink Driving Suits” and “Drug Driving Suits.” Students attending Ford DSFL driving clinics during 2016 got to try both suits to understand how being impaired can slow movement, reduce reaction times, and affect vision and coordination.

**In Europe, alcohol is a factor in a sixth of road accident fatalities.**

› [See the “Drink Driving Suits” in action.](#)

› [See the “Drug Driving Suits” in action.](#)

### ...Even the Next Day

Drink driving is now one of society's biggest taboos but hitting the road the next morning can be just as dangerous. Even when drivers are no longer over the legal alcohol limit, drivers are likely to be sleep deprived and have slower reaction times.

That's where the “Hangover Suit,” again developed by the Meyer-Hentschel Institute, comes in. Weighing more than 17 kg, the suit – currently available on Ford DSFL courses in Europe – consists of a special vest, wrist and ankle weights, weighted cap and goggles, and headphones. Together, these simulate the classic hangover symptoms of fatigue, dizziness, sensitivity to sound, a throbbing head and difficulty concentrating.

**Ford supports and contributes to the Automotive Coalition for Traffic Safety (ACTS) participation into DADSS (Driver Alcohol Detection System for Safety) research, aimed at developing a non-intrusive and robust system to support NHTSA's initiative to reduce drunk driving.**

### Anatomy of a “Hangover Suit”

Ford's “Hangover Suit” simulates all the classic hangover symptoms of a throbbing head, feeling tired and weak for the person wearing it.



#### 1. Vision impaired glasses

Give you double vision, decreasing concentration and hyper-sensitivity to light

#### 2. Cap

Together with goggles, stimulate dizziness and a blinding headache

#### 3. Headphones

Play pulsating sounds to mimic a migraine headache

#### 4. Body vest and ankle weights

Affect balance and slow movement, especially when worn on the opposite limb to the wrist weight

*“There is a lot of social pressure to prevent those who may be tempted to drink drive after a night out, but those who drive the morning after often are traveling alone. The “Hangover Suit” shows how debilitating a hangover can be and the risk that driving in that condition can present to all road users.”*

**Jim Graham**

Manager, Ford Driving Skills for Life

› [See how the Ford “Hangover Suit” demonstrates the dangers of driving while hungover.](#)

## Giving Teen Drivers a Helping Hand

A new report from the GHSA, funded by a grant from Ford Fund, shows that while much progress has been made in reducing teen driver-involved traffic crashes and deaths over the past decade, teen drivers are still 1.6 times more likely to be involved in a fatal crash than their adult counterparts, and teen-involved fatal crashes increased by 10 percent in 2015.

The report, [Mission Not Accomplished: Teen Safe Driving, the Next Chapter](#), also reveals that while great progress has been made at reducing younger teen driver deaths (ages 15–17), more needs to be done for those aged 18–20. It also provides recommendations for actions that can be taken.

For our part, we've developed the Ford MyKey® system to help parents encourage their teenagers to drive more safely. Available on millions of Ford and Lincoln vehicles, the programmable key can:

- Limit the vehicle's top speed and provide speed-limit alert chimes
- Initiate a “Do not disturb” feature to redirect incoming phone calls and text messages
- Activate Belt-Minder® to chime every minute and mute the audio system until both front occupants are buckled
- Limit the maximum audio system volume to help with hearing nearby first responders
- Prevent safety and driver assist systems from being disabled

› [Read our front page story about how we're helping drivers make good decisions behind the wheel](#)