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Climate Change

2009 HIGHLIGHTS:

- Introduced the new Fiesta global small car in Europe and China
- On track to surpass our goal of a 30 percent reduction in CO_2 emissions from our U.S. and European new vehicles

Our blueprint for sustainability details our near-, mid- and long-term product plans to meet our CO_2 emissions goal.

Concerns about climate change and growing constraints on the use and availability of carbon-based fuels affect our operations, our customers, our investors and our communities. The issue warrants precautionary, prudent and early actions to enhance our competitiveness, protect our profitability in an increasingly carbon-constrained economy and do our share to prevent or reduce the potential for environmental harm due to climate change.

We have responded to the significant risks and opportunities presented by the climate change issue by developing a comprehensive global strategy to reduce greenhouse gas (GHG) emissions from our products and processes while working cooperatively with the public and private sectors to advance climate change solutions. We are taking a holistic approach to the climate change issue, recognizing that it affects all parts of our business and is interconnected to other important issues, from water availability and energy security to human rights.

We are making progress in implementing our strategy, improving the fuel economy of our vehicles and reducing GHG emissions from our products and operations. According to the U.S. Environmental Protection Agency (EPA), for example, no automaker has posted a larger fleet-wide gain in fuel economy in the past five years than Ford. Based on EPA measurements, Ford's combined car and truck fuel economy has improved nearly 20 percent since 2004 – almost double the gain of the next-closest competitor. In addition, Ford's 2009 fleet-wide average carbon dioxide (CO_2) emissions were 5 percent lower than in 2008. In Europe, we have reduced the average CO_2 emissions of the vehicles we sell by more than 27 percent compared with a 1995 baseline (excluding Volvo).

We believe our commitment to addressing the climate change issue in a comprehensive and strategic way is one of the factors that has helped transform our Company's current and future products and prospects.

Our Commitment

In early 2008, Ford announced a goal to reduce CO_2 emissions[1] from its U.S. and European new vehicles by 30 percent by 2020, relative to a 2006 model year baseline. We also set out a technology migration plan – embodied in our blueprint for sustainability – that details our near-, mid- and long-term plans to meet this goal. Our commitment and plan are aligned with doing our part to achieve a 450 ppm climate stabilization pathway[2] (see figure below). Despite challenging economic conditions, we are making significant progress in implementing the plan and are on track to surpass the goal.

PERSPECTIVES ON SUSTAINABILITY

David Chock

Former Ford Scientist (1989–2009), Current Member of the Science Advisory Board (SAB), U.S. Environmental Protection Agency

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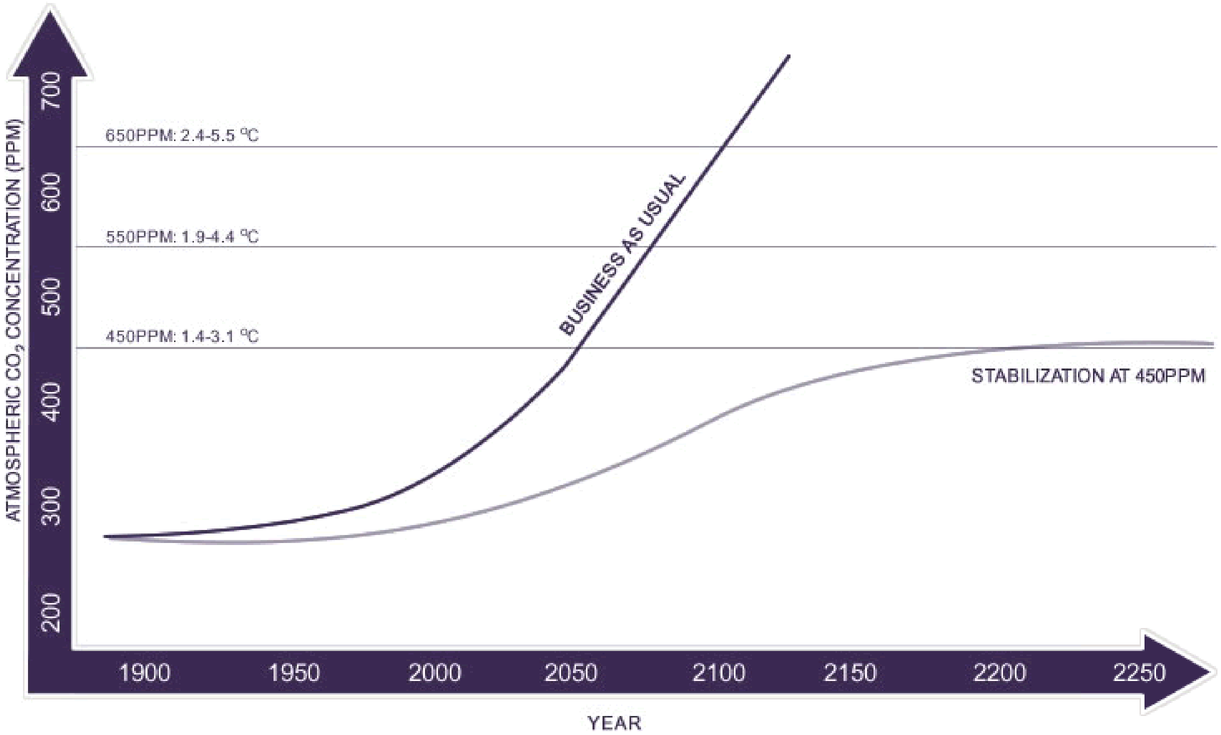
Delivering more Fuel-Efficient Vehicles

External Web Sites:

U.S. Climate Action Partnership

Stabilizing Atmospheric CO_2 Levels



We have also announced an ongoing commitment, beginning with the 2010 model year, that all new or significantly refreshed vehicles will be best in class, or among the best in class, for fuel economy in their segment. We are committed to reducing CO_2 emissions from our operations, and we are exploring carbon emissions in our supply chain through participation in the Carbon Disclosure Project's supply chain initiative and the World Resources Institute/World Business Council on Sustainable Development's Scope 3 road testing project. These and other climate change commitments are summarized in the Climate Change: Related Commitments and Progress table.

During 2009, we expanded our analysis of GHG emission reductions to include the products we sell in Brazil and China. In this analysis, we compared our current product plans to potential reductions aligned with long-term CO_2 stabilization at 450 ppm and considered the impact of low-carbon fuels. This is a step toward developing goals for these markets.

Our climate change strategy is based on delivering products that our customers want while doing our share to stabilize GHG concentrations in the atmosphere at levels generally accepted to minimize the effects of climate change. It encompasses our products, operations and, increasingly, our customers, dealers and suppliers.

Ford cannot achieve climate stabilization alone. Reducing emissions by the amount required calls for an integrated approach – a partnership of all stakeholders, including the automotive industry, the fuel industry, government and consumers. It can only be achieved by significantly and continuously reducing GHG emissions over a period of decades in all sectors of the economy. In the transportation sector, this means increases in vehicle fuel economy globally, as well as the development of lower-carbon fuels along with price signals to align consumers with climate stabilization goals.

We are committed to advocating effective and appropriate climate change policy in the United States and around the world. We are an active member of the U.S. Climate Action Partnership (USCAP), a coalition of diverse stakeholders that released its Blueprint for Legislative Action in January 2009, setting out consensus recommendations for U.S. climate protection legislation. The USCAP blueprint includes an aggressive emission-reduction schedule, a proposed scope of coverage for a cap-and-trade program, and recommendations for how to include as much of the U.S. economy under the cap as administratively and politically feasible. It is a balanced and integrated approach to key linked issues that must be addressed in any national climate legislation; however, we recognize that the blueprint recommendations are not the only possible path forward.

Our CO_2 product goal is aligned with the USCAP recommendations and with the broad goal of climate stabilization. It also aligns our product plans to meet or exceed new fuel economy requirements in the United States and Europe. We recognize that future developments in technologies, markets, policy actions and even the natural manifestations of climate change are all uncertain. Accordingly, we will continue to monitor and adjust our goal based on changing conditions.

In This Section

In this section of our sustainability report we provide an overview of GHG emissions, including data on the contribution of light-duty vehicles, life-cycle CO_2 emissions from a typical vehicle, Ford's own climate "footprint" and stabilization pathways. We also discuss the risks and opportunities the climate change issue poses for Ford, our climate change strategy – including our blueprint for sustainability – and how we are addressing climate change public policy issues.

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1. CO_2 is the major long-lived greenhouse gas. Greenhouse gases trap heat in the Earth's atmosphere, contributing to global climate change. CO_2 is the most prevalent GHG associated with the manufacture and use of our products, so our targets are set for CO_2 rather than all GHGs. See the Beyond CO_2 section for discussion of Ford's other GHG emissions.
2. It is generally accepted that stabilization of CO_2 in the range 450–550 ppm is required to avoid the most serious impacts of climate change. Our target is aligned with a 450 ppm stabilization pathway and assumes that fuel providers, consumers, governments and other energy sectors deliver their contributions.

Climate Change: Related Commitments and Progress

Commitment	Target	Progress
Products		
Ford U.S. and EU new products	Reduce CO_2 emissions by 30 percent by 2020, relative to a 2006 model year baseline	On track
Australian Industry-wide National Average CO_2 Emissions (NACE), previously known as National Average Fuel Consumption (NAFC) (industry)	Voluntary target to achieve national average CO_2 emissions of 222 g/km for light vehicles under 3.5 metric tons gross vehicle mass by 2010. Requires an overall reduction in average CO_2 emissions of 12 percent between 2002 and 2010	Met in 2009; industry is working on a new target for Australia for 2015 and 2020
Canadian Greenhouse Gas Memorandum of Understanding (industry)	Industry-wide voluntary agreement to reduce GHGs from the Canadian car and truck fleet by 5.3 megatonnes by 2010 compared to projected emissions	First target met in 2007; on track to meet 2010 target
Operations		
Global manufacturing energy efficiency (Ford)	Improve facility energy efficiency by 3 percent during 2010	On track
EU Emission Trading Scheme (Ford)	Ensure compliance with European Union CO_2 Emission Trading Scheme requirements annually, including third-party verification	Met
Chicago Climate Exchange (Ford)	Reduce North American facility emissions by 6 percent between 2000 and 2010, as verified by third-party auditors	Met
Alliance of Automotive Manufacturers (industry)	Reduce U.S. facility GHG emissions by 10 percent per vehicle produced between 2002 and 2012	On track
Voluntary GHG reporting (Ford)	Voluntarily report facility CO_2 emissions to national emissions registries in Australia, Canada, Mexico, the Philippines and the United States	Met; added all of China and Brazil in 2009

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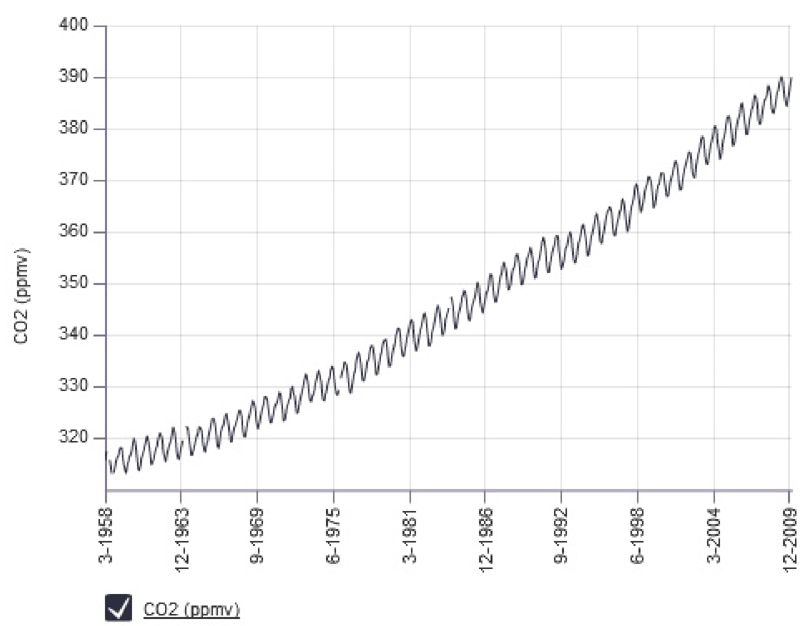
Greenhouse Gas Emissions Overview

Climate change is the result of an increase in heat-trapping (greenhouse) gases in the atmosphere. Carbon dioxide (CO_2) is the major long-lived greenhouse gas (GHG). The burning of fossil fuels (to provide electricity, heat and transportation, and to support industry and agriculture), as well as deforestation, lead to emissions of CO_2 and increased levels of atmospheric CO_2 (see Figure 1).

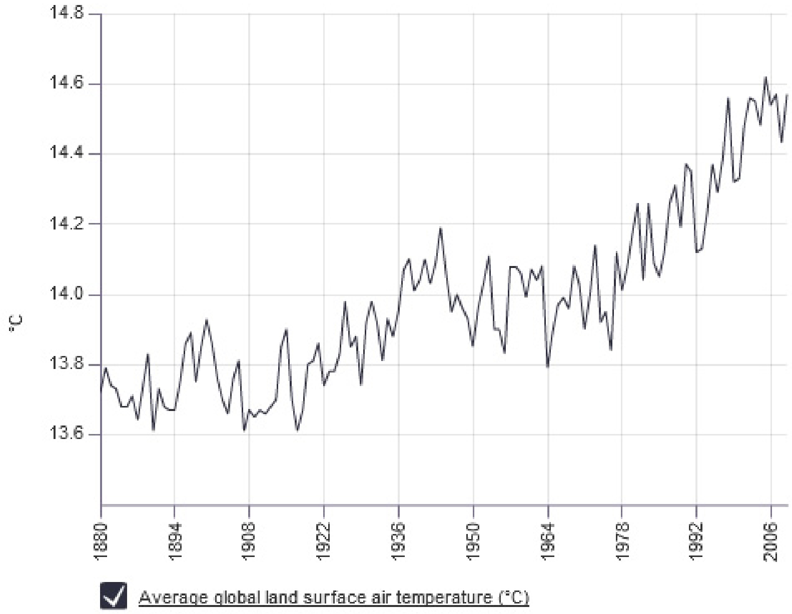
There has been discussion recently in the media regarding the integrity of the temperature record. Specifically, it has been claimed that climate scientists at the Climate Research Unit (CRU) at the University of East Anglia in the UK have misrepresented the instrumental temperature record. This has become known as "Climategate." We do not believe these developments undermine the broad scientific basis for concern about climate change. Indeed, we continue to monitor original research and discussion pertaining to climate change and support the vigorous application of the scientific method in this and other fields of inquiry. We also note that the temperature record independently reported by scientists at the National Aeronautics and Space Administration (NASA) shows a distinct warming trend. As seen in Figure 2, the past decade was the warmest decade in the instrumental temperature record. Moreover, independent measurements of an increase of sea level and ocean acidification are consistent with the impact of rising GHG concentrations and global temperature.

Figure 1: CO_2 concentration measured at the observatory in Mauna Loa, Hawaii



Data source: NOAA (2010)

Figure 2: Global temperature



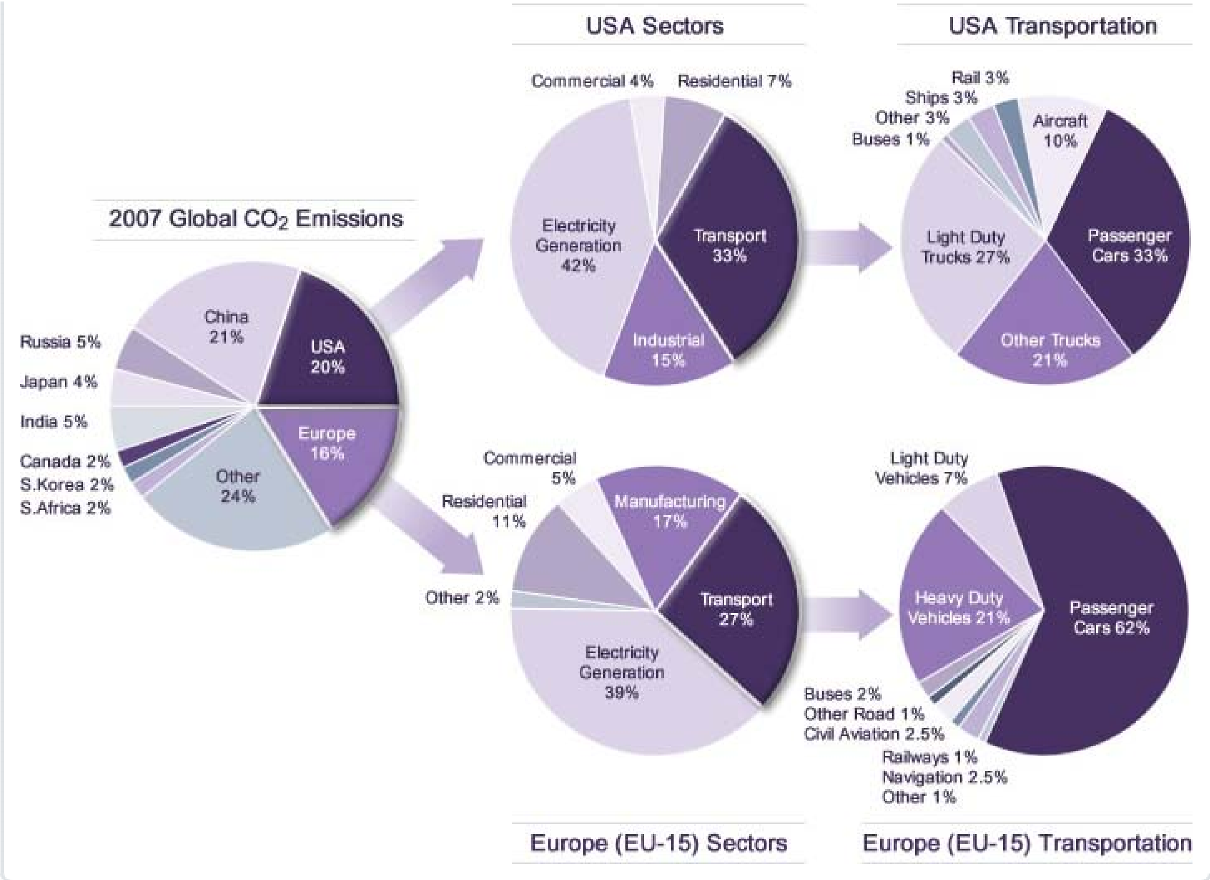
Data source: NASA (2010)

Global CO_2 Emissions

Figure 3 (below) provides a breakdown of estimated 2007 fossil fuel CO_2 emissions by region. For the United States and Europe, the emissions are further broken down by sector and by mode in the transportation sector. The data were taken from reports published by the International Energy Agency, European Environment Agency and U.S. Environmental Protection Agency. Globally, emissions from cars and light-duty trucks comprise about 11 percent of all fossil fuel CO_2 emissions. In the United States, cars and light-duty trucks account for approximately 20 percent of fossil fuel CO_2 emissions, or approximately 4 percent of global fossil fuel CO_2 emissions. In Europe, passenger cars and light-duty trucks account for approximately 19 percent of fossil fuel CO_2 emissions, or about 3 percent of global fossil fuel CO_2 emissions.

Until recently, the United States was the largest CO_2 emitter. In 2007, however, emissions from China surpassed those from the United States. It is expected that the gap between emissions from China and the United States will widen in the future, although per-capita emissions of CO_2 in the U.S. remain higher (by approximately a factor of four) than those in China.

Figure 3: Distribution of Fossil Fuel CO_2 Emissions 2007



Life-Cycle Vehicle Emissions

The GHG emissions attributable to Ford's activities include emissions from our facilities, from the transportation of our products and people, from the vehicles we produce once they are in use by customers, and from our suppliers. In this report, we provide data on CO_2 emissions from our facilities and our U.S. and European new products. Additional information on our GHG footprint is found in the Life-Cycle Vehicle CO_2 Emissions section.

Most of the life-cycle CO_2 emissions from vehicles are released when the vehicles are driven, rather than when they are manufactured, maintained or recycled at end-of-life. As vehicle fuel efficiency improves and lower-carbon fuels are made available, we expect that the relative contribution of CO_2 emissions from the fuel-consumption phase will decrease (see Life-Cycle Vehicle CO_2 Emissions).

Greenhouse Gas Emissions Snapshot

In 2001, we estimated the greenhouse gas emissions from our operations and products as part of an assessment of the impact of the climate change issue on our Company. We updated this estimate for our 2006/7 report. Many assumptions were required to generate the estimate, and we do not control all of the factors that influence its magnitude. Therefore, we do not use this estimate as an ongoing performance measure. We intend to continue to reduce our facility GHG emissions, improve the energy efficiency of our operations and the vehicles we sell, closely track those results and update the estimate in the future.

Supply Chain

We are currently evaluating climate change risks and opportunities across our supply chain and searching for new opportunities and relationships that will enhance supplier environmental performance. (See the Progress and Performance section for details of our participation in initial efforts to assess GHG emissions in our supply chain.) Within the Aligned Business Framework agreement with suppliers, environmental leadership is integral to overall business performance metrics. Climate-change-related activities are highlighted as potential leadership opportunities. In addition, our requirement that suppliers implement robust environmental management systems will better enable them to understand, measure and report their emissions. We also will seek out opportunities to partner with suppliers to improve the greenhouse gas emissions performance of our products and processes, and improve energy efficiency throughout the vehicle life-cycle, including in the supply chain.

Beyond CO_2

We have a holistic view of climate change and have addressed non-CO_2 long-term greenhouse gases such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), nitrous oxide (N_2O) and sulfur hexafluoride (SF_6). We have prohibited SF_6 in tires and PFCs in open systems since 1999. We have conducted scientific research to determine the relative contribution of a wide range of long-lived greenhouse gases to radiative forcing of climate change and have published our results to reduce uncertainties in the scientific assessments. We are working with our suppliers to optimize air conditioning efficiency, reduce refrigerant leakage rates and investigate alternatives. We are also actively conducting research to evaluate the environmental fates of potential alternative air conditioning refrigerants that may replace HFC-134a and have made our research data available to the scientific community. Scientific reports on the environmental impact of hydrofluoroolefins as potential replacements for HFCs have been published in peer-reviewed scientific literature. We prohibited the use of SF_6 in magnesium casting as of January 2004 through our Restricted Substance Management Standard. Given the impressive reductions in the emission of criteria pollutants (hydrocarbons, NOx, particulate matter and carbon monoxide) enabled by improvements in engine and exhaust after-treatment technology, we believe that the contribution to climate change by such short-lived pollutants from light-duty vehicles will be of relatively minor importance in the future.[1]

While carbon dioxide is by far the most important greenhouse gas associated with the use of motor vehicles, small amounts of other greenhouse gases are also emitted, notably methane (CH_4), N_2O and HFC-134a. A small amount of methane is formed in the engine and emitted into the atmosphere. We have assessed the contribution to climate change made by methane emissions from vehicles as about 0.3 to 0.4 percent of that of the CO_2 emissions from vehicles. We have assessed the contribution to climate change from N_2O emissions from vehicle tailpipes (not including potential emissions associated with fuel production) as about 1 to 3 percent of that of the tailpipe CO_2 emissions from vehicles. Finally, we have estimated that the radiative forcing contribution of HFC-134a leakage from an air-conditioner-equipped vehicle is approximately 3 to 5 percent of that of the CO_2 emitted by the vehicle.[2] When expressed in terms of "CO_2 equivalents," the contribution of vehicle emissions to radiative forcing of climate change is dominated by emissions of CO_2.

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1. T.J. Wallington, J.E. Anderson, S.A. Mueller, S. Winkler, and J.M. Ginder, "Emissions omissions," *Science*, 327, 268, (2010).
2. T. J. Wallington, J. L. Sullivan, and M. D. Hurley, "Emissions of CO_2, CO, NOx, HC, PM, HFC-134a, N_2O and CH_4 from the Global Light Duty Vehicle Fleet," *Meteorol. Z.*, 17, 109 (2008).

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Life-Cycle Vehicle CO_2 Emissions

Life-cycle assessment tracks emissions generated and materials consumed for a product system over its entire life-cycle, from cradle to grave, including material production, product manufacture, product use, product maintenance and disposal at end of life. For vehicles, this includes the environmental burdens associated with making materials (e.g., steel, aluminum, brass, copper, plastics, etc.), fabricating them into parts, assembling the parts into a vehicle, operating the vehicle over its entire lifetime, producing fuel for the vehicle, maintaining the vehicle and finally disposing of the vehicle at the end of its life. Life-cycle assessment is an essential tool when thinking about the environmental impacts of complex systems.

The table below details the results of a life-cycle analysis for a representative midsize car and SUV in the United States. At present, life-cycle CO_2 emissions from vehicles are dominated by CO_2 released during fuel consumption. Product disposal has a minor impact on airborne emissions and energy consumption relative to other phases of the product system. As vehicle fuel efficiency improves and lower-carbon fuels are made available, the relative contributions of CO_2 emissions from the fuel-consumption phase will likely decrease. We are working on life-cycle emission estimates for electrified vehicles (i.e., plug-in hybrids and battery electric vehicles).

This analysis incorporates many assumptions, some of which reflect factors over which we have little or no control. Therefore, we do not expect to use the estimate as an ongoing performance measure. The analysis did, however, enable us to gain a better perspective of life-cycle emissions and hence understand the opportunities for reducing emissions.

	Midsize car		Midsize SUV	
	Metric tons of CO_2	% of total	Metric tons of CO_2	% of total
Raw material production (steel, aluminum, plastics, ...)	3.5	5.6%	4.3	5.2%
Manufacturing/assembly	2.6	4.2%	2.6	3.2%
Ford manufacturing logistics	0.3	0.5%	0.3	0.4%
Fuel (120,000 miles [192,000 km]) [well to wheels]	55.1	88.6%	74.6	90.4%
Maintenance and repair	0.6	1.0%	0.6	0.7%
End of life/recycling	0.1	0.2%	0.1	0.1%
Total life-cycle	62.2	100%	82.5	100%

RELATED LINKS
This Report:
Quantifying Our Environmental Impacts

MATERIAL ISSUES
- Materiality Analysis
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  - Climate Change: Related Commitments and Progress
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    - Life-Cycle Vehicle CO_2 Emissions
    - Climate Stabilization
  - Climate Change Risks and Opportunities
  - Our Strategy: Blueprint for Sustainability
  - Ford's Sustainable Technologies and Alternative Fuels Plan
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Climate Stabilization

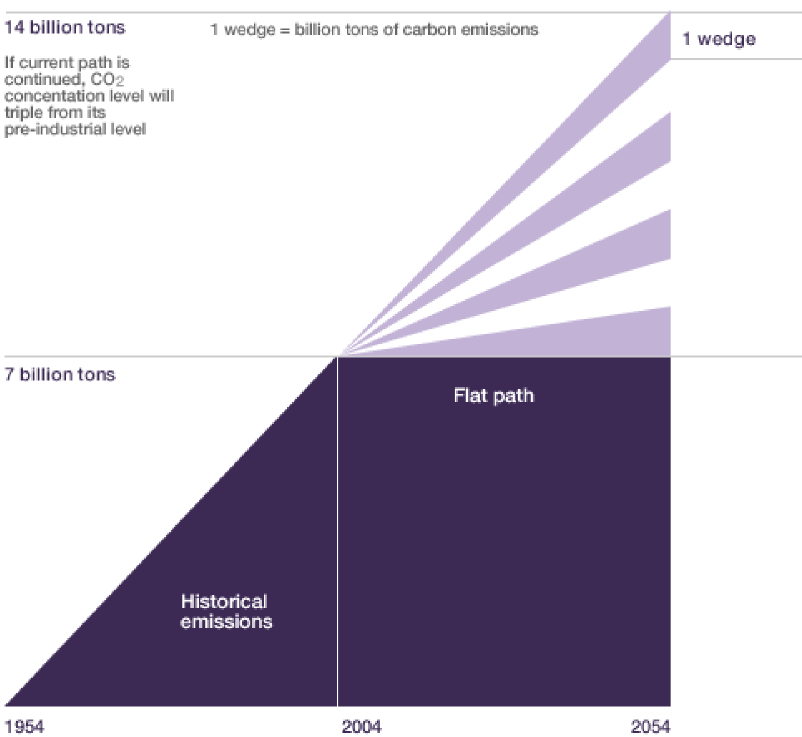
RELATED LINKS

External Web Sites:
- Intergovernmental Panel on Climate Change
- Carbon Mitigation Initiative

The assessment of the science of global warming issued in February 2007 by the Intergovernmental Panel on Climate Change concluded that, "Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic [man-made] greenhouse gas emissions." It also concluded that the effects of this warming, such as melting snow and ice and rising sea levels, are being felt, and that, "Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century."[1]

Ford researchers have played a leading role in scientific research to understand and quantify the contribution of vehicles to climate change. We have also worked with a variety of partners to understand the current and projected man-made GHG emissions and the steps that can be taken to reduce them. Many scientists, businesses and governmental agencies have concluded that stabilizing the atmospheric concentration of CO_2 at approximately 450 parts per million (ppm) may help to forestall or substantially delay the most serious consequences of climate change.

The Carbon Mitigation Initiative, a research partnership based at Princeton University and supported by BP and Ford, has examined what it would take to stabilize atmospheric CO_2 at 500 ppm compared with the 2010 level of approximately 388 ppm and the pre-industrial level of approximately 270–280 ppm. Researchers broadly identified a set of high-level stabilization strategies they call "wedges."[2] Each wedge represents the implementation of a strategy that could cut global annual carbon emissions by 1 billion metric tons by 2054.[3] The wedges concept is a powerful tool to demonstrate the scale of the climate stabilization challenge, the need for an approach that includes many different economic sectors (power, transportation, agriculture, industry), and the options that are available.



To explore which vehicle and fuel technologies might be most cost-effective to stabilize CO_2 at 450–550 ppm, we have worked with colleagues at Chalmers University in Gothenburg, Sweden, to include a detailed description of light-duty vehicles in a model of global energy use in 2010 to 2100. Nine technology cost cases were considered. We found that variation of vehicle technology costs over reasonable ranges led to large differences in the vehicle technologies utilized to meet future CO_2 stabilization targets. We concluded that given the large uncertainties in our current knowledge of future vehicle technology costs, it is too early to express any firm opinions about the future cost-effectiveness or optimality of different future fuel and vehicle powertrain technology combinations.[4] This conclusion is reflected in the diversity of fuel and vehicle technologies included in our sustainability strategy.

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1. *Climate Change 2007: The Physical Science Basis Summary for Policymakers*, Intergovernmental Panel on Climate Change, February 2007.
2. cmi.princeton.edu/wedges/
3. S. Pacala, R. Socolow, "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies," *Science*, 305, 968 (2004).
4. M. Grahn, M. I. Williander, J. E. Anderson, S. A. Mueller, T. J. Wallington, "Fuel and Vehicle Technology Choices for Passenger Vehicles in Achieving Stringent CO_2 Targets: Connections between Transportation and Other Energy Sectors," *Environ. Sci. Technol.*, 43, 3365 (2009).

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Climate Change Risks and Opportunities

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Delivering More Fuel-Efficient Vehicles

Climate Change Policy and Partnerships

Over the past decade, concerns about climate change, the price of fuel and energy security – along with the global recession – have dramatically reshaped the automotive business. This creates substantial risks for automakers but also opportunities to grow and expand. Below we discuss the general trends driving change in our markets and take a closer look at several key markets. We also discuss the physical and supply chain risks to our business posed by climate change.

Our Markets

During 2009, the global economic recession took its toll on the market for new automobiles, with sales down significantly in the United States, and South America. In Europe, passenger car sales held steady, spurred by government incentives, while commercial vehicle sales declined. In China, sales continued to grow. By the end of the year, China had surpassed the United States as the world's largest market for new automobiles. Other factors influencing our markets included the following:

- The policy landscape is becoming more complex and interconnected with other market forces. The Public Policy section of this report discusses regulatory developments in detail, but in brief, all of our major markets are increasingly shaped by government actions to regulate fuel economy and CO_2 emissions and provide incentives to shift consumer and business behavior. Many governments are also actively involved in promoting research and development into new vehicle and battery technologies.

- Although the cost of gasoline and diesel fuels moderated during 2009, concern about the potential for rising fuel prices and price volatility continues to drive a long-term trend toward smaller and more fuel-efficient vehicles.

- In many markets, governments and consumers are seeking to rely as much as possible on domestic sources of transportation fuel and reduce imports of petroleum products.

- Investors are showing greater concern about climate change as a material risk for many companies. A variety of voluntary public registries and information services (like the Carbon Disclosure Project) are providing information on greenhouse gas emissions to investors, while in some countries companies are required to disclose information about their climate risks. Most recently, the U.S. Securities and Exchange Commission (SEC) issued guidance to help publicly traded companies assess whether climate-related impacts on their businesses will require disclosure to the SEC. Thus, providing climate-change-relevant information to investors and shaping our business strategy with climate change in mind are important elements of maintaining access to capital.

These market shifts are very significant to our Company. Everywhere we operate, the financial health of our Company depends on our ability to predict market shifts of all kinds and to be ready with the products and services our customers demand. Our actions to improve the fuel economy of our vehicles, along with their quality, performance and features, have helped us take advantage of these changes and gain market share in North America, Europe and South America. However, continued uncertainty about the GHG regulatory framework, particularly in the United States, and the possibility that fuel prices could decline mean that there is also a risk that consumer preferences will shift back toward less fuel-efficient vehicles.

Our product globalization strategy is designed to help us respond to changing markets and regional preferences. We are leveraging our best technology from around the world to create global platforms that offer superior fuel economy, safety, driving dynamics and customer features. We then tailor each global platform to national or regional preferences and requirements. New technology is also cutting the time required to bring new vehicles to market, which helps us respond more effectively to the ever-increasing pace of change in our markets.

Please see the Economy section for further discussion of our changing markets and how we are responding to them, and the Our Strategy: Blueprint for Sustainability section for discussion of Ford's strategic response to the risks and opportunities posed by the climate change issue.

REGIONAL MARKET TRENDS

North America

New regulations (discussed in the Climate Change Policy and Partnerships section) and concerns about fuel prices, energy security and the impacts of climate change are encouraging the sales of more fuel-efficient vehicles. Between 2005 and 2009, the car share of the U.S. market increased from 45.4 percent to 52.5 percent, while truck sales declined from 54.6 percent to 47.5 percent of the market. Sales of small cars increased from 17.1 percent to 23.7 percent of all sales. Hybrid electric vehicles made up about 3 percent of the market in 2009.

Europe

In Europe, the long-term trend of high-priced fuel and more fuel-efficient vehicles has continued the market shift toward diesel-powered vehicles, which now make up more than half of all new vehicle sales. This trend is reinforced by sales incentives in some European countries designed to encourage new vehicle sales, with the aim of reducing carbon dioxide emissions from older, less-efficient vehicles. Some of these incentives are bound to upper limits of CO_2 emissions of 160 g/km and less, which has boosted sales of small cars. Other schemes are linked to regulatory emissions standards (e.g., Euro 4). In addition, tough new CO_2 emission regulations have come into effect, which will continue to drive fuel-economy improvements in new automobiles. Automakers, including Ford, have begun to introduce and announce plans for hybrid electric, battery electric and plug-in hybrid electric vehicles for the European market.

Asia

As auto sales slumped in North America during 2009, the Asian auto market continued to grow, and China surpassed the United States to become the largest single automobile market in the world. Rising incomes are fueling growth in all segments of the market.

The Chinese government is promoting hybrids and electrics and supporting research in those areas, based on an interest in growth balanced with a desire for energy security and a cleaner environment. The government currently provides limited incentives to fleet purchasers of "new energy vehicles" (mostly electric) under local government control through a pilot program in 13 cities. Both domestic and global automakers are considering the introduction of electric vehicles, and some hybrids are currently available.

South America

In Brazil, our largest market in South America, the use of biofuels is widespread as a result of national policy and consumer preference. All gasoline in Brazil is blended with 20 to 25 percent ethanol, and pure ethanol is also widely used. Most new vehicles offered are flexible fuel. While fuel economy and CO_2 emissions are not currently regulated in Brazil, a voluntary fuel-economy labeling program is already in place, along with a star ranking program for light vehicles that favors low-emission, low-CO_2, ethanol, flexible-fuel and hybrid vehicles. Consumers tend to choose vehicles with small engines, and 90 percent of new vehicles purchased have flexible-fuel capabilities. Several hybrid vehicles are currently offered or are planned for introduction to Brazil.

Physical Risks

Global climate change raises the potential for shifting patterns of extreme weather and other risks to our facilities. For insurance purposes, we assess the risks each of our facilities faces (with input from third-party engineers) at least annually. This risk assessment is updated based on new data and takes into account the risk of exposure to hurricanes, tornadoes, other storms, flooding and earthquakes. As a result of this process, we believe we have a good understanding of the physical risks faced by our facilities and how those risks are changing over time.

Extreme weather has the potential to disrupt the production of natural gas, a fuel necessary for the manufacture of vehicles. Supply disruptions raise market rates and jeopardize the consistency of vehicle production. To minimize the risk of production interruptions, Ford has established firm delivery contracts with natural gas suppliers and installed propane tank farms at key manufacturing facilities as a source of backup fuel. Higher utility rates have prompted Ford to revisit and implement energy-efficiency actions that previously did not meet our internal rate of return.

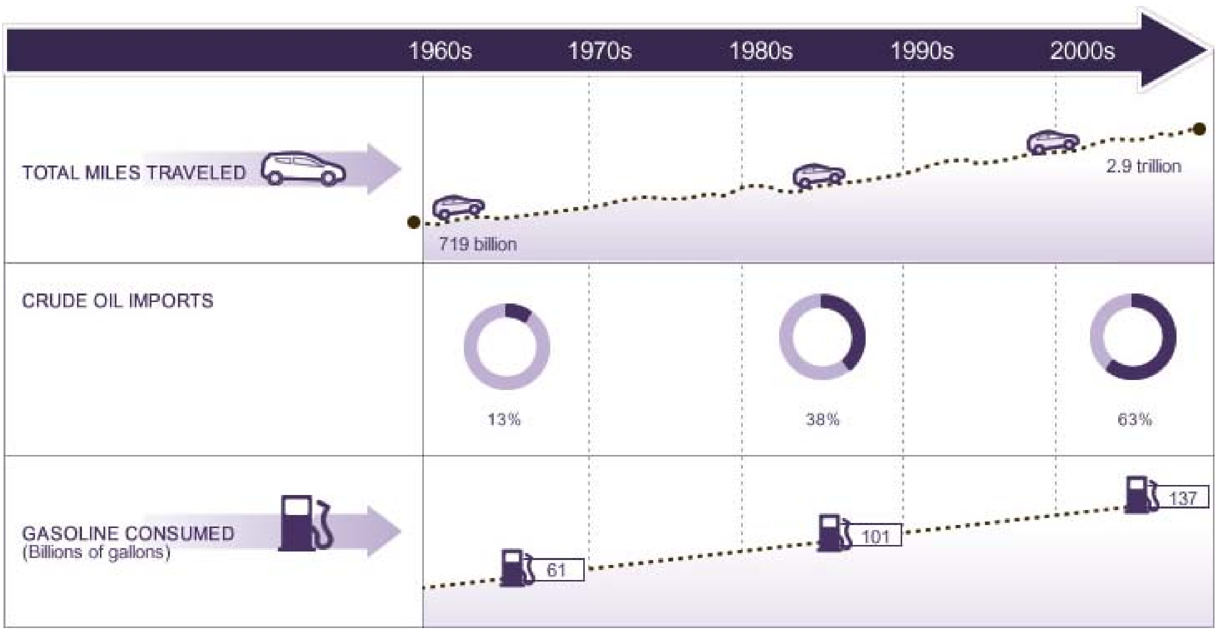
Climate change also has the potential to affect the availability and quality of water. We are examining this issue as part of the development of our water strategy.

Supply Chain Risks

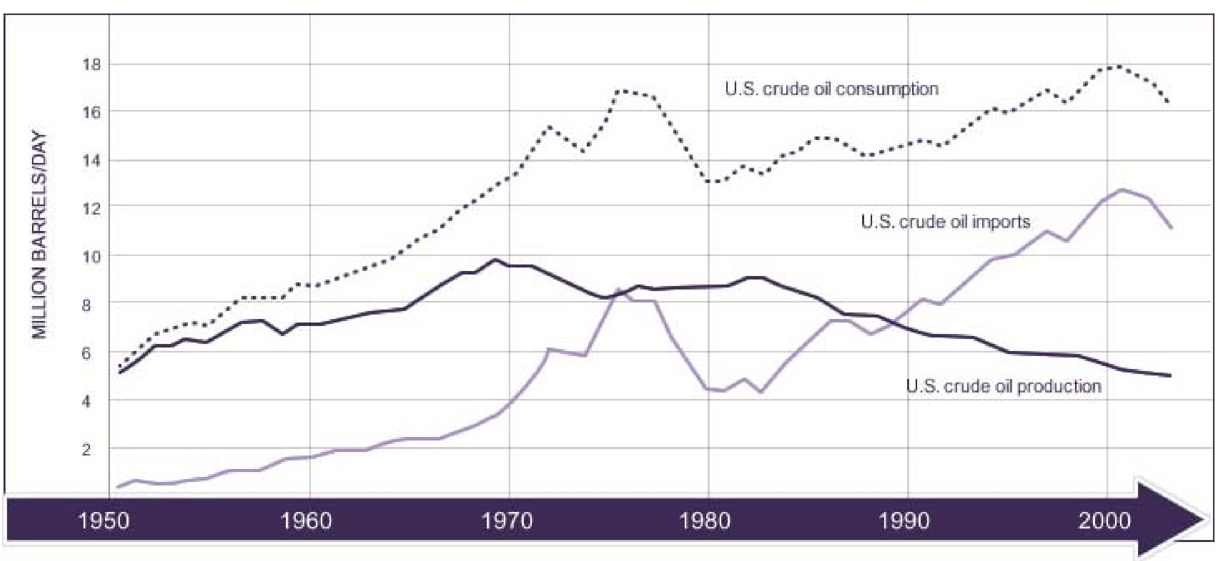
Our suppliers, which are located in more than 60 countries, are subject to market, regulatory and physical risks as a result of GHG regulation and the impacts of climate change. These risks could affect their competitiveness or ability to operate, creating the potential for disruptions to the flow of supplies to Ford. For example, suppliers may be subject to reporting requirements, fees or taxes, depending on where their operations are located. See the Progress and Performance section for a discussion of actions we are taking to better understand the climate risks of our suppliers and promote a competitive supply chain.

U.S. Energy Security

The following charts illustrate the primary issue underlying concerns about U.S. energy security – crude oil consumption is increasing, while domestic energy production is decreasing. Therefore, the United States is increasingly reliant on imported crude oil. The first chart shows the increase in the number of miles U.S. drivers are traveling, the increasing consumption of gasoline, and the increasing percentage of fuel consumption being filled by imported crude oil. The second chart shows the increase in U.S. demand for crude oil and the simultaneous decrease in U.S. crude oil production.



U.S. Crude Oil Consumption, Imports and Production



Our Strategy: Blueprint for Sustainability

To respond to the risks and opportunities posed by the climate change issue, our long-term strategy is to contribute to climate stabilization by:

- Continuously reducing the greenhouse gas emissions and energy usage of our operations.
- Developing the flexibility and capability to market more lower-GHG-emission products, in line with evolving market conditions.
- Working with industry partners, energy companies, consumer groups and policy makers to establish an effective and predictable market, policy and technological framework for reducing GHG emissions.

We have set a goal to reduce our U.S. and EU new-vehicle CO_2 emissions by 30 percent by the year 2020, compared to a 2006 model year baseline. Our blueprint for sustainability, which spells out our technology and product strategy to meet this goal, is based on modeling of vehicle and fuel contributions to emission reductions and an analysis of market and regulatory trends (see figure below). The blueprint encompasses a series of commitments the Company has made, or participated in, to reduce the greenhouse gas emissions from our products and operations.

Product Sustainability Process

In addition, we have conducted dialogues with stakeholders, exploring sustainable mobility projects to demonstrate potential approaches to urban mobility that would integrate private and public transportation by multiple modes, enabled by information technology. Please see the Mobility section for more details.

The blueprint's product strategy – called the Sustainable Technologies and Alternative Fuels Plan – details the near-, mid- and long-term steps we are taking to develop and deploy vehicle and fuel technologies. The blueprint is supported by our sustainable mobility governance, which establishes structures and accountability for implementing the strategy.

We believe this strategy is already showing results by positioning our Company to take advantage of opportunities created by shifts in markets. Our commitment to outstanding fuel economy aligns well with consumer interest in fuel-sipping vehicles. During 2009, for example, our U.S. market share grew for the first time since 1995, driven in part by the popularity of several of our vehicles (including the Ford Fusion and Mercury Milan) that achieve best-in-class fuel economy.

For the longer term, we are preparing to provide regionally appropriate approaches based on global platforms to advanced vehicle technologies, including electric vehicles, biofuel vehicles and hydrogen fuel cell vehicles.

Sustainable Mobility Governance

To plan and implement our blueprint for sustainability, we have established sustainability-related governance systems, which include a strong focus on fuel economy and CO_2 improvements. The strategic direction is provided by a senior executive committee, made up of vice president and executive stakeholders, who guide the development of the vision, policy and business goals. (See Governance and Management Structures.)

Related executive planning teams are responsible for developing detailed and specific policy, product and technical analyses to meet objectives. These teams base their plans on scientific data and promote actions that will help achieve the Company's environmental ambitions, recognizing the need to use a holistic approach to effectively protect the environment. Metrics have been established and are reviewed regularly to ensure satisfactory progress. We have also developed strategic principles to guide our approach.

During 2009, several climate-change-related issues were reviewed at Ford's top-level Special Attention Review and Automotive Strategy meetings, including climate policy and cap-and-trade systems, electrification (including electric vehicle infrastructure), biofuels and global alternative fuels.

During 2009, the senior executive committee reviewed progress on key elements of the climate change strategy.

TOOLBOX
Print report
Download files

Climate Change Strategic Principles

Our approach to GHG stabilization is aligned around the following key strategic principles:

1. Technical, economic and policy approaches to climate change need to recognize that all CO_2 molecules (or GHG equivalents) produced by human activities make the same contribution to the atmosphere's concentration of greenhouse gases. Once those molecules reach the atmosphere, they contribute to the greenhouse effect, regardless of the source. However, the cost of reducing those emissions varies significantly depending on their source, and we should attempt to achieve the most economically efficient solutions possible.
2. The transportation sector represents a closely interdependent system, characterized by the equation: "Vehicle + Fuel + Driver = GHG emissions." Each link in this chain depends on the others. For example, vehicle manufacturers can bring to market flexible-fuel vehicles, but successfully reducing GHG emissions with them will depend on fuel companies providing renewable biofuels, as well as consumer demand for the vehicles and fuels.
3. Future developments in technologies, ever-changing markets, consumer demand and political uncertainties require flexible solutions. The business strategies that Ford implements, and the public policies that we encourage, must have the flexibility to succeed in a range of potential scenarios.
4. Early affordable steps to reduce GHG emissions from our products and processes may delay the need for drastic and costly reductions later. Lack of agreement on long-term solutions cannot be used as an excuse to avoid near-term actions.

A Look Inside the "Black Box"

In 2004, Ford's internal Climate Change Task Force faced a dilemma. After an extensive study, it was clear to the cross-functional group of senior executives that several forces were converging to fundamentally change vehicle markets, especially in North America and Europe. Current and anticipated climate change and fuel economy regulation, rising fuel prices and growing consumer awareness of the climate change issue all pointed to a shift in sales toward cars rather than trucks and toward smaller and more fuel-efficient vehicles. We needed to rapidly reorient our product offerings.

But what should drive new product goals? As a practical matter, the Company needed to be able to meet new regulatory mandates. Beyond that imperative, we had taken to heart our responsibility to contribute to meeting the challenge of climate change. So, Task Force members decided to base product planning on the goal of climate stabilization, and they asked Ford's in-house scientists to devise a way to test scenarios for meeting that goal.

In 2005, Ford's scientists began development of a CO_2 model. To create it, they modified the Sustainable Mobility Project model (developed by the International Energy Agency) and combined it with global carbon dioxide (CO_2) emission-reduction pathways for varying levels of atmospheric CO_2 stabilization (as described by the Model for the Assessment of Greenhouse-gas Induced Climate Change, developed by the National Center for Atmospheric Research). The scientists then calculated the CO_2 emission reductions required of new light-duty vehicles up to the year 2050 for a range of CO_2 stabilization levels and different regions of the world, using a simplifying assumption that the rates of CO_2 emission reduction should be the same across all sectors.

At the lower CO_2 stabilization levels, the required emission reductions are extremely challenging and cannot be accomplished using vehicle technology alone. Joint investigations with BP provided insight into how the best new vehicle technologies and low-carbon alternative fuels can jointly and realistically fulfill the low-CO_2 emission requirements. Ford's CO_2 model and other modeling tools were combined to explore assumption sensitivities around vehicle technologies, baseline fuels, biofuels, costs and consumer response. The CO_2 model is not intended to provide "the answer," but rather a range of possible vehicle and fuel solutions that contribute to a pathway to CO_2 reductions, and eventually, climate stabilization. Our blueprint for sustainability – and the technology and product actions it spells out – are based on options developed through this modeling exercise.

The model and its results have been a centerpiece of discussions with a variety of stakeholders. Below are some of the questions that have been raised through these discussions, and answers to them.

How does the model account for emissions growth or reduction in developing countries?

We recognize that developing countries generally have relatively low per-capita energy use but high rates of emissions growth, reflecting growing economies. The CO_2 model uses a science-based approach that allows for equitable growth in developing countries, to derive CO_2 reduction targets for light-duty vehicles consistent with 450 parts per million (ppm) to 550 ppm CO_2 stabilization pathways.

Since fuel use is the dominant cause of CO_2 emissions, how does the model account for projected changes in the carbon footprint of automotive fuels?

Ford has studied multiple scenarios in which the auto industry and the energy industry work together to reduce overall well-to-wheels CO_2 emissions from the light-duty transportation sector. These joint strategy scenarios (see figure below) allow us to develop a least-cost vehicle technology roadmap. For the carbon footprint of fuels, we rely on the well-to-tank CO_2 emissions for different alternative fuels estimated by different region-based models, including the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model for North America, and the EUCAR/JRC/CONCAWE analysis for Europe.

Are you continuing to test alternative scenarios?

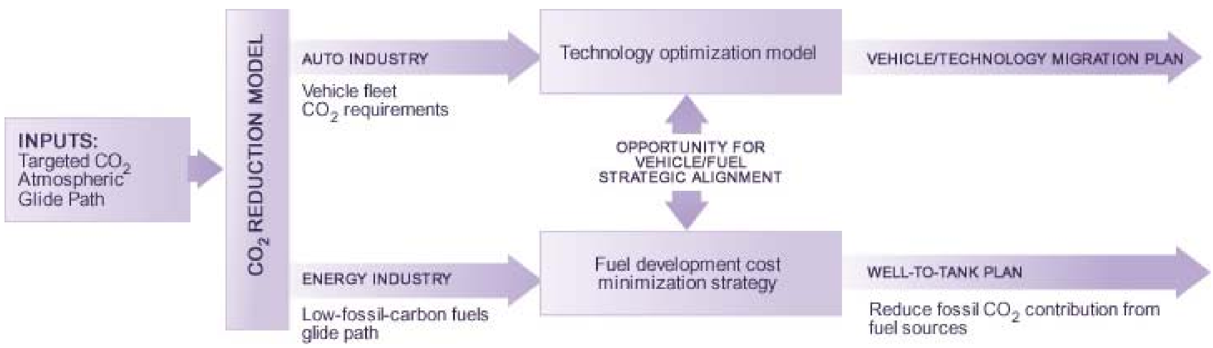
In the long run, the roles of consumers, governments and fuel availability will be pivotal in dictating actual CO_2 emission reductions, and Ford continues to take them into consideration in fine-tuning a truly viable and sustainable CO_2 stabilization pathway.

How does the model consider the cost of technologies and alternative fuels?

The costs of technologies and alternative fuels that are not yet in the market are separately estimated. These estimates obviously have large uncertainties, but are useful for planning purposes. Ford has other models that look into potential market response to fuel/vehicle cost variations.

In a separate study, Ford has developed a model that looks into minimal-cost scenarios across different sectors and explores assumption sensitivities around vehicle technologies, fuel technologies, connections between the different energy sectors, and biofuels. The model provides information on the combinations of options that will yield the required emissions reductions at an affordable cost to consumers. We have used this model to develop scenarios to assess the global lowest-cost vehicle and fuel technology solutions consistent with CO_2 stabilization.

Ford's Sustainability Framework for CO_2 and Technology Migration Development



Ford's Sustainable Technologies and Alternative Fuels Plan

IN THIS SECTION

Improving Fuel Economy

This section outlines our plans for improving the fuel economy of traditional gas and diesel engines. These actions include implementing advanced engine and powertrain technologies, improving aerodynamics and reducing weight.

Read more

Migration to Alternative Fuels and Powertrains

Our plans for migrating to alternative fuels and powertrains include implementing vehicles that run on renewable biofuels, increasing advanced clean diesel technologies, increasing our hybrid vehicle applications and introducing battery electric vehicles and plug-in hybrids. We are also working to advance hydrogen internal combustion engine and hydrogen fuel cell vehicle technologies.

Read more

Ford's Green Partnerships with the Federal and State Governments

Ford is working with federal and state governments to advance the development and commercial implementation of technologies that improve fuel efficiency and increase the use of alternative fuels and powertrains.

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Fuel Economy and Greenhouse Gas Emissions

In the very early years of our industry, automotive engineers experimented with a variety of methods for powering vehicles, including electricity and biofuels. The internal combustion engine using petroleum-based gas and diesel rose to the top fairly quickly and has been the standard vehicle power source for the past hundred years or so. Reminiscent of those early years in the industry, we are now in a period of intense experimentation and adoption of new vehicle technologies and fuels. This time, however, there may be no single winner in the race for the vehicle of the future.

Ford is taking a portfolio approach to developing sustainable technologies and alternative fuel options. Our goals are to diversify the fuels our vehicles can use and to improve their energy efficiency and long-term sustainability. Traditional gasoline- and diesel-powered vehicles based on internal combustion engines will continue to be part of the mix for quite some time. That is why we are working to improve the fuel efficiency of the engines and transmissions of our current vehicles, along with every vehicle subsystem. In fact, in the next two years, we will be implementing 30 new powertrains that will improve the fuel efficiency of internal combustion engines and transmissions, as well as continuing to improve vehicle aerodynamics and reduce weight.

In addition, a variety of alternative powertrain technologies and alternative fuels are currently under development. At this point, we do not see a single clear winner. Rather, we believe a wide range of options will be needed to serve different kinds of consumers and different markets, depending on the regional availability of fuels and other factors. For example, biofuels may make sense for consumers in the Midwestern United States and much of South America – where biofuels are widely available – while battery electric vehicles and plug-in hybrids may make sense for urban drivers across the globe who have access to recharging opportunities. Other alternative fuels like compressed natural gas (CNG) and propane or liquid petroleum gas (LPG) may be most appropriate for fleet users who have access to central refueling infrastructure and who have well-defined driving patterns. As refueling infrastructure for these alternative fuels becomes more widespread, these vehicles will be attractive to more and more of our customers.

To prepare for this more complex future for vehicle technologies and fuels, we are developing a range of energy-efficient, alternative fuel and advanced powertrain technologies.

Most importantly, we are developing global vehicle platforms that are compatible with a wide range of fuels and powertrain technologies. This will allow us to offer a portfolio of options to our customers, target options to regions where they make the most sense, and evolve our vehicles as technologies and markets develop. Global platforms that have "plug-and-play" compatibility with a wide range of technologies will also allow us to make the range of fuel and powertrain options available more affordably.

For example, at present we produce 14 flexible-fuel vehicle models across our global markets that can run on either regular gas or E85 (a blend of 85 percent ethanol and 15 percent gasoline). Though biofuels are not available in every market, they are widely available in the Midwestern United States and throughout South America, so it makes sense for us to provide this option to customers who can take advantage of it. In addition, biofuel availability is expected to increase in Europe, as the EU's renewable energy directive mandates that 10 percent of energy in the transportation sector come from renewable fuels by 2020. Ford's flexible-fuel vehicles, which are provided at no or low additional cost, allow consumers to choose fuels based on availability and price.

We are also making CNG- and LPG-ready engines available on select vehicle models, enabling their conversion to run on one of those fuels. And, we are working with qualified vehicle modifiers to ensure that conversion to those fuels meets our quality, reliability and durability requirements. For example, we recently announced that the new Transit Connect, which went on sale in the United States in early 2010, is available with a CNG/LPG conversion-ready engine package. Our F-Series trucks and E-Series vans are also available with a propane-ready engine. In Europe, we recently introduced a Ford Mondeo that can run on regular gasoline, E85 ethanol or LPG.

CNG and LPG are good options for fleet customers, such as taxi companies and delivery services, that use a central refueling system. In addition, CNG and LPG are widely available as vehicle fuels throughout South America and Europe. We are delivering CNG/LPG-ready engines to provide another lower-carbon option to those customers for whom this option makes sense.

We are also developing a range of electrification technologies, including hybrid electric vehicles, battery electric vehicles and plug-in hybrid vehicles. Battery electric and plug-in hybrid vehicles may initially make the most sense for urban drivers and fleet users who have daily commutes under 40 miles. However, as battery and recharging options continue to advance, we expect these vehicles to work for a wider range of our customers. In the longer term, we are working on vehicles that can run on hydrogen fuel cells, as these fuels become available and commercially viable.

This section describes our current actions and future plans to develop a wide range of energy-efficient technologies, alternative fuels and advanced powertrain technologies that will give our customers near-, mid- and longer-term options for more sustainable vehicles.

Improving Fuel Economy

This section outlines our plans for improving the fuel economy of traditional gas and diesel engines. These actions include implementing advanced engine and transmission technologies, weight reductions and aerodynamic improvements, as well as increasing the efficiency of vehicle sub-systems.

For more information about each of our fuel efficiency technologies please click on the icons in the graphic above.

EcoBoost™

2007	2011	2020 – 2030
NEAR TERM	MID TERM	LONG TERM
Begin migration to advanced technology	Full implementation of known technology	Continue to leverage advanced fuel-efficiency technologies and increase deployment of alternative powertrains and energy sources
Significant number of vehicles with EcoBoost™ engines	EcoBoost engines available in nearly all vehicles	Increase percentage of internal combustion dependent on renewable fuels

The centerpiece of our near-term fuel-economy improvement efforts is the EcoBoost engine, which uses turbocharging, direct injection and reduced displacement to deliver significant fuel-efficiency gains without sacrificing engine power or performance. EcoBoost engines improve vehicle fuel economy 10–20 percent and reduce CO_2 emissions up to 15 percent compared to larger-displacement engines.

EcoBoost is also more affordable than many other fuel-efficiency technologies. Due to its affordability relative to competing technologies, and its compatibility with most of the gas-powered vehicles we produce, we will be able to spread EcoBoost's fuel-economy benefits throughout our product lineup and to more of our customers more quickly. Our rapid deployment of EcoBoost in high volumes across a wide array of our vehicle nameplates will also help us make a dramatic step forward in CO_2 emission reductions.

EcoBoost was introduced first in North America as a 3.5-liter V6 engine on the 2010 Lincoln MKS, Lincoln MKT, Ford Taurus SHO and Ford Flex. This engine provides similar performance to a normally aspirated V8 engine, but with the fuel economy of a V6 engine. Thanks largely to EcoBoost technology, the V6, Taurus SHO and Lincoln MKT deliver unsurpassed fuel economy in their respective segments.

EcoBoost has already been a great success in North America. For example:

- EcoBoost is influencing many consumers to consider and buy Ford vehicles who were not previously Ford customers. EcoBoost is proving especially attractive to 35- to 55-year-old males, an important demographic segment that has been less likely to purchase Ford vehicles in past years.
- EcoBoost is also increasing Ford's "conquest rate" – i.e., the number of customers who are switching from other manufacturers to buy Ford vehicles. The Taurus SHO with EcoBoost has the second-highest conquest rate in its segment, and the Flex EcoBoost had a 75 percent conquest rate during its first year on sale.

In addition to these commercial successes, the EcoBoost engine has received multiple awards, including *Popular Mechanics* magazine's Breakthrough award and a "10 Best Engines" award from Ward's Automotive.

We are continuing to expand the application of EcoBoost technology to more engine types and vehicles. For example:

- We have announced plans to make the 3.5-liter V6 EcoBoost available on the Ford F-150. Later this year, Ford will introduce the new 2.0-liter I-4 EcoBoost in the new Edge and the all-new Explorer. In both vehicles, the 2.0-liter I-4 EcoBoost is expected to deliver best-in-class fuel economy, but with the performance feel of a traditional V6. The Explorer will feature fuel economy that is at least 25 percent better than the current model.

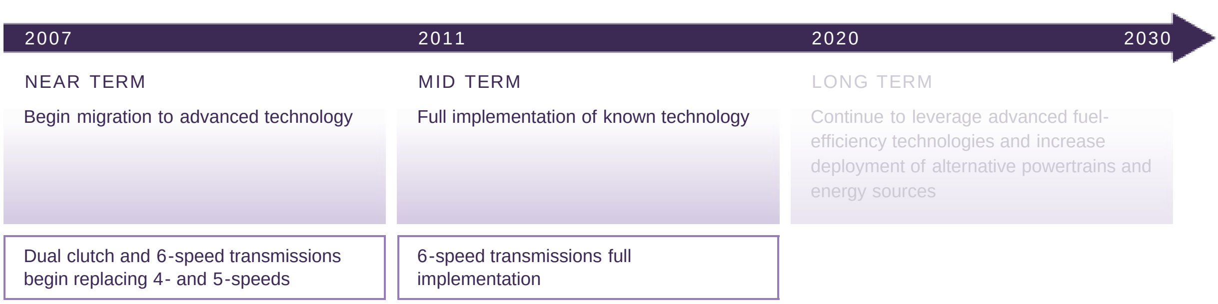
In 2010 we also began taking the EcoBoost engine global:

- In European markets, we have introduced a 2.0-liter I-4 EcoBoost engine on the Ford Galaxy, S-MAX and Mondeo and a 1.6-liter I-4 EcoBoost engine on the Ford C-MAX. We have also announced plans to use the 1.6-liter I-4 EcoBoost engine in the all-new Ford Focus, which will launch in Europe in 2010.
- In 2010, we will also launch the EcoBoost engine in China on the Ford Mondeo.
- In 2011, we will introduce a 2.0-liter I-4 EcoBoost engine to the Australian market on the Ford Falcon.
- Ultimately, we plan to launch an advanced 1.0-liter, three-cylinder EcoBoost engine for use in Europe and other global markets.

These EcoBoost engines illustrate Ford's plans to use smaller, power-boosted engines to deliver improved fuel economy and performance throughout our vehicle lineup.

By 2013, Ford plans to offer EcoBoost engines on 80 percent of our global nameplates, with an annual volume of vehicles with EcoBoost at 1.5 million globally.

PowerShift Transmission



To further improve the fuel economy of our vehicles, we are implementing a dual-clutch transmission system. This technology, called PowerShift, combines manual and automatic transmission technologies to deliver the fuel efficiency of a manual with the driving ease of an automatic. PowerShift uses six speeds instead of the four or five on most automatics, which further increases fuel efficiency. PowerShift technology increases fuel efficiency by up to 9 percent compared to traditional automatic transmissions, depending on the application.

- A "wet clutch" version of this technology has already been implemented in Europe on the Ford Focus, C-MAX, Kuga, S-MAX, Galaxy and Mondeo in combination with a 2.0-liter Duratorq

TDCi diesel and is the standard transmission for the new 2.0-liter EcoBoost engine on the Ford Mondeo, S-MAX and Galaxy.

- A "dry clutch" version was introduced globally in April 2010 on the all-new Ford Fiesta; it will also be introduced globally on the new Ford Focus in November 2010. The dry clutch version gets even better gas mileage. Unlike wet clutch systems, the six-speed dry PowerShift transmission does not use an oil pump, making the system more efficient with the same weight as a traditional four-speed automatic transmission.

We are also introducing regular six-speed transmissions to replace less-efficient four- and five-speed transmissions in a range of vehicles. Six-speed transmissions improve fuel economy by 4 to 6 percent compared to typical four- and five-speed gearboxes; they also provide better acceleration, smoother shifting and a quieter driving experience. By the end of 2012, 98 percent of Ford's North American transmissions will be advanced six-speed gearboxes. And by 2013, we plan to offer advanced six-speed transmissions – both Powershift and regular six-speed technology – on 100 percent of our new, non-hybrid vehicles in Europe and North America and many new vehicles in other regions.

Weight Reductions

2007	2011	2020	2030
NEAR TERM	MID TERM	LONG TERM	
Begin migration to advanced technology	Full implementation of known technology	Continue to leverage advanced fuel-efficiency technologies and increase deployment of alternative powertrains and energy sources	
Increased unibody applications	Weight reduction of 250–750 lbs		

We are also working to improve fuel economy by decreasing the weight of our vehicles by using unibody vehicle designs, lighter-weight components and lighter-weight materials.

- We are increasing our use of unibody vehicle designs, which reduce weight by eliminating the need for the body-on-frame design used in truck-based products. Unibody-based crossover vehicles provide many of the benefits of truck-based SUVs, such as roominess, all-wheel drive and higher stance, with significantly reduced total vehicle weight. The new 2010 Ford Explorer will use a lightweight unibody design, as do the current Ford Edge and Lincoln MKX crossovers.

- We are increasing the use of lighter-weight components. For example, the EcoBoost engine technology allows us to use a smaller, lighter engine system while delivering more power and better fuel economy. Similarly, the dual-clutch PowerShift system weighs up to 30 pounds less than the four-speed automatic transmission it is replacing.

- We are using lighter-weight materials, such as advanced high-strength steel; aluminum; magnesium; natural fibers; and nano-based materials. These "lightweighting" efforts can reduce the weight of our vehicles by 250 to 750 pounds, without compromising vehicle size, safety, performance or customer-desired features. The 2010 Lincoln MKT crossover, for example, has an advanced lightweight magnesium and aluminum liftgate. Also, we use an aluminum hood on the Ford F-150 and high-strength, lighter-weight steels in more than 50 percent of the F-150 cab. We are also expanding our use of aluminum engine parts and all-aluminum engines. For example, the 2011 Mustang will have an aluminum engine. This lighter-weight engine, combined with other fuel-efficiency improvements, is expected to result in class-leading fuel economy at 19 mpg city/30 highway with six-speed automatic transmission, a 25 percent improvement over the 2010 model.

Please see the Environment section for further information on materials-based weight reductions.

Aerodynamics

2007	2011	2020	2030
NEAR TERM	MID TERM	LONG TERM	
Begin migration to advanced technology	Full implementation of known technology	Continue to leverage advanced fuel-efficiency technologies and increase deployment of alternative powertrains and energy sources	
Aerodynamic improvements	Additional aerodynamic improvements		

We are improving vehicle aerodynamics to improve the fuel economy of our global product lineup. Using a systems engineering approach, we combine aerodynamic improvements and other fuel-economy technologies to ensure that we maximize the fuel efficiency of every vehicle we develop. Systems engineering uses interdisciplinary and collaborative design and development processes to ensure that engineers who are developing adjacent areas of the vehicle work together to maximize vehicle attributes like fuel economy. During the development process, we use advanced computer simulations and wind tunnel testing to deliver vehicle designs that deliver up to 5 percent better fuel economy. In addition, we are developing simulation systems that will allow us to replicate on-the-road driving conditions during the virtual design phase of vehicle development, to further improve the real-world benefits of aerodynamic improvements.

Using these approaches, we made significant improvements to the aerodynamics of our 2009 model year vehicles. For example:

- The 2009 Ford Flex is the most aerodynamic vehicle in its class.
- The 2009 Ford Escape has 6 percent lower aerodynamic drag than previous models.
- The 2009 F-150 has an average of 8 percent better fuel efficiency than previous models due in part to aerodynamic improvements.
- In Europe, we improved the fuel efficiency of the 2009 Ford Focus and Fiesta ECOnetic models through aerodynamic improvements such as lowering the vehicle, adding an aerodynamics kit and using low-rolling-resistance tires.

In 2010 we are continuing to build on these achievements in aerodynamics. In North America, we improved the fuel efficiency of Ford's midsize family sedans, including the 2010 Ford Fusion, Mercury Milan and Lincoln MKZ, by reducing aerodynamic drag by 5 percent. We accomplished this by further streamlining the exterior design and lowering the vehicles' ride height. These aerodynamic improvements were a key enabler for the Ford Fusion Hybrid's 41 mpg rating, which makes it the most fuel-efficient midsize sedan available in North America.[1] We have also reduced the aerodynamic drag of the 2010 Mustang by 4 percent for the V6 model and 7 percent for the V8 model. These aerodynamic improvements resulted in a 0.5 mpg and 1 mpg improvement in fuel economy at 70 mph cruising speeds, for the V6 and V8 models respectively.

For 2011, we have plans to continue to improve vehicle aerodynamics. For example, we are developing an active grille shutter technology that reduces aerodynamic drag by up to 6 percent, thereby increasing fuel economy and reducing CO_2 emissions. This technology will be implemented first on our European vehicles and will be migrated to North American vehicles in future model years.

1. Midsize sedan segment based on the R.L. Polk segment definition.

Electric Power-Assisted Steering

2007	2011	2020 – 2030
NEAR TERM	MID TERM	LONG TERM
Begin migration to advanced technology	Full implementation of known technology	Continue to leverage advanced fuel-efficiency technologies and increase deployment of alternative powertrains and energy sources
Electric power steering	Electric power steering full implementation	

We are phasing in electric power-assisted steering (EPAS) technology, which typically will improve fuel economy by 0.09 to 0.17 gallons per 100 miles and will decrease CO_2 emissions by up to 3.5 percent over traditional hydraulic systems, depending on the vehicle and powertrain application. For example, on the 1.4-liter Duratorq Diesel Fiesta, which is available in Europe, EPAS provides a 3 to 4 percent improvement in fuel efficiency compared with a hydraulic-based power steering system. By combining EPAS with aerodynamic improvements, we improved the gas mileage of this vehicle by approximately 8 percent compared to the previous model year. In addition, EPAS supports other fuel-saving activities we plan to introduce. For example, "automatic start/stop" technology can be introduced without degrading steering assist to the driver. (For details on this technology see "Automatic Start/Stop.")

We began implementing EPAS in 2008 in North America on the Ford Escape and Mercury Mariner gasoline and hybrid vehicles. In Europe, we introduced EPAS on the new Ford Fiesta, which launched in the summer of 2008, and will be launched in the United States in 2010. In 2009, we added EPAS to the North American Ford Fusion, Mercury Milan, Ford Flex and Lincoln MKS with the EcoBoost engine, and in Europe we implemented EPAS on the 2009 Ka. Several additional launches of this technology are planned for 2010, including on the new Ford Mustang and Ford Explorer in North America and the new C-MAX and Focus in Europe. Ultimately, we will introduce EPAS into all of our passenger cars and light-duty vehicles.

Battery Management Systems (BMS)

2007 | 2011 | 2020 | 2030

NEAR TERM	MID TERM	LONG TERM
Begin migration to advanced technology	Full implementation of known technology	Continue to leverage advanced fuel-efficiency technologies and increase deployment of alternative powertrains and energy sources
Introduction of battery management systems		

Electrical systems are another area in which we are making progress. By reducing vehicle electricity loads and increasing the efficiency of vehicle electrical systems, we can improve fuel efficiency. Our Battery Management Systems (BMS), for example, control the power supply system (in particular the alternator) to maximize the overall efficiency of the electrical system and reduce its negative impacts on fuel economy. This is accomplished by maximizing electricity generation during the most fuel-efficient situations, such as during vehicle deceleration. In less fuel-efficient situations, the alternator's electricity generation is minimized to meet in-vehicle electrical requirements (e.g., for entertainment systems). BMS has already been launched in Europe and will be incorporated in the United States beginning with the 2011 Edge. We have also introduced more-efficient alternators, which improve fuel economy.

Aggressive Deceleration Fuel Shut-Off

2007 | 2011 | 2020 | 2030

NEAR TERM	MID TERM	LONG TERM
Begin migration to advanced technology	Full implementation of known technology	Continue to leverage advanced fuel-efficiency technologies and increase deployment of alternative powertrains and energy sources
Begin implementing ADFSO	ADFSO – High volume	

We are deploying Aggressive Deceleration Fuel Shut-Off (ADFSO) technology to improve fuel efficiency. ADFSO allows fuel supply to the engine to be shut off during vehicle deceleration and then automatically restarted when needed for acceleration or when the vehicle's speed approaches zero. This new system builds on the Deceleration Fuel Shut-Off technology available in our existing vehicles by extending the fuel shut-off feature to lower speeds and more types of common driving conditions, without compromising driving performance or non-CO_2 emissions reductions.

This improved fuel shut-off will increase fuel economy by an average of 1 percent. An additional benefit of the ADFSO technology is increased deceleration rates, which should extend brake life and improve speed control on undulating roads. This technology was implemented in mid-2008 on the new Ford Flex and the Lincoln MKS and in late 2008 on the 2009 model year Ford F-150, Ford Expedition and Lincoln Navigator regular and extra-long models, as well as the Ford Escape and Mercury Mariner. In the next two to three years we plan to implement this technology on as many vehicles as possible, beginning with front-wheel-drive, six-speed-transmission vehicles.

Automatic Start/Stop

2007 | 2011 | 2020 | 2030

NEAR TERM	MID TERM	LONG TERM
Begin migration to advanced technology	Full implementation of known technology	Continue to leverage advanced fuel-efficiency technologies and increase deployment of alternative powertrains and energy sources
Start/stop systems (micro hybrids)	Increased application of start/stop	

We have developed a "start/stop" technology that shuts down the engine when the vehicle is stopped and automatically restarts it before the accelerator pedal is pressed to resume driving. This technology maintains the same vehicle functionality as a vehicle without the technology, but it improves city driving fuel economy by up to 6 percent.

Start/stop technology includes sensors to monitor functions such as cabin temperature, power supply state and steering input, so that vehicle functioning remains exactly the same to the driver as when the engine remains on continuously. If the system senses that a vehicle function has been reduced and will negatively impact the driver's experience, the engine will restart automatically. Start/stop technology is already being used in our hybrid vehicles and will eventually provide a cost-effective way to improve fuel efficiency on a large volume of non-hybrid vehicles. In the United States, we are planning to introduce the technology into non-hybrid, automatic transmission vehicles by the 2013 model year. In Europe, auto start/stop is already available on the Ford Focus ECOnetic. By 2016, 90 percent of our vehicle nameplates will be equipped with start/stop technology.

Smaller Vehicles

2007	2011	2020 – 2030
NEAR TERM	MID TERM	LONG TERM
Begin migration to advanced technology	Full implementation of known technology	Continue to leverage advanced fuel-efficiency technologies and increase deployment of alternative powertrains and energy sources
Introduction of additional small vehicles	Engine displacement reduction facilitated by weight savings	

Smaller vehicles provide consumers with another way to get better fuel economy. We are planning to launch additional small cars to provide more fuel-efficient options. For example:

- We are introducing subcompact vehicles commonly referred to as "B-cars." These include the all-new Ford Fiesta, which was introduced in Europe in 2008 and in the Asia Pacific region in 2009, and will be available in the Americas in 2010.
- In addition, we brought the European Transit Connect small commercial van to North America. This vehicle fills an unmet need in the U.S. market by offering the large cargo space that small business owners need in a fuel-efficient, maneuverable, durable and flexible vehicle package.
- We have also announced plans to bring the next-generation European Focus to North America. This vehicle, which will be our new global "C-sized" or compact offering, was revealed at the 2010 North American International Auto Show. It includes the first in a series of powertrain technology developments we are introducing that will give our new global C-car segment offerings a combination of power, performance and unsurpassed fuel economy. Ford has disclosed that North American models of the new Focus will be equipped with a responsive, fuel-efficient combination of a 2.0-liter I-4 engine with Twin Independent Variable Camshaft Timing and direct injection plus a dual-clutch PowerShift transmission.

All of these smaller vehicles illustrate Ford's actions to provide consumers with a wider range of fuel-efficient options as well as our efforts to leverage the best of our global products to offer new choices and solutions to customers in all of our global regions.

Migration to Alternative Fuels and Powertrains

IN THIS SECTION


Advanced Clean Diesel


HEVs


BEVs


PHEVs


Renewable Biofueled Vehicles


H_2ICEs


FCVs

Our plans for migrating to alternative fuels and powertrains include implementing vehicles that run on renewable biofuels, increasing advanced clean diesel technologies, increasing our hybrid vehicle applications and introducing battery electric vehicles and plug-in hybrids. We are also working to advance hydrogen internal combustion engine and hydrogen fuel cell vehicle technologies.

For more information on our plans to advance alternative fuels and powertrain technologies, please click on the Ford vehicle for each fuel or technology above.

Migration to Alternative Fuels and Powertrains

IN THIS SECTION

Advanced Clean Diesel | HEVs | BEVs | PHEVs | Renewable Biofueled Vehicles | H_2ICEs | FCVs

Advanced Clean Diesel

Ford Fiesta ECOnetic

Ford offers the ECOnetic line of super-fuel-efficient, low-carbon-emission diesel vehicles in Europe. In the United States, we are introducing advanced clean diesel technologies on our diesel truck engines.

2007	2011	2020 – 2030
NEAR TERM	MID TERM	LONG TERM
Begin migration to advanced technology	Full implementation of known technology	Continue deploying advanced powertrains and alternative fuels and energy sources
Advanced Clean Diesel	Advanced Clean Diesel	

Modern diesels offer some significant advantages over traditional gasoline engines. They consume 30 to 40 percent less fuel, and on a well-to-wheels basis they emit 15 to 30 percent less CO_2[1]. In addition, direct-injection diesel engines provide exceptional power and torque, resulting in better driving performance and towing capabilities.

In Europe, diesel-powered vehicles account for more than 50 percent of new vehicle sales and make up approximately 30 percent of the total vehicle fleet on the road. Ford continues to improve its strong lineup of fuel-efficient and clean diesel vehicles in Europe. For example, we continue to introduce ECOnetic versions of Ford models that deliver improved fuel economy and emissions. The ECOnetic lineup currently includes versions of the Ford Focus, Mondeo, Fiesta and Transit. Several of the ECOnetic models use diesel engines, which meet the stringent EU V emissions standards and achieve less than 100 g/km C02 emissions. For example, the Fiesta ECOnetic has fuel economy of 3.7 liters/100 km and emits just 98 g/km of CO_2. This vehicle is powered by a specially calibrated version of the 90 PowerShift 1.6-liter Duratorq TDCi, combined with a coated diesel particulate (soot) filter.

In North American markets, diesels all but disappeared in the light-duty passenger vehicle market years ago, for a variety of reasons. However, with the introduction of low-sulfur diesel fuels in 2007 and advances in clean diesel technology, there is new opportunity for the expanded use of diesel in North America. Ford engineers are developing next-generation diesel technologies that will maintain the fuel economy advantages of diesels while minimizing emissions to meet strict U.S. air pollution standards. These technologies include diesel particulate filters and NOx-reduction catalysts, along with advanced combustion systems that will significantly reduce the particulate matter and NOx emissions associated with diesel engines. These advances will provide another route to more fuel-efficient and cleaner mobility.

In the North American medium-duty truck market there is a large demand for diesel products, with diesel engines accounting for more than 50 percent of sales. In response to this demand, Ford will introduce, for the 2011 model year, the next-generation F-Series Super Duty® truck with a new state-of-the-art diesel engine. The 6.7-liter PowerStroke® V8 diesel is cleaner and more powerful than previous engines. As a result of the new engine and a transmission upgrade, the 2011 Super Duty will deliver best-in-class fuel economy and towing capability.

This new diesel engine also meets the Environmental Protection Agency's strict 2010 heavy-duty truck emission regulations, which require 80 percent lower NOx emissions than the 2007 regulations. The new Super Duty uses a range of advanced technologies to meet these new regulations. First, the new 6.7-liter PowerStroke engine employs an innovative exhaust gas recirculation system to efficiently recycle the combustion gases. The system runs the engine with the least amount of oxygen possible, in order to reduce NOx emissions without degrading performance and fuel economy. In addition, the Super Duty uses a three-part "after-treatment" system, including:

- a diesel oxidation catalyst that converts and oxidizes hydrocarbons into water and carbon dioxide;
- a selective catalytic reduction that uses an ammonia and water solution to convert the NOx in the exhaust stream into water and inert nitrogen, which is present in the atmosphere and harmless; and
- a diesel particulate filter that traps any remaining soot and periodically burns it away when sensors detect the trap is full.

The engine will also use a high-precision, common-rail fuel-injection system featuring piezo-electric injectors. This system uses a stack of more than 300 wafer-thin ceramic platelets to control the fuel injector nozzle, allowing it to operate faster than other electro-mechanical fuel injectors, to decrease fuel consumption and reduce emissions.

The 2011 Super Duty will also be Ford's first vehicle in North America that is B20 compatible, meaning it can run on fuel composed of 20 percent biodiesel and 80 percent ultra-low-sulfur diesel. Biodiesel is a renewable fuel made from soybean oil and other fats. We went through extensive testing to ensure that the new Super Duty would meet performance and durability requirements when fueled with B20, including running durability cycles on multiple blends of diesel and biodiesel fuels to ensure the robustness of the system. Previously, Ford Super Duty products in North America were approved to use B5 fuel, which is composed of 5 percent biodiesel and 95 percent petroleum diesel. In Europe, our vehicles are also compatible with B5, and we are working with European fuel standards organizations to establish fuel-quality standards for biodiesel blends greater than B5. The use of biodiesel helps reduce dependence on foreign oil and reduces life-cycle CO_2 emissions. For more information on biofuels, please see the Renewable Biofueled Vehicles section.

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1. Values based on J.L. Sullivan, R.E. Baker, B.A. Boyer, R.H. Hammerle, T.E. Kenney, L. Muniz, and T.J. Wallington, 2004,"CO_2 Emission Benefit of Diesel (versus Gasoline) Powered Vehicles," *Environmental Science and Technology*, 38: 3217-3223.

Migration to Alternative Fuels and Powertrains

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Advanced Clean Diesel


HEVs


BEVs


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H_2ICEs


FCVs

Hybrid Electric Vehicles (HEVs)

Ford Fusion

Ford currently offers four hybrid models in the United States. By 2013, we will offer seven hybrid models in the United States and Europe.

2007	2011	2020 – 2030
NEAR TERM	MID TERM	LONG TERM
Begin migration to advanced technology	Full implementation of known technology	Continue deploying advanced powertrains and alternative fuels and energy sources

Hybrid Electric Vehicles (HEVs)

In 2004, Ford introduced the world's first hybrid SUV, the Ford Escape Hybrid. We followed up with the Mercury Mariner Hybrid in 2005. In early 2009 we further expanded our hybrid vehicle lineup by introducing the Ford Fusion and Mercury Milan Hybrids. All of these vehicles are full parallel hybrids, meaning they can run exclusively on battery power, exclusively on gas power or on a combination of both to deliver the best overall energy or fuel efficiency. As of early 2010, we had produced more than 125,000 hybrids worldwide. We are currently increasing our hybrid volume, targeting a cost reduction of more than 30 percent in our 2012 next-generation hybrid systems and preparing for hybrid capability across our highest-volume global product platforms.

The Ford Fusion Hybrid has an Environmental Protection Agency fuel economy rating of 41/36 mpg city/highway, making it the most fuel-efficient midsize sedan in the United States today.[1] The Fusion Hybrid's fuel economy significantly exceeds that of its nearest midsize sedan competitor, and it can go more than 700 miles on a single tank of fuel. It includes an innovative new SmartGauge™ with EcoGuide instrument cluster that coaches hybrid drivers to maximize fuel efficiency. With the Fusion and Milan Hybrids, we doubled the number and volume of our hybrid lineup in the United States.

In 2010, we will launch the Lincoln MKZ Hybrid, which is expected to be the most fuel-efficient luxury sedan in America. In 2012 we plan to deliver our next-generation hybrid vehicles, including a hybrid based on a compact or "C-car" platform. The next-generation system, already under development, will be even more efficient and more cost-effective than the current system and will use lithium-ion battery cells. All of Ford's electrified products, including hybrids, plug-in hybrids and battery electric vehicles, will use lithium-ion battery cells by 2012.

As part of our global electrification plan, we will extend our hybrid vehicle technology to Europe. By 2013, we plan to introduce two next-generation hybrid vehicles and a plug-in hybrid in Europe. The European HEVs will be based on our global "C-car" platform and our "CD-car" (or midsize) sedan. The European PHEV will be based on the all-new C-MAX, a derivative of our global "C-car" platform.

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1. Midsize sedan segment based on the R.L. Polk segment definition.

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Battery Electric Vehicles (BEVs)

Transit Connect Electric

Ford will introduce a BEV version of the Transit Connect in the United States in 2010, followed by the Focus Electric in 2011. We will introduce these BEVs in Europe in 2011 and 2012.

2007	2011	2020 – 2030
NEAR TERM	MID TERM	LONG TERM
Begin migration to advanced technology	Full implementation of known technology	Continue deploying advanced powertrains and alternative fuels and energy sources

Battery Electric Vehicles (BEVs)

Ford has announced an expanded, comprehensive electric vehicle strategy aligned with growing public interest in advanced technologies that can help reduce the use of gasoline and diesel. We are employing a comprehensive approach to electrification that will tackle commercial issues such as battery cost, standards development and infrastructure deployment. Strategic partnerships are an important part of this new approach. We are working with partners to develop appropriate battery cells, collaborate on government policy and define the infrastructure needed to speed the commercialization and acceptance of electric vehicles. This global electrification strategy is not a test program. It is a vital element of our business plan going forward and is aimed at making Ford a leader in sustainable transportation. To read more about Ford's approach to vehicle electrification, please see Electrification: a Closer Look.

Battery electric vehicles do not have an internal combustion engine and do not use any on-board gasoline. Instead, they use a high-voltage electric motor, which gets its power from a high-voltage battery pack charged by plugging into a standard 110-volt or 220-volt outlet in the United States, or a 230-volt outlet in Europe. Our early BEV test vehicles charge in six hours when plugged into a 220-volt outlet. The production models will be rechargeable in seven to eight hours from 230- and 220-volt outlets or 14–16 hours from a 110-volt outlet. As fast-charge technology standards are developed, Ford's BEVs will be designed to take advantage of this capability. Ford is actively working to help develop the standards to ensure that plug-in and charge stations work for all BEVs and to also ensure that the technology is reliable and durable for customers.

In 2010, we will deliver a BEV version of our Transit Connect light commercial utility van for use by small business owners and fleet customers in the United States. This vehicle is being developed in partnership with Azure Dynamics, a world leader in the development and production of hybrid electric and battery electric commercial vehicles. In 2011 we will deliver a Focus BEV, called the Focus Electric, which will be aimed at U.S. retail customers. We are working with Magna International for the supply and integration of several of the BEV components for this vehicle. This car will have a driving range of approximately 100 miles on a single charge of its lithium-ion high-voltage battery. We are targeting urban markets with this vehicle and expect to sell between 5,000 and 10,000 units annually to start. We will be ready to ramp up to higher volumes as the infrastructure develops and customer demand grows.

We recently announced plans to expand our BEV lineup to Europe. We will launch the Transit Connect Electric in 2011 followed by the Ford Focus Electric in 2012. The Focus Electric will be based on Ford's next-generation Focus model and is one of up to 10 vehicles that will be developed from the company's new global C-car platform. We also plan to introduce two next-generation hybrid-electric vehicles and a plug-in hybrid in Europe in 2013. In preparation for the launch of these vehicles in Europe, Ford will participate in BEV test trials in the UK and Germany with Transit commercial vehicles equipped with a pure electric powertrain as well as battery electric prototype passenger car vehicles, to test the technology's suitability in real-world situations.

In North America, the Society of Automotive Engineers, with Ford's participation, successfully aligned all major original equipment manufacturers on a standard charge connector and communication protocol that will enable all plug-in vehicles to use common charge points. This will be a key enabler for adoption in North America; the same connector is under consideration in Europe and China. Ford also recently announced it is partnering with Microsoft to deliver a new energy management software program called Microsoft Hohm™ that will help owners of Ford BEVs assess the most efficient times to recharge their vehicles. For more information on this partnership, please see Electrification: a Closer Look.

Ford's aggressive new electrification plan represents the next step in the Company's sustainability plan. The plan includes a commitment to greater vehicle fuel economy and lower CO_2 emissions as part of Ford's longer-term commitment to addressing climate change and energy security.

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Plug-in Hybrid Electric Vehicles (PHEVs)

Ford Escape

Ford plans to have a plug-in hybrid vehicle available commercially in North America in 2012 and in Europe by 2013.

2007	2011	2020 – 2030
NEAR TERM	MID TERM	LONG TERM
Begin migration to advanced technology	Full implementation of known technology	Continue deploying advanced powertrains and alternative fuels and energy sources

Plug-in Hybrid Electric Vehicles (PHEVs)

We are currently developing and testing plug-in hybrids in preparation for bringing them to market in 2012. PHEVs are similar to HEVs in that they are equipped with both an electric battery and a gas-powered engine. Unlike today's hybrids, however, PHEVs are equipped with a high-capacity battery that can be charged from a private household or public electric outlet. In addition, while regular HEVs maintain a roughly constant battery charge, plug-in hybrids discharge the battery while driving to provide additional fuel savings. PHEVs have the potential to reduce tailpipe emissions to near zero when running on battery power. However, the vehicle's overall life-cycle emissions depend on the electrical power source and the performance characteristics of the vehicle. PHEVs could be significantly less expensive for consumers to operate because they allow drivers to travel on grid-based electricity stored in batteries instead of more costly gasoline.

In 2007, Ford committed to a collaborative project with Southern California Edison to develop a fleet of plug-in hybrid Ford Escapes as part of a PHEV demonstration project. The project seeks to provide real-world usage data and to understand critical implementation issues, including the vehicle-utility interface, the impact of plug-ins on utility operations and emissions, and the value to users, utility companies and vehicle manufacturers. Since the project began, numerous organizations have joined the partnership and helped to evaluate our PHEVs in different geographical locations. These partners include the Electric Power Research Institute, the New York State Energy Research and Development Authority, the New York Power Authority, American Electric Power, ConEdison of New York, DTE Energy, National Grid, Progress Energy, Southern Company-Alabama Power, Pepco Holdings and Hydro Quebec. For more information on some of the key learnings generated by this collaboration so far, please see Electrification: A Closer Look.

In 2008, Ford also announced a program with the U.S. Department of Energy (DOE) to identify a sustainable pathway toward accelerated, successful mass production of plug-in hybrid electric vehicles. The program includes a three-year demonstration project with a vehicle fleet deployed by DOE and energy partners to collect real-world battery performance data and evaluate PHEV and grid performance. Ford was awarded a $10 million contract by DOE in support of this work. In 2008 and 2009, Ford deployed 20 vehicles with its utility partners and DOE.

The PHEV demonstration fleet uses a blended, or parallel, hybrid configuration. Parallel hybrids can be propelled by an electric motor or a gasoline internal combustion engine, or both can work together seamlessly to provide the most efficient combination. This parallel system enables flexibility and efficiency in battery sizing while maximizing battery life and investment.

In early 2010, Ford announced that we are partnering with Microsoft on a new energy management software that will help customers determine when and how to most efficiently and affordably recharge BEVs and PHEVs. For more information on this technology, please see Electrification: A Closer Look.

The Plug-In Hybrid Escapes demonstration vehicles have two distinct operational modes: charge depletion and charge sustaining. In charge depletion mode, which is used when the high-voltage battery is above a predetermined state of charge, the vehicle will draw the majority of the power required for operation from the battery. During normal driving, this usually translates into full-electric operation when the vehicle is traveling less than roughly 40 mph. When the power demand of the driver exceeds the power output capacity of the high-voltage battery, the gasoline engine will automatically start up to provide the difference. However, even when the engine is used to supplement power while in charge depletion mode, the battery still provides the vast majority of the power required to propel the vehicle, giving the driver a sense that the engine is merely idling, even at highway speeds.

In charge sustaining mode, which is used when the high-voltage battery is below a predetermined state of charge, the vehicle will rely mainly on the engine to meet the driver's power demand. The high-voltage battery will be charged during braking events and discharged during acceleration events to improve the overall fuel economy of the vehicle – similar to the operation of today's conventional hybrids.

Initial field data shows significant improvements in fuel economy when operated in charge depleting mode. The data also shows that in city environments, a fully charged Plug-in Escape is capable of an all-electric range in excess of 25 miles when driven below 40 mph and if aggressive acceleration events are avoided.

Ford's PHEV demonstration fleet vehicles use advanced lithium-ion batteries. We plan to have a plug-in hybrid vehicle available commercially in North America in 2012 and in Europe by 2013 as part of our overall plan for vehicle electrification. The European PHEV will be based on the all-new C-MAX and the U.S. PHEV platform is still being determined.

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Renewable Biofueled Vehicles

Ford Galaxy

Ford currently offers 14 vehicle models globally that run on biofuels. We are working to advance the development of next-generation biofuels that will further reduce life-cycle CO_2 emissions.

2007	2011	2020	2030
NEAR TERM Begin migration to advanced technology	MID TERM Full implementation of known technology	LONG TERM Continue deploying advanced powertrains and alternative fuels and energy sources	

Renewable Biofueled Vehicles

Current Generation Biofuels

Ford has a long history of developing vehicles that run on renewable biofuels. Our founder, Henry Ford, was a strong proponent of biofuels, and we produced our first flexible-fuel vehicle approximately 100 years ago; the Ford Model T was capable of running on gasoline or ethanol.

Biofuels are an important component of our sustainability strategy for three reasons. First, biofuels can help to address economic, social and environmental sustainability as well as helping us meet our CO_2-reduction goals. Second, the use of biofuels requires relatively modest modifications to existing vehicle and fueling technology, which makes them a viable near-term option. Third, biofuels offer synergies with our other strategies. For example, the high octane of ethanol would enable the use of higher compression ratios and higher levels of boost, thereby improving the efficiency of and generating more torque from our future downsized engines, provided this fuel is available. Similarly, we can use biofuels to fuel the internal combustion engine portion of our plug-in hybrid electric vehicles, which will further lower their carbon footprint. We are aware that there are fundamental limitations associated with the scale of biofuel production, and therefore we do not see biofuels as the only solution to providing sustainable mobility. Nonetheless, we do see biofuels as part of the solution.

Ford has taken a leadership position on implementing biofuels. Since 1997, we have offered flexible-fuel vehicles (FFVs) capable of running on gasoline or E85 ethanol – a blended fuel that contains up to 85 percent ethanol and at least 15 percent petroleum-based gasoline. To date, we have more than 5 million E85-capable vehicles on the road globally, including more than 2.5 million in North America and nearly 2 million in Brazil. In the United States, we have introduced more than 550,000 FFVs over the last two years alone. In Europe, Ford is a market leader and pioneer in bioethanol-powered FFVs, with more than 70,000 vehicles delivered to customers since 2001. Ford FFV models are now available in 17 European markets, with Sweden, Germany, the Netherlands, Spain and France showing the strongest demand.

Ford currently offers 14 vehicle models in the United States, Europe, Asia and South America that can run on E85. These include the Ford Crown Victoria, Mercury Grand Marquis, Lincoln Town Car, Ford Fusion, Mercury Milan, Ford Escape, Mercury Mariner, Lincoln Navigator, Ford Expedition, Ford Econoline and Ford F-150 in North America; the Ford Focus, C-MAX, Mondeo, S-MAX and Galaxy in Europe; the Ford Fiesta, EcoSport and Focus in Brazil; and the Ford Focus in Thailand. In 2009 in Europe we launched a tri-fuel version of the Ford Mondeo capable of running on gasoline, E85 or propane (LPG).

Next-Generation Biofuels

We are continuing to develop the next generation of biofueled vehicles, including vehicles capable of running on advanced biofuels. Our current research focuses on two primary biofuels: bioethanol and biodiesel. Bioethanol (used for example in E85) is a gasoline alternative derived from plant material. Most bioethanol in the United States is made from corn. In other parts of the world it is made from other locally available crops, including sugar cane in Brazil and sugar beets in Europe. All modern gasoline vehicles can run on E10, a gasoline/bioethanol mixture of up to 10 percent by volume bioethanol.

Biodiesel is a diesel alternative made from vegetable oils obtained from oil seeds, including soy, canola, palm and rapeseed, or from animal fat. In the United States, most biodiesel is currently made from soybeans. In the United States and Europe all of our diesel vehicles can run on B5, a blend of 5 percent biodiesel and 95 percent petroleum diesel. We have worked with fuel standards organizations to allow the use of biodiesel blends of greater than B5 in our future products. For example, our 2011 F-Series Super Duty® trucks with a new 6.7-liter diesel engine are compatible with B20, which is 20 percent biodiesel and 80 percent petroleum-based diesel. In addition, the gasoline version of these vehicles will be compatible with gasoline, E85, or any ethanol-gasoline blend between E0 and E85.

Bioethanol, biodiesel and other renewable fuels have significant advantages. They can be made with locally available raw materials, reducing the need for foreign-supplied oil and increasing energy security, and they produce fewer lifetime CO_2 emissions. However, important issues remain regarding biofuels' energy density, the best way to use these fuels to reduce greenhouse gas (GHG) emissions, and their ability to meet fuel needs without diminishing food supplies. (These issues are discussed in more detail later in the Biofuel Challenges section.)

Ford is working to support and promote the next generation of biofuels, including cellulosic biofuels. These are fuels made from plant cellulose – stalks, leaves and woody matter – instead of from sugars, starches or oil seeds. Cellulosic biofuels have many advantages. They minimize possible market competition between food and fuel. They allow the more-efficient use of crops such as corn and soybeans by using more of the plant. In addition, cellulosic biofuels can be made from crops that require less energy-intensive farming, such as switchgrass and wood, further reducing the total CO_2 footprint of fuels used for operating vehicles. We are also investigating the potential for algae-based biofuels to provide another feedstock for future biofuels.

Biofuel Infrastructure

To make an impact on GHG emissions and energy security, biofuels must become more widely available. In the United States, Ford has committed to doubling the number of FFVs in our lineup by 2010. And, if the market dictates and the supporting infrastructure is in place, we have committed to expanding FFV output to 50 percent of total vehicle production by 2012. Despite this commitment, E85 refueling infrastructure remains inadequate. Out of more than 160,000 refueling stations in the United States, approximately 2,200 (or less than 2 percent) offer E85. In order for consumers to have a true transportation fuel choice, increased access to biofuels is necessary.

United States Renewable Fuel Standard and the Future of Biofuels

The Energy Independence and Security Act of 2007 established a new renewable fuel standard (RFS) requiring a significant increase in the use of biofuels – 36 billion gallons per year by 2022. In addition, this law requires that, beginning in 2010, a certain portion of biofuels must be advanced and/or cellulosic-based fuels. Ethanol blended into gasoline is expected to supply a large percentage of this biofuel mandate and could displace nearly 20 percent of U.S. gasoline demand by 2022.[1] The use of biodiesel in the United States is also likely to increase in the coming years. However, it will not likely increase to the same levels as ethanol, because the RFS mandates lower volumes of biomass-based diesel and because a relatively small percentage of light-duty passenger vehicles in the United States use diesel.

Using low-level ethanol blends such as E10, which is the current compatibility limit for all non-FFV light-duty vehicles, would achieve approximately 40 percent of the RFS-mandated biofuel use by 2022. Therefore, meeting the full RFS biofuel requirement will require the use of more E85-capable FFVs and/or the development of vehicles that can use mid-level blends of ethanol (i.e., between E10 and E85). Furthermore, the expanded use of E85-compatible vehicles would require a corresponding increase in the E85 fueling infrastructure in the next 10 to 20 years. An approach using mid-level blends would require that all new vehicles be designed for higher ethanol capability, and the existing fueling infrastructure would need to be redesigned for higher ethanol compatibility. For any of these cases to work in the real world, the new fuels will have to provide value to give consumers a compelling reason to buy ethanol-blend fuels. Regardless of the specific strategy used, coordinated efforts will be required between automakers, fuel suppliers, consumers and the government to meet the RFS mandate while ensuring the compatibility of vehicles and ethanol-blended fuel.

Biofuel Challenges

Much of the interest in biofuels results from their potential to lessen the environmental impacts of transportation fuels while contributing to energy independence. Biofuels are made from domestic and renewable resources, they provide an economic boost to farmers, and they help to reduce greenhouse gas emissions because the plants from which they are made absorb CO_2 while they are growing. But are biofuels the solution to our growing fuel-related environmental, economic and political problems? The issues are complex. We believe biofuels are an important part of the equation for addressing climate change and energy security. We recognize, however, that major advances need to be made in production processes, source materials and fuel types to achieve the full promise of biofuels.

Some of the challenges relating to today's biofuels include the following.

Energy density

The energy density of ethanol is approximately two-thirds that of gasoline.[2] This means there is approximately one-third less energy in a gallon of ethanol than in a gallon of gasoline. As a result, drivers using blends with a high amount of ethanol will have to refuel more frequently to drive the same distance. Biodiesel has approximately the same energy density as conventional diesel.

Life-cycle greenhouse gas emissions

The plants used to produce biofuels capture as much carbon dioxide during their growth as they release when burned. However, current farming and production processes utilize fossil fuels in the production of bioethanol and biodiesel, so the production of these biofuels for use in vehicles results in a release of some fossil-fuel-based GHG emissions on a life-cycle basis. Recent studies have suggested that nitrous oxide (N_2O) emissions from the fertilizers required to grow biofuel feedstocks may have been underestimated, and that these emissions reduce the GHG benefits attributed to biofuels. N_2O emissions from biofuel production need to be carefully considered for all types of biofuel feedstocks and farming techniques on a full life-cycle basis, including allocation of emissions to co-products derived from biofuel production. Government and academic studies suggest that current E85 ethanol from corn results in 20 to 30 percent fewer life-cycle GHG emissions than today's gasoline, on an energy-equivalent basis. In addition, GHG emissions related to petroleum can vary greatly depending on the source. Producing crude oil from tar sands, for example, results in a greater release of GHGs than producing crude oil from conventional sources. The use of renewable energy sources in the production of bioethanol and biodiesel production can reduce their life-cycle GHG emissions further. We believe that developing cellulosic or biomass-based biofuels with next-generation processes will significantly decrease the GHG emissions associated with biofuels, perhaps by up to 90 percent.[3]

Competition with the food supply

Another concern about current corn- and soybean-based biofuels is that they compete in the marketplace with food supplies and are one of the factors that increase food prices. Demand for corn used directly for human food (including high-fructose corn syrup) comprises less than 10 percent of the total corn supply. Approximately 42 percent of the corn produced in the United States is used for animal feed. In 2009, about 32 percent of the corn harvest in the United States was used to produce ethanol. The ethanol process removes only the starch from the corn – the remaining portion is a highly valued feed product (called distiller grains) and a good source of energy and protein for livestock and poultry. If next-generation biofuels can efficiently utilize biomass such as plant stalks, woodchips or grasses and be grown on marginal land with little irrigation, then competition with food crops should be minimized.

Land use conversion for biofuel production

Recent studies have looked at the overall CO_2 and N_2O impacts of converting natural ecosystems to farmland for the production of biofuels. This is an important and complex issue. Converting natural lands to croplands for fuel production can lead to the release of carbon stored in above- and below-ground biomass. Releasing this carbon in the form of CO_2 during land conversion to energy crops creates a carbon "debt," which may take a very long time to repay through the greenhouse gas benefits of biofuel use. The use of degraded pastures or abandoned farmland, by contrast, rather than natural ecosystems, would incur minimal carbon debt, because there is limited CO_2 storage in these previously altered ecosystems.

At Ford, we are following the debates about biofuels closely. As we proceed, we need to consider how biofuels are derived and carefully review issues such as the potential net greenhouse gas benefits; political, economic, social and environmental concerns related to biofuel and petroleum use; and the management of land, food and water resources. We agree with the general consensus among scholars and industry experts that the current generation of biofuels (e.g., corn-based bioethanol and soybean-based biodiesel) have modest environmental benefits and are a first step toward cleaner vehicles and energy independence. We are actively investigating next-generation biofuels that have greater environmental, energy security and economic benefits. We believe that improvements in the efficiency of farming technologies and biomass production processes, and the development of advanced biofuels, will significantly increase the benefits and long-term sustainability of biofuels. Even with these improvements, solving our climate change and energy security problems will require a multifaceted set of solutions, including new fuels, improvements in vehicle fuel economy and changes in consumer driving patterns and practices.

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3. *Ethanol: The Complete Energy Lifecycle Picture*, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, March 2007.

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Hydrogen Internal Combustion Engines (H_2ICEs)

450 H_2ICE shuttle buses

Ford was the first automaker to develop commercially available hydrogen-powered internal-combustion engines, which virtually eliminate CO_2 emissions.

2007	2011	2020
NEAR TERM	MID TERM	LONG TERM
Begin migration to advanced technology	Full implementation of known technology	Continue deploying advanced powertrains and alternative fuels and energy sources
		Hydrogen Internal Combustion Engines (H_2ICEs)

2030

Ford was the first automaker to develop commercially available hydrogen-powered internal combustion engines (H_2ICEs), which use the same basic technology as gasoline-powered engines but run on hydrogen fuel. We view this as a possible bridge technology to hydrogen-powered fuel cells, because it is less expensive than fuel cells and uses existing engine manufacturing capability.

We currently have a fleet of 13 E-450 H_2ICE shuttle buses on the road in North America. These E-450 shuttle buses use a 6.8-liter supercharged Triton V10 engine with a hydrogen storage system equivalent to 29 gallons of gasoline. We have placed 10 of the H_2ICE shuttles with the Canadian government in Vancouver, Prince Edward Island, Ottawa and Toronto in support of their vision for a hydrogen-based economy. We also have buses on the road in California and Pennsylvania. Our H_2ICE buses formerly located in Detroit, Las Vegas, Pennsylvania and Missouri have returned to Ford after successfully completing their fleet evaluations. At year-end 2009, our H_2ICE fleet had successfully logged 332,000 miles in operation.

H_2ICEs still face considerable challenges. Like all hydrogen-powered vehicles, H_2ICEs are limited by fuel storage, fuel infrastructure issues and concerns about hydrogen safety. For example, current H_2ICE vehicles have a driving range of 150 to 200 miles, due to fuel storage limitations. The vehicles are also still very expensive. However, if these problems can be overcome, H_2ICEs have the potential to deliver significant environmental benefits, including near-zero CO_2 and other tailpipe emissions and 13 percent better fuel economy than traditional vehicles.

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Migration to Alternative Fuels and Powertrains

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H_2ICEs


FCVs

Hydrogen Fuel Cell Vehicles (FCVs)

Ford Focus

Ford has a decade-long history of fuel cell vehicle development and technology demonstration, including a five-year demonstration project with vehicles that accumulated more than a million driving miles without significant technical problems.

2007	2011	2020 – 2030
NEAR TERM	MID TERM	LONG TERM
Begin migration to advanced technology	Full implementation of known technology	Continue deploying advanced powertrains and alternative fuels and energy sources
		Hydrogen Fuel Cell Vehicles (FCVs)

Fuel cell vehicles, like battery electric vehicles, produce zero tailpipe emissions. Unlike BEVs, however, which must be recharged via an external power source, FCVs use an on-board fuel cell to create electrical power through an electro-chemical reaction based on hydrogen fuel and air. Vehicles using fuel cells as the primary source of motive power can also be hybridized with a high-voltage battery, to improve vehicle performance and better optimize the cost and robustness of the fuel cell system. In fact, all of our efforts to improve high-voltage electronics and battery technology on HEVs, BEVs and PHEVs will be applicable to FCVs, if and when these vehicles become more commercially viable.

We believe that hydrogen-powered fuel cell vehicles may be an important long-term solution for reducing GHGs, if hydrogen fuel emerges as a viable low-carbon energy carrier. Therefore, Ford has committed to significant hydrogen fuel cell research and development.

Ford has a decade-long history of fuel cell vehicle development and technology demonstration. The Company developed the first research prototype FCV in 1999. In 2004, we introduced the first production-intended FCV using the Ford Focus as a base vehicle. The Focus FCV uses a Ballard fuel cell technology, called HyWay1. It is one of the industry's first hybridized fuel cell vehicles, meaning it has a battery system as well as a fuel cell system.

From 2004 to 2009, Ford participated in a technology demonstration program, partially funded by the U.S. Department of Energy (DOE), as well as other demonstration programs in Canada and

Europe. A total of 30 Ford Focus FCVs have been in operation in these programs. These vehicles have been tested to demonstrate durability and reliability; for example, they were subjected to driving tests at sub-zero temperatures and high altitudes to prove vehicle performance under a range of customer-encountered driving environments. By 2009, these vehicles had accumulated over a million driving miles without significant technical problems, thereby demonstrating the reliability of fuel cell powertrain systems in real-world driving conditions. The data collected from this fleet is critical for the further development of fuel cell technology. Based on the knowledge gained from the Focus FCV test fleet, we have completed the development and laboratory validation of our new fuel cell technology, called HyWay2/3. This new technology improves the robustness and "freeze start" capability of the fuel cell propulsion system.

Even with the advances we have made in hydrogen technology over the past 10 years, however, we still have many challenges to overcome before hydrogen FCVs can compete in the market with current vehicle technology. The cost and durability of the fuel cell system are the most significant challenges. These challenges remain too significant to allow for the commercialization of FCVs at this point, even with the incremental improvements in current state-of-the-art fuel cell technology. For example, extensive DOE analysis has not yet revealed an automotive fuel cell stack that meets the DOE's cost targets for real-world commercialization, or that maintains proper performance throughout the targeted lifetime while staying within the targeted cost. There are also still significant challenges related to the cost and availability of hydrogen production, hydrogen distribution and on-board hydrogen storage. To overcome these challenges, and to make fuel cell vehicle technology commercially viable, we believe that further scientific breakthroughs are required.

Given these significant challenges to commercialization, we believe that further investment in demonstrating hydrogen FCVs and integrating current FCV technology into existing vehicles are not high-value investments for Ford. Therefore, Ford is now reprioritizing its resources to concentrate on fundamental fuel cell research that will help increase the commercialization potential of FCV technology. For example, Ford is focusing on materials development, basic scientific research into reducing the costs and increasing the durability of the fuel cell stack and system, and the development of improved analytical models. We are working on these critical issues with our alliance partners: Daimler AG and Automotive Fuel Cell Corporation, a Vancouver-based company owned by Ballard, Daimler and Ford.

Our materials research is focused on the membrane electrode assembly (MEA) and bipolar plates, which make up key elements of the fuel cell stack. Currently, these components are made from expensive materials. We are working to find alternatives to replace these materials, such as developing new catalyst membranes and corrosion-resistant bipolar plates. Simultaneously, we are working to increase the density of fuel cell materials, which will improve the utilization of the expensive materials used in the MEA and bipolar plate. Fuel cell catalyst research is also crucial to our ability to optimize fuel cell stack operating conditions and reduce system complexity.

We are also developing advanced computational modeling that will help us understand the mechanisms underlying ideal fuel cell functioning and anticipate failure modes under the real-world usage profiles. These modeling tools will assist with our materials research.

Hydrogen storage on-board the vehicle is another critical challenge to the commercial viability of hydrogen FCVs. We recognize that compressed hydrogen storage, which is currently used in the demonstration vehicles, may not be sufficient to achieve commercialization goals. We are therefore pursuing research on materials-based on-board hydrogen storage technology, including complex hydride and novel hydrogen sorbent technologies, which show technical potential.

Producing and distributing hydrogen fuel is another important hurdle on the road to implementing hydrogen-powered FCVs. The GHG reduction benefits of hydrogen fuel depend on what procedures and feed stocks are used to produce hydrogen. Currently, the most state-of-the-art procedure for producing hydrogen is a distributed natural gas steam reforming process. However, when FCVs are run on hydrogen reformed from natural gas using the current processes, they do not provide significant environmental benefits on a well-to-wheels basis that take into account GHG emissions from the natural gas reformation process. It would be necessary to employ carbon sequestration technologies in hydrogen production from fossil fuels or increase the use of renewable energy sources to make hydrogen for hydrogen-fueled FCVs to provide significant environmental benefits.

Even if the challenges of producing hydrogen can be overcome, there is still no widespread hydrogen fueling system. Therefore, new infrastructure must be designed and executed throughout the country to make hydrogen FCVs feasible.

Working alone, Ford will not be able to overcome all of the challenges hydrogen vehicles face. That is why Ford is collaborating with a wide range of partners on the development of hydrogen vehicles, fuels and fueling systems. In addition to our work with Ballard and Daimler described above, we are working with:

- The Freedom CAR and Fuel Partnership: a partnership between Ford, General Motors, Chrysler, five energy providers and the DOE to develop vehicles and fuels that will provide freedom from imported oil and carbon-based fuel emissions, and

- The Clean Energy Partnership Berlin: a consortium of 13 corporate partners and the German government that is working to demonstrate the suitability of hydrogen as a fuel for everyday use.

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Ford's Green Partnerships with the Federal and State Governments

The 2007 Energy Independence and Security Act (EISA) continued the effort to transition the interactions between automakers and the government on fuel economy standards from an adversarial relationship to a partnership. EISA authorized tough standards for new vehicle fuel economy while creating the Section 136 Advanced Technology Vehicle Manufacturing Incentive Program. Section 136 authorized the Secretary of Energy to make direct loans to eligible applicants for projects that reequip, expand or establish manufacturing facilities in the United States to produce advanced technology vehicles or qualifying components and also for engineering integration costs associated with such projects.

Last summer, Ford Motor Company was the first automaker deemed by the government to be among the best companies with the best technologies in American manufacturing and fuel efficiency. This green partnership between Ford and the U.S. government will help to accelerate the development of advanced technologies for even better fuel economy while maintaining jobs in the United States.

In total, Ford is investing nearly $14 billion in advanced technology vehicles in the next seven years in the United States, and the advanced technology loans will help Ford achieve its ambitious goals for fuel-efficient vehicles and technologies. We expect to receive a direct loan of up to $5.9 billion through our partnership with the Department of Energy. This loan program was not part of the Troubled Asset Relief Program, the emergency taxpayer assistance provided to prevent ailing U.S. companies from going out of business. Instead it represents an affirmation of Ford's leading fuel-efficiency technologies and the beginning of a partnership with the federal government to advance these technologies more quickly.

An outstanding example of how Section 136 partnership funds are going to be used is the Ford Focus produced at the Michigan Assembly Plant (MAP). MAP is being transformed from a large SUV factory into a modern, flexible small car plant to produce the global Ford Focus. The new Focus will be one of up to ten unique models to be built from Ford's new C-car platform, which is expected to generate total sales in all regions of 2 million units annually by 2012. In addition to beginning production of the Focus this year at MAP, we will also produce the Focus Electric next year and next-generation hybrid and plug-in hybrid vehicles in 2012 at MAP.

The Focus exceeds Section 136's Advanced Technology Vehicle requirements by combining key technologies to achieve class-leading fuel economy, including: an advanced combustion engine, six-speed transmission, deceleration fuel shut-off, electric power-assisted steering, improved aerodynamics and lightweight materials.

Ford is investing approximately $550 million to introduce the North American market to Ford's global C-platform, which underpins the Focus. This investment will support more than 4,000 high-tech manufacturing and engineering jobs, not to mention more than 10,000 supplier jobs and 175,000 dealership positions.

Ford's sustainability commitments have received state government support as well. Working in close partnership with the state of Michigan, Ford received incentives and tax credits totaling $188 million to help in the continuous transformation of MAP. In addition to building the next-generation hybrid in Michigan, the incentives enabled Ford to bring advanced lithium-ion battery system design, development and assembly in house.

Ford also received a $2 million grant from the state of Michigan to install a large stationary battery-based energy storage facility with 750 kw capacity and 2 MWh of storage. This facility will support the state's "smart-grid" development initiatives as well as Ford's efforts to develop battery technology and secondary uses for vehicle batteries. As part of this facility, Ford will demonstrate the possibility for using vehicle batteries as stationary power storage devices after their useful life as vehicle power sources is over. Ford is participating in this project in partnership with DTE Energy, a Michigan-based energy provider. DTE Energy will install a 500 kw solar photovoltaic (PV)

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electricity generation system at the demonstration facility, which will produce some of the energy to be stored in Ford's stationary battery storage facility. When commissioned at the end of 2010, it is anticipated that it will be the largest PV array in Michigan. This solar PV system, which will feed into the battery facility, is being funded by DTE Energy to support Ford's sustainability efforts and to help the state of Michigan meet its renewable energy production requirements. As part of this project, Ford will also develop 10 electric vehicle charging stations, which will demonstrate advanced battery charging technologies and associated integration with renewable energy and other smart-grid advances.

Progress and Performance

How is Ford doing in its quest to reduce GHG emissions? Based on analyses of life-cycle vehicle CO_2 emissions, approximately 80 to 90 percent of GHGs are emitted while the vehicle is in use, rather than during its manufacture or disposal. The in-use emissions depend on three major factors:

1. The fuel economy of the vehicles, which in turn depends on many characteristics of the vehicles themselves (such as their weight, powertrain and aerodynamics).
2. The well-to-wheels greenhouse gas profile[1] of the fuels used in the vehicles.
3. How the vehicles are used and maintained by their drivers.

Our shorthand for this is "Vehicle + Fuel + Driver = GHG emissions." This section reviews our progress reducing these emissions, as well as our progress reducing emissions from our facilities, our logistics and our supply chain.

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1. In other words, emissions resulting from making, distributing and using the fuel.

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Vehicle

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Ford ECOnetic vehicles

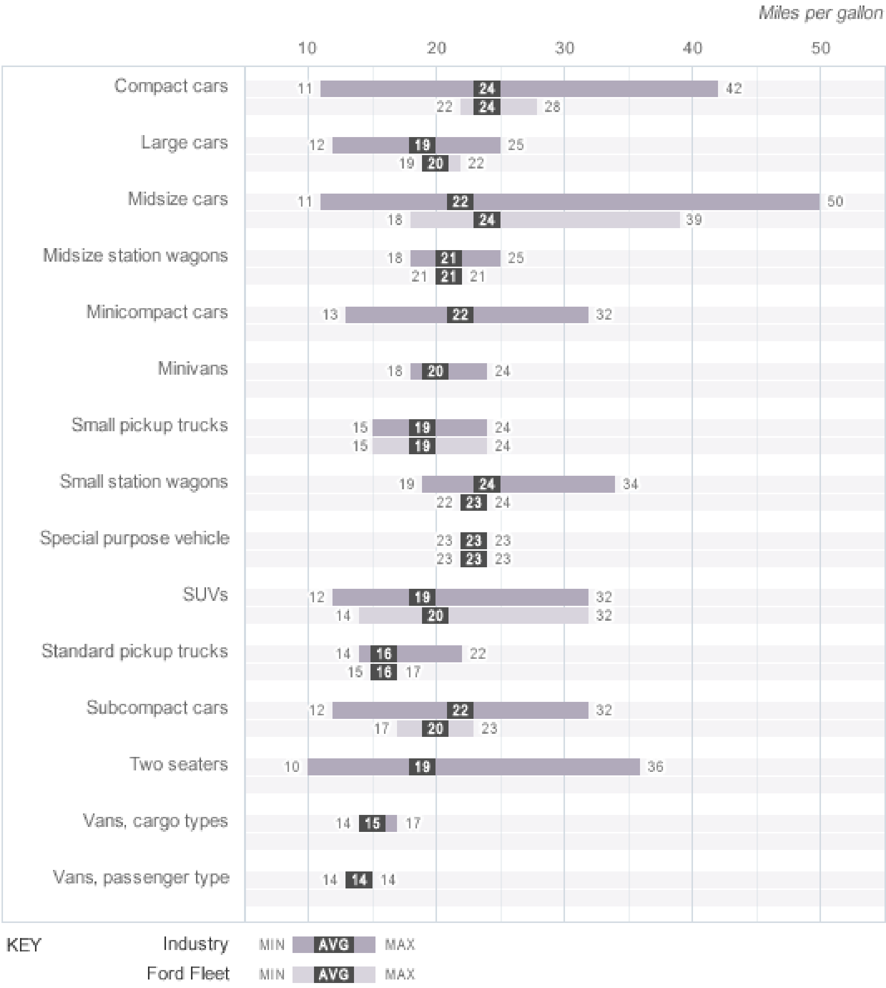
In the United States, for the 2009 model year, our fleet CO_2 emissions decreased (i.e., improved) by approximately 5 percent relative to the 2008 model year and 12 percent compared to the 2006 model year. Preliminary data for the 2010 model year shows a 3.2 percent improvement in Corporate Average Fuel Economy (CAFE) for cars and a slight decline of 2.4 percent in CAFE for trucks as compared to 2009. The increase for cars is due to increased customer demand for the more fuel-efficient medium-sized cars, which rose by 18 percent. This includes increased demand for the newly introduced 2010 Fusion Hybrid. The decrease in truck CAFE can be attributed to increased demand for standard pickup trucks and larger SUVs, which increased by 6 percent and 5 percent respectively.

As seen in the Fuel Economy of U.S. Ford Vehicles by EPA Segment graphic (below), compared to the industry fuel economy average, Ford's 2010 model year U.S. vehicles rank better than average in four of 10 categories, worse in two and the same in four.

In Europe, we achieved a significant reduction in average vehicle CO_2 emissions of 8.1 g/km from 2008 to 2009. This was largely due to changed model mix, or selling a higher proportion of smaller cars, which was likely caused by the economic downturn in 2009. We have reduced the average CO_2 emissions of the vehicles we sell by 27.1 percent compared with a 1995 baseline and 6.7 percent compared to the 2006 model year.[1] We have achieved this through the introduction of a variety of innovations, such as advanced common rail diesel engines available across the European model range – including the ECOnetic range of low-CO_2 vehicles – and the use of lightweight materials.

These improvements – and progress in other regions – are the result of delivering on our climate change product strategy by introducing new vehicles and improving existing ones to deliver lower CO_2 emissions, along with better performance and features customers want. Some examples of actions by region are below. (Also see Improving Fuel Economy.)

Fuel Economy of U.S. Ford Vehicles by EPA Segment



Miles per gallon

	Industry			Ford		
	Minimum	Average	Maximum	Minimum	Average	Maximum
Compact cars	11	24	42	22	24	28
Large cars	12	19	25	19	20	22
Midsize cars	11	22	50	18	24	39
Midsize station wagons	18	21	25	21	21	21
Minicompact cars	13	22	32	-	-	-
Minivans	18	20	24	-	-	-
Small pickup trucks	15	19	24	15	19	24
Small station wagons	19	24	34	22	23	24
Special purpose vehicle	23	23	23	23	23	23
SUVs	12	19	32	14	20	32
Standard pickup trucks	14	16	22	15	16	17
Subcompact cars	12	22	32	17	20	23
Two seaters	10	19	36	-	-	-
Vans, cargo types	14	15	17	-	-	-
Vans, passenger type	14	14	14	-	-	-
Total	10	21	50	14	21	39

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North America

In North America, we continued to introduce new vehicles and technologies that offer outstanding fuel economy. For example, during 2009 and early 2010, we:

- Launched two new hybrid vehicles – the Ford Fusion Hybrid and Mercury Milan Hybrid – and announced the launch in 2010 of the Lincoln MKZ Hybrid, which will be the most fuel-efficient luxury sedan available in North America.
- Introduced the Transit Connect to North America, creating a new class of nimble commercial vans with outstanding fuel economy. The Transit Connect will be the basis for Ford's first 21st century battery electric vehicle.
- Prepared for the launch of our global compact car, the Ford Fiesta. When it launches in the United States in 2010, it is expected to have best-in-class fuel economy in its segment.
- Announced plans for the 2011 Mustang, which will be the first car ever to achieve 300-plus horsepower and 30-plus miles per gallon. The 2011 Ford Mustang equipped with a six-speed transmission and V6 engine is certified by the EPA at 31 mpg on the highway and 19 mpg in the city.
- Announced plans for the all-new Ford Explorer, which will have 25 percent better fuel economy than the previous model.

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Europe

Ford already offers one of the broadest low-CO_2 vehicle portfolios in Europe. With the launch of the new generation of the Focus ECOnetic,[2] we extended the availability of best-in-class or among-best-in-class, extremely low-CO_2 vehicles, which now include the following:

- The all-new Fiesta 1.6-liter 90 PS TDCi, available since January 2009, is the most fuel-efficient five-seat family car in the UK at 63.6 mpg, and it emits only 98 g/km of CO_2.
- The second generation of the Ford Focus ECOnetic, 1.6-liter 109 PS TDCi with conventional technology has class-leading 104 g/km CO_2 emissions (which corresponds to a fuel consumption of 4.0 l / 100 km).
- The second-generation Focus ECOnetic equipped with optional start/stop technology achieves 99 g/km CO_2, corresponding with a fuel consumption of 3.8 l / 100 km.
- A 139 g/km CO_2 Mondeo 1.8- and 2.0-liter TDCi (115–125 PS), since autumn 2008.

After the successful introduction of the new EcoBoost™ gasoline engine family in the United States, Ford will launch 2.0- and 1.6-liter EcoBoost engines in Europe in 2010. These turbocharged, direct-injection gasoline engines will deliver up to 20 percent better fuel economy and fewer CO_2 emissions compared to conventional gasoline engines.

In addition, our global electric vehicles plan is extending to Europe with five full electric or hybrid vehicles. Specifically, Ford will launch two zero-emission full battery electric vehicles, including the Transit Connect Electric light commercial vehicle in 2011 followed by the Ford Focus Electric in 2012. Three other vehicles – two next-generation gasoline hybrid vehicles and a plug-in hybrid – will be introduced in 2013.

Ford of Europe's innovative Product Sustainability Index (PSI) shows how the vision of sustainability can be made operational. By combining comprehensive sustainability criteria into the earliest stages of the product development process, Ford's PSI provides a ground-breaking design-for-sustainability tool. Designers can use it to assess the life-cycle CO_2 emissions of a vehicle, and consumers can use it to understand a vehicle's footprint.

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Asia Pacific

In our Asia Pacific and Africa region we are focusing our near-term fuel efficiency efforts on implementing EcoBoost engines and our PowerShift transmission technology, which we plan to introduce across our vehicle lineup in this region in the next few years. In China we will introduce the Ford Mondeo with an EcoBoost engine and PowerShift transmission in 2010. We expect it to be best in its segment for fuel economy when it launches. We also will be launching the Ford Fiesta with a 1.6-liter Ti-VCT powertrain and six-speed PowerShift transmission throughout our Asian markets. This vehicle will be the first in the "B-car" segment to offer consumers this level of sophistication in powertrain technology, and it will be among the leaders in its segment in fuel economy. In India, we recently introduced the Ford Figo, which has very fuel-efficient 1.4-liter TDCi diesel and 1.2-liter gas engine options. This introduction is highly significant to our success in India, as fuel economy is the most important criteria in purchase consideration in that country.

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South America

In South America, we are improving fuel economy by introducing some of the efficient engine and transmission technologies currently used in North America, and by using technologies specifically relevant to the widespread use of biofuels in Brazil. For example, we have implemented improved engine compression ratios – or the ratio in which the air and fuel mixture is compressed in the engine combustion chamber – on flexible-fuel vehicles in Brazil. This optimizes fuel efficiency in vehicles using biofuels, which have a higher octane rating than petroleum-based gasoline. We have also improved the gearing ratios and aerodynamics of our South American models, further increasing fuel economy, and we will introduce a more fuel-efficient engine in the Focus in 2010.

The figures below show how we are leveraging complementary technologies to cut CO_2 emissions significantly.

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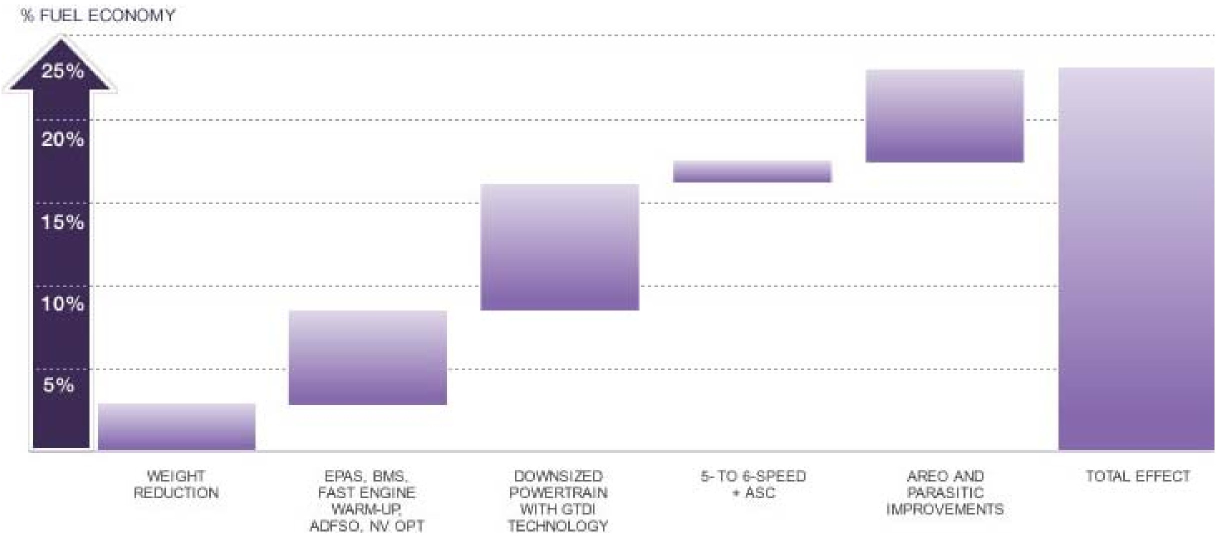
Typical Near-Term Fuel Economy Improvements

Midsize Utility



Small Car

For an explanation of the terms used in these figures, see the glossary.

Please note that improvements in fuel economy resulting from the use of the technologies identified in the above charts are often not additive or linear. The charts depict approximate percentage improvements estimated for particular technologies in a generic vehicle; actual improvements will vary depending on the characteristics of each specific vehicle.

1. These data do not include Volvo.

2. ECOnetic vehicles are only available in Europe. The ECOnetic fuel economy calculations are based on European Fuel Economy Directive EU 93/116/EEC, which uses European drive cycles. They differ from fuel economy calculations developed in the United States and other regions of the world.

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Fuel

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To reduce the life-cycle GHG emissions to the levels required for CO_2 stabilization requires the development of fuels with lower fossil carbon content,[1] in order to augment the improvements in the fuel economy of our vehicles.

Electrification

Running vehicles partly or wholly on electricity reduces or eliminates CO_2 and other emissions from the vehicles and shifts the emissions to the electricity generation facility. The overall emission benefits depend on the fuel or mix of fuels used to make the electricity. Electrification addresses both energy security and climate change concerns because electricity can be made from a wide variety of fuels, including domestic sources and renewable energy. It also offers flexibility in tailoring lower-carbon solutions based on locally available fuels and technology options like carbon capture and storage. Our plans to introduce electric vehicles include the following:

- We will introduce the Transit Connect battery electric vehicle, a compact commercial utility van, for sales to fleets in North America in 2010 and then to Europe in 2011.
- By 2011, we will bring a battery electric Ford Focus to North America and then to Europe in 2012.
- We will introduce our next-generation hybrid technology and plug-in hybrid vehicles in North America in 2012 and in Europe in 2013.

Expanding electrification holds tremendous promise, but a range of implementation challenges must be considered. These challenges relate to cost, battery technology, the development of charging infrastructure, the interface with utilities and how to ensure that potential emissions-reduction benefits are realized. We have partnered with the U.S. Department of Energy, the Electric Power Research Institute, the New York State Energy Research and Development Authority and Southern California Edison to explore these and other issues involved in expanding the use of plug-in hybrid electric vehicles. This partnership was expanded in early 2009, and through it Ford has supplied plug-in vehicles to 10 additional partners for real-world testing:

- Alabama Power of Birmingham, Alabama, and its parent, Atlanta-based Southern Company
- American Electric Power of Columbus, Ohio
- Consolidated Edison of New York
- DTE Energy of Detroit, Michigan
- Hydro Quebec
- National Grid of Waltham, Massachusetts
- New York Power Authority
- New York State Energy and Research Development Authority
- Pepco Holdings
- Progress Energy of Raleigh, North Carolina

Electrification issues and our partnerships are discussed in more detail in the Electrification section.

Biofuels

Biofuel use is expanding globally, with bioethanol made from corn, beets or sugar cane substituting for gasoline, and biodiesel derived from plant oils substituting for diesel fuel. In the United States, 2007 legislation expanded the Renewable Fuel Standard (RFS), mandating a significant increase in the use of biofuels by 2022.

While current corn-based bioethanol production in the United States is estimated to provide a modest reduction in vehicle GHG emissions on a well-to-wheels basis, next-generation biofuels such as lignocellulosic bioethanol could offer up to a 90 percent GHG reduction benefit. Building a substantial fleet of flexible-fuel vehicles (FFVs) provides a bridge to the widespread use of lower-carbon biofuels in the future.

Ford has a long history of developing vehicles that run on renewable biofuels. We produced the first flexible-fuel vehicle approximately 100 years ago: a Model T capable of running on gasoline or ethanol. Globally, Ford offers 14 models in the United States, Europe, Asia and South America that can run on E85, a blend of up to 85 percent bioethanol mixed with gasoline. Ford has manufactured more than five million FFVs, including 2.5 million in the United States and nearly 2 million in Brazil.

In Europe, Ford is a market leader and pioneer in bioethanol-powered FFVs, with more than 70,000 vehicles delivered to customers since 2001. Ford FFV models are now available in 17 European markets, with Sweden, Germany, the Netherlands, Spain and France showing the strongest demand.

In the United States, we have committed to doubling the number of FFVs in our lineup by 2010. Assuming continuing incentives that encourage the manufacture, distribution and availability of renewable fuels and the production of FFVs, we stand ready to expand FFV output to 50 percent of total vehicle production by 2012.

Alternative fuels pose a classic chicken-and-egg problem – automakers can produce a range of products capable of running on fuels with varying carbon content, but the benefits are only realized if energy providers bring the fuels to market and consumers demand both the vehicle and the fuel.

In the long term, we believe that next-generation biofuels made from a variety of feedstocks, including agricultural wastes (particularly lignocellulosic material) will be an important part of the GHG emission-reduction equation and will help address concerns about current-generation biofuels, including the potential competition between food and fuel crops and the conversion of natural lands to fuel production. These issues are explored in more detail in the Sustainable Technologies and Alternative Fuels Plan.

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1. Of course, there is not only a need to reduce the fossil carbon content of the fuel itself, but to reduce any fossil-based CO_2 emitted during feed-stock excavation, fuel production and distribution.

2. *Ethanol: The Complete Lifecycle Picture*, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, March 2007.

Driver

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Fordmotorcompany.com:

Eco-Driving: Ten Easy Tips for Saving Fuel

External Web Sites:

Driving Skills for Life: Eco-Driving

Paradoxically, the "driver" portion of the GHG emissions equation holds the potential for substantial emission reductions at minimal cost, but it is often overlooked. Ultimately, drivers decide which vehicles and fuels they will purchase and how those vehicles will be driven. While our major focus is on the vehicles we make, we have also reached out to drivers around the world to promote the practice of "eco-driving." We do this by providing training, information and vehicle technology that helps drivers learn how to drive using the least fuel possible.

Information Technology

The Ford Fusion Hybrid and Mercury Milan Hybrid come equipped with Ford's award-winning SmartGauge™ with EcoGuide digital instrument cluster. SmartGauge is designed to coach Ford hybrid owners to maximize fuel efficiency. High-resolution, full-color LCD screens can be configured by the driver to show different levels of information, including fuel and battery power levels, as well as average and instant miles per gallon. The technology gives the customer real-world feedback to make the most of their hybrid, acting as a good "coach" and engaging drivers in real time to help them achieve maximum fuel economy.

In Europe, the Ford EcoMode system that was first presented in the new Focus ECOnetic has been made available in a wider range of vehicles. Like SmartGauge, Ford EcoMode is an all-new driver information system that helps to educate the driver to achieve improved real-world fuel economy. The system will be implemented as an option in more European Ford models in the future.

In early 2010, Ford announced that its new in-vehicle system – MyFord Touch™ – will offer an array of real-time information on fuel-economy performance that can coach drivers to get more miles to the gallon and save on fuel costs. In addition, MyFord Touch's map-based navigation system offers an Eco-Route option that quickly calculates the most fuel-efficient route a driver can take to get from A to B. Ford testing shows that Eco-Route can help achieve fuel economy gains of up to 15 percent. MyFord Touch launches this summer on the 2011 Ford Edge and will be available globally on the 2012 Ford Focus. MyLincoln Touch will be standard equipment on new Lincoln vehicles beginning with the 2011 Lincoln MKX.

Eco-Driving Information and Training

Ford has demonstrated that drivers who practice "eco-driving" can improve their fuel economy by an average of 24 percent. Eco-driving tips are available to the public on Ford's website, and online training is available through the Ford Driving Skills for Life (FDSFL) program. In addition, a web-based eco-driving program has been available to all U.S. salaried Ford employees since 2006.

Ford began work on the eco-driving concept in 2000, when we first offered an eco-driving program through our German dealerships, in partnership with the German Federation of Driving Instructor Associations and the German Road Safety Council. That program trains drivers in conservation-minded driving and vehicle maintenance habits. It uses specially trained and certified instructors to run programs for several target groups, including fleet drivers and customers. By the end of 2009, more than 16,000 German drivers had been "eco-trained" under real-world conditions.

In Asia, Ford launched the FDSFL driver training program in 2008 with a "train-the-trainers" workshop in Bangkok, Thailand, in March. At the workshop, Ford professionals from Germany trained two to three representatives from the Philippines, Vietnam, Thailand and Indonesia. The FDSFL program was customized to address the higher average age of beginner drivers in the region, as well as the unique driving environments within each market. It places equal emphasis on safe driving and eco-driving, as customers in the region are interested in both.

In 2009, we continued with the successful roll-out of the program to additional markets. FDSFL is now in Indonesia, the Philippines, Thailand, Vietnam, China, Taiwan and India. During 2009 in these markets, Ford provided training for roughly 11,000 licensed drivers and several thousand Ford India employees.

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Facilities

Ford has been a leader in facilities-related GHG and energy-use reductions, public reporting of our GHG emissions, and participation in GHG reduction and trading programs. Between 2000 and 2009, we:

- Reduced global energy consumption by 44 percent
- Reduced energy consumption per vehicle by 17.7 percent
- Reduced our total facilities-related carbon dioxide emissions by approximately 50 percent, or 4.8 million metric tons
- Reduced facilities-related CO_2 emissions per vehicle by 27 percent

In 2009, Ford improved energy efficiency in its North American operations by 4.6 percent, resulting in savings of approximately $15 million. To drive continued progress, we have set targets to improve our facility energy efficiency by 3 percent globally and 3 percent in North America in 2010.

These improvements have resulted from a sustained focus on improving energy efficiency. In early 2010, for example, we implemented a PC power management system to power down all of our desktop and notebook computers at night. We expect the program to reduce our annual energy costs by $1.2 million and our annual CO_2 emissions by 16,000 to 25,000 metric tons.

In several locations, we are using renewable energy to provide power and cut CO_2 emissions. Ford's Dagenham Diesel Centre in the UK, for example, was the first automotive plant in the world to obtain all of its electrical power needs from two on-site wind turbines, which have been in operation since 2004. A third two-megawatt wind turbine will be installed at Dagenham in 2010. In November 2009, we began powering the Genk, Belgium, plant with two wind turbines which will provide a significant portion of the plant's electrical power needs.

The U.S. Environmental Protection Agency and U.S. Department of Energy awarded Ford a 2010 Energy Star Sustained Excellence Award, which recognizes Ford's continued leadership and commitment to protecting the environment through energy efficiency. This is Ford's fifth consecutive year winning this prestigious award. For more information on our energy efficiency and renewable energy programs, please see the Environment section.

RELATED LINKS
This Report:
Operational Energy Use and Greenhouse Gas Emissions

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Logistics

Our logistics operations provide for the safe and efficient transport of parts from our supply base to our manufacturing plants and of finished vehicles from the end of our assembly lines to our dealerships. Though logistics accounts for a relatively small percentage of total vehicle life-cycle emissions, we are working hard to maximize the efficiency of these operations to reduce costs and environmental impacts. We have taken steps to quantify the CO_2 footprint of our logistics operations and reduce it through a variety of measures, such as shifting to rail and sea shipping and other efficiency measures. Please see the Environment section for more details.

RELATED LINKS
This Report:
Supply Chain: Logistics

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Supply Chain

In 2009 and early 2010, we took significant steps to better understand the risks and opportunities of GHG regulation and climate change for our suppliers and, by extension, for Ford. We have worked hard to reduce GHG emissions from our products and operations, which enhances our competitiveness, and we hope to help promote similar competitiveness throughout the automotive supply chain.

Ford has signed on to be a "road tester" of the World Resources Institute/World Business Council for Sustainable Development's Scope 3 Greenhouse Gas Reporting Protocol. Ford road tested the widely used and respected Scope 1 (direct GHG emissions) and Scope 2 (indirect emissions, e.g., from electricity production) protocols. The Scope 3 protocol covers outsourced activities, supplier manufacturing and product use. The draft standards were developed through a global, collaborative multi-stakeholder process, with participation from over 1,000 volunteer representatives from industry, government, academia and nongovernmental organizations. The road testing process will provide real-world feedback to ensure the standards can be practically implemented by companies and organizations from a variety of sectors, sizes and geographic areas around the world. The final standards are scheduled to be published in December 2010. Ford's contribution will be to request data from selected Tier 1 production suppliers, representing close to 30 percent of Ford's $65 billion in annual procurement spending, and to provide feedback on practical aspects of using the protocol.

Ford has also joined the Carbon Disclosure Project's Supply Chain initiative. Through this effort, Ford is working with selected suppliers to gather qualitative as well as quantitative information about the suppliers' climate risks and emissions and how they are managing them.

RELATED LINKS

External Web Sites:

WRI/WBCSD Greenhouse Gas Protocol

Carbon Disclosure Project Supply Chain Initiative

Climate Change Policy and Partnerships

During 2009, the climate change policy landscape continued to evolve. The recession put economic issues at the top of government and public agendas. The Copenhagen summit fell short of producing a binding global agreement, and climate change legislation did not pass the U.S. Congress.

In the United States and elsewhere, we continue to actively advocate for comprehensive policy approaches that will provide a coherent framework for greenhouse gas (GHG) emission reductions, so that companies can move forward in transforming their businesses with a clear understanding of their obligations. GHG regulations can have a critical impact on an automaker's business, because they can have the effect of regulating what vehicles we are allowed to build and sell. Carbon dioxide (CO_2) emissions standards for motor vehicles are functionally equivalent to fuel economy standards, because the amount of CO_2 produced by a vehicle is proportional to the amount of fuel used.

Our global approach to product planning and policy participation is based on the science of climate stabilization. We accept that simply "not getting worse" is not good enough. The auto industry must work together with suppliers, government, the fuel industry and consumers to reduce CO_2 levels from transportation so we can help stabilize atmospheric CO_2 concentrations. Accomplishing this goal will require that all sectors of the economy, including the transportation sector, do their share. To achieve real and lasting results, all global stakeholders must make long-term commitments for a sustainable future.

In our major markets, the regulation of fuel economy and/or vehicle CO_2 emissions is becoming increasingly complex. In addition to competing federal and regional regulations, governments are taking diverse approaches to incentives for emission reduction through rebates, fees, "feebates," privileges for low-emitting vehicles and penalties for high-emitting vehicles. This creates a very complex policy environment, and it is one important driver of our strategy to develop fuel-efficient and advanced technology platforms that can be shared globally and tailored to the needs of our customers.

We hope that the information that follows helps to illustrate the diverse array of GHG and fuel economy regulations and incentives that are now shaping our markets. This section provides more detail on developments and Ford's involvement in:

- U.S. policy
  - Climate change legislation
  - Greenhouse gas and fuel economy regulation
  - Incentives and market-based mechanisms
- European policy
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- Asia Pacific policy
- South American policy
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U.S. Policy

ON THIS PAGE
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RELATED LINKS

External Web Sites:
- U.S. Climate Action Partnership
- National Highway Traffic Safety Administration
- California Air Resources Board

Climate Change Legislation

In the United States, the policy debate surrounding climate change intensified in 2009, particularly at the end of the year. Among other developments: the U.S. government took an active role in the Copenhagen climate negotiations; Senator Cantwell introduced legislation that would cap greenhouse gases (GHGs) and return revenues from the program back to U.S. citizens; Senator Murkowski introduced an amendment that would have prevented the U.S. Environmental Protection Agency (EPA) from regulating greenhouse gases under the Clean Air Act; and Senators Kerry, Lieberman and Graham proposed a framework outlining principles for a comprehensive approach to climate and energy legislation.

Ford has been one of the more supportive companies on climate policy for some time. In 1999, we discussed greenhouse gases in our first corporate citizenship report. In late 2005, we published a special report on the Business Impact of Climate Change, and in 2007 we joined the United States Climate Action Partnership (USCAP) to support the prompt enactment of climate legislation.

These experiences, as well as our participation in carbon markets globally, have helped to shape Ford's position on climate policy. The linked issues of climate change and energy security create an urgent need to transform the country's economy into one with lower greenhouse gas emissions, higher energy efficiency and less dependence on fossil fuels and foreign oil. This transformation will require changes in all sectors of the economy and society. A comprehensive legislative framework is needed to spur these changes.

We believe we need a national, market-based approach to reducing GHG emissions if the United States is going to reduce emissions at the lowest cost per ton. Thus, we support the creation of an efficient, economy-wide cap-and-trade framework with mechanisms to avoid unintended adverse effects on the economy. An economy-wide cap-and-trade program would provide flexibility to regulated entities while allowing market mechanisms to determine where GHG reductions can be achieved at the lowest cost. The environment doesn't care where reductions occur, but the economy does, and given the potentially high cost of abatement, it is important to achieve the lowest cost possible.

This position is consistent with that of USCAP, a group of businesses and leading environmental organizations that have come together to call on the federal government to quickly enact strong national legislation to require significant reductions of GHG emissions.

Ford has been criticized for taking this position. On one side of the argument, some stakeholders do not think Ford should be supporting climate legislation and question our membership in groups like USCAP. To those, we say that without a cohesive national energy and climate policy that places a price on carbon, we could be caught in a cycle of starting and stopping technology development. That is simply not good policy or good business, particularly when the technology development requires billions of dollars of investment. We need predictability in order to plan our products.

On the other side are stakeholders who urge Ford to be more aggressive and want us to drop out of groups like the U.S. Chamber of Commerce that may have views and actions on climate change that potentially conflict with Ford's position. To them we say that despite differences on this specific issue, Ford has not changed its position on climate change.

The Chamber has been a critical ally on a broad range of business and environmental issues important to Ford and the global auto industry, including the One National Program, vehicle scrappage program, trade issues, anti-counterfeiting parts actions and legal reforms. It is important to our business, our customers and other stakeholders that we remain a member of the Chamber.

Yet Ford will always speak with its own voice. We will do so on climate change (and other issues, for that matter) where it is essential to our business that we articulate our position separately from that of any association of which we are a member.

We believe our position on climate change is very clear. You know it by our actions. You see it in our commitment to reduce the CO_2 emissions from both our products and facilities. Bottom line – we are doing what's right for our customers and the environment.

We will continue to advocate for effective climate change policies that drive down GHG emissions and provide a framework for sound business and product planning.

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Greenhouse Gas and Fuel Economy Regulation

Since our last report, a number of significant developments have taken place in the United States with respect to regulatory programs that would set greenhouse gas emissions or fuel economy standards for motor vehicles.

- In May 2009, President Obama announced an agreement in principle among the EPA, the National Highway Traffic Safety Administration (NHTSA), the state of California and the automotive industry to implement a National Program for motor vehicle greenhouse gas and fuel economy standards.
- In September 2009, the EPA issued a final rule mandating greenhouse gas reporting. The rule requires facilities that emit 25,000 metric tons or more carbon dioxide equivalent per year to submit annual reports to the EPA. It also imposes new reporting requirements on heavy-duty engine and vehicle manufacturers, who must measure and report CO_2 beginning in the 2011 model year, methane in the 2012 model year, and N_2O in the 2013 model year.
- In December 2009, the EPA finalized its endangerment finding that greenhouse gas concentrations in the atmosphere threaten public health and the welfare of current and future generations. This finding is a prerequisite to establishing federal regulations for greenhouse gas emissions.
- On April 1, 2010, the EPA and NHTSA published a joint final rule that implements the National Program agreement by establishing harmonized Corporate Average Fuel Economy and greenhouse gas emissions standards for the 2012 to 2016 model years. The standards target an overall industry fleet-wide average for fuel economy of 35.5 mpg (250 g/mi CO_2). After the 2016 model year, the standards are expected to increase year-over-year, approaching 40 mpg by 2020.
- The EPA and NHTSA are planning to set greenhouse gas and fuel economy standards for medium- and heavy-duty trucks. The EPA plans to publish draft greenhouse gas regulations for these vehicles in mid-2010, with a phase-in beginning in 2014 model year, while NHTSA's fuel economy standards are not expected to take effect until the 2016 model year. The focus will be on complete vehicles with 8,500–14,000 lb. gross vehicle weight rating.

The finalization of the National Program for fuel economy and greenhouse gas emissions sets the regulatory path forward that we need to carry out our plans and achieve the goals of improved fuel efficiency, increased energy security and reduced GHG emissions. The National Program will employ an attribute-based vehicle target-setting methodology, which allows manufacturers to build a single light-duty fleet that would satisfy all of the requirements under both programs.

From an environmental standpoint, the National Program avoids a patchwork of competing state and federal regulations that would have led to unnecessary duplication, market disruption and increased compliance costs. This program addresses our concerns about state-by-state overlapping and competing regulations.

The National Program also gives us flexibility to meet the final standards by making the progression toward the 2016 goal more linear, allowing us the time needed to phase in advanced technology on future models. The National Program also allows for fleet averaging on a nationwide basis, which is critical to vehicle manufacturers. Since a manufacturer's fleet mix at the state level can vary considerably from its overall national fleet mix, state-specific standards would likely lead to product restrictions and reduced consumer choice in some states. Nationwide fleet averaging avoids this problem with no loss of environmental benefits.

We support the manner in which President Obama and the federal agencies have harmonized fuel economy and greenhouse gas emissions rules into a single National Program. Ford views the One

National Program as a significant and positive step for all stakeholders toward our common goals of energy security and reduced greenhouse gas emissions. We are committed to working constructively with the Obama administration, Congress and federal regulators at NHTSA and EPA toward the implementation of One National Program beyond the 2016 model year.

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Incentives and Market-Based Mechanisms

In June 2009, the U.S. Congress passed and the President approved a "Cash for Clunkers" program. For two months over the summer, the program provided a popular consumer incentive for trading in a less fuel-efficient vehicle for a new, more fuel-efficient one. The Ford Focus and Ford Escape were among the top new vehicles purchased in the Cash for Clunkers program. Ford increased production to meet demand and saw sales rise significantly during those months. Ford supported the legislation, as did several associations of which it is a member, including the Alliance of Automobile Manufacturers and the U.S. Chamber of Commerce. The benefits of this program in terms of reduced fuel consumption and lower carbon emissions from the vehicle fleet have been significant and will be realized over the coming years as these more-efficient vehicles continue to operate.

Ford also supports comprehensive legislation that will create a price signal for consumers. Thoughtful and comprehensive national energy and climate policy that places a price on carbon is needed to support the billions of dollars being invested into low-carbon and fuel-efficient vehicle technologies. Without a cohesive policy that includes a price signal, we could be caught in a cycle where development of the advanced technologies needed to help address climate change and energy security is sporadic.

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European Policy

During 2009, the EU finalized CO_2 car targets based on car weight, part of an ambitious European energy and climate change package to which the industry will continue to contribute. The European auto industry is ready to meet the new law's standards for passenger cars, despite the sudden dramatic economic downturn that has severely limited the resources available to respond.

Under the new rules, manufacturers are required to ensure that the industry average fleet CO_2 emissions – for all the vehicles they make that are registered in the EU – are below 130 g/km. In 2012, 65 percent of each manufacturer's fleet must comply with this target. The percentage increases to 75 percent in 2013, 80 percent in 2014 and 100 percent in 2015. The long-term target for CO_2 emissions is set to 95 g/km; it will be reviewed again in 2013.

This approach gives the auto industry the necessary lead-time to adjust its development and production cycles to the legal requirements and to limit the financial risks caused by largely unpredictable factors, including consumer preferences, market trends, economic developments and legal requirements in different fields.

In some member states, CO_2 taxation is in place to encourage the early introduction of low-CO_2 vehicles with major tax break points, often around 100 g/km, 120 g/km and 160g/km. Unfortunately, these tax break points are not harmonized between the European countries.

Commercial vehicle targets have also been proposed of 175 g CO_2/km (with phase in during 2014 to 2016, with 75 percent of the fleet to comply in 2014, 80 percent in 2015 and 100 percent in 2016) and 135 g CO_2/km in 2020 for commercial vehicles. European policy makers are now urged to perform a thorough analysis of the proposal's impact on the economy, employment and the environment, in particular with regard to the long-term target.

The industry will continue to invest heavily in research and development and new product programs in order to reach the short-term targets. The long-term target will require technological breakthroughs, new refuelling infrastructure and a swift renewal of the car fleet on Europe's roads.

Canadian Policy

In April 2010, Environment Canada released a draft greenhouse gas emissions regulation for 2011 to 2016 model year passenger automobiles and light trucks. This proposal attempts to align emission standards and test procedures with those of the United States. The proposal provides companies with similar compliance flexibilities to those available under the EPA's GHG proposal, including advanced technology credits, air conditioning leakage and efficiency credits, flexible-fuel vehicle credits through the 2015 model year, and credit transfer among fleets. A final rule is expected to be published in 2010.

The Provinces of Quebec and British Columbia are participants in the Western Climate Change Initiative and have committed to follow California's lead on vehicle CO_2 regulation. Quebec has adopted a GHG regulation based on the California standards, but California has agreed to defer to the U.S. federal program for the 2012 to 2016 model years. We are hopeful that, like California, the provinces will see the benefit of a single continental standard that includes the United States and Canada. Ford has participated in regulatory discussions on this issue, providing technical expertise and supporting a tough aligned standard.

Asia Pacific Policy

In Ford's Asia Pacific and Africa region, sales in China are growing rapidly. Economic growth is a key priority of the Chinese government, to be balanced with energy security and a cleaner environment.

The China Automotive Technology and Research Center released for comment a draft national standard on the Stage III fuel economy limits for passenger cars, with phase-in of implementation targeted for the 2012 model year. During the phase-in period, the ratio of the Corporate Average Fuel Consumption to the Target Corporate Average Fuel Consumption must meet a declining ratio from 109 percent in 2012 to 100 percent in 2015.

The Chinese government provides limited incentives for electric vehicle fleet purchasers under local government control in 13 cities initially, with plans to expand to others up to 2012. Diesel use is discouraged in passenger car applications in the near term, due to fuel availability concerns.

Japan, South Korea and Taiwan have released new or modified fuel economy limits, while Hong Kong, South Korea and Taiwan have linked tax incentives to fuel economy and CO_2 targets.

South American Policy

In Brazil, our largest South American market, the use of biofuels is a national policy, with 100 percent of gasoline blended with 20 to 25 percent ethanol, and extensive use of pure ethanol as motor fuel. Most new vehicles are designed to accommodate varying amounts of ethanol. A minimum of 5 percent biodiesel must be added to diesel. Emission requirements are periodically updated by an emissions-control program. A voluntary fuel economy labeling program is also in place. A star ranking for light vehicles was recently introduced, favoring low-emission, low-CO_2, ethanol, flexible-fuel or hybrid vehicles. Diesel use in light vehicles under 1.0 ton payload is not allowed, except for combined usage vehicles with special off-road characteristics. The government is also studying incentives for hybrids and electric vehicles.

Ford has supported the region's biofuels initiatives since the 1970s and offers a wide range of vehicles capable of running on 100 percent ethanol. We also provide light- and heavy-duty vehicles that meet biodiesel requirements.

Renewable Fuel Policies

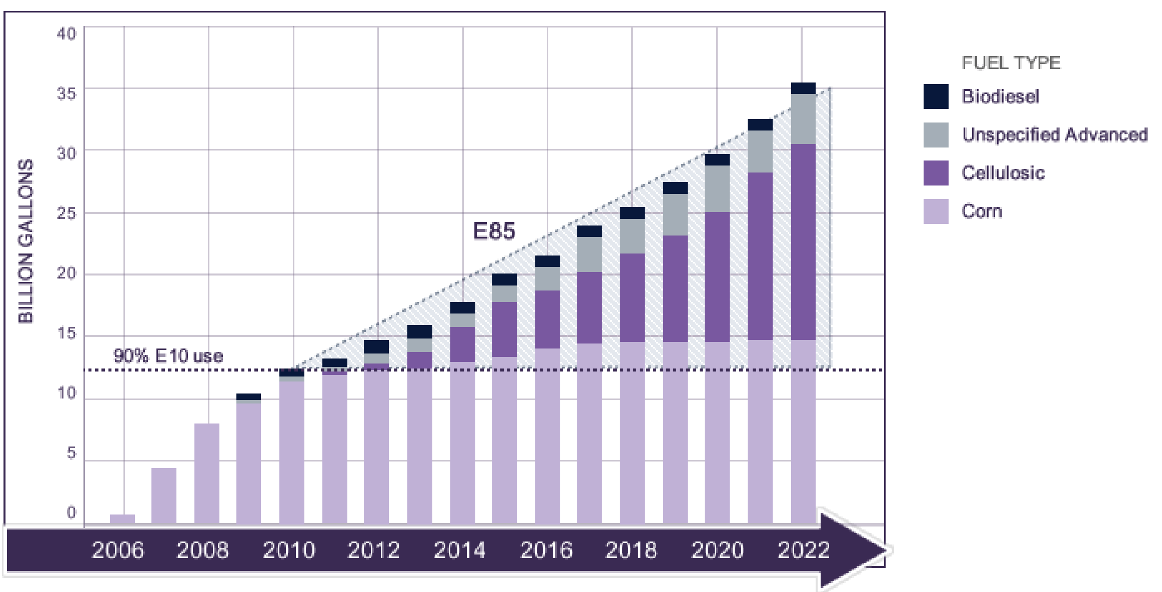
Today, more than 80 percent of global oil reserves are limited to 10 countries, while biofuels made from sugarcane can be produced in more than 100 countries. First-generation biofuels are playing an important role in building consumer awareness and spurring capital investment in infrastructure and facilities that can be used for more promising second-generation biofuels.

Policies across the globe are aimed at increasing the use and availability of biofuels. The United States adopted the Renewable Fuel Standard requiring 36 billion gallons of biofuels by 2022, including more than 20 billion gallons of low-carbon advanced biofuels. The EU Renewable Energy Directive establishes a 10 percent renewable energy target for transportation energy in 2020. And Brazil has had a very aggressive domestic ethanol program for years.

But these policies aren't enough. Providing value is critical to engage consumers and get them to use alternative energy sources. Hundreds of millions of vehicles in operation today were designed to use ethanol blends containing less than 10 percent ethanol, and our transportation energy infrastructure was set up to deliver petroleum-based fuels.

Ford is a leader in providing vehicles that can operate on biofuels. We are expanding our offerings of flexible-fuel vehicles because of the tremendous opportunities with biofuels. Ford's vision for biofuels is for them to be an alternative to gasoline rather than simply a gasoline additive – where accelerated use of renewable fuels delivers increased energy security, enhances economic development and helps to address climate change. This vision will require rapidly expanding the number of vehicles that can operate on biofuels, increasing the number of stations offering biofuels, developing the fuel distribution network to support customer choice and value, and achieving technology breakthroughs to commercialize advanced biofuels.

U.S. Renewable Fuel Standard



Partnerships and Collaboration

Addressing the linked issues of climate change and energy security requires an integrated approach – a partnership of all stakeholders, including the automotive industry, the fuel industry, other industries and enterprises, governments and consumers. It will also require the best thinking from all of these sectors.

Ford is involved in numerous partnerships and alliances with universities, coalitions, nongovernmental organizations and other companies to improve our understanding of climate change. For example, Ford is:

- A member of USCAP, an alliance of major businesses and leading climate and environmental groups that have come together to develop an economy-wide, market-driven approach to reduce greenhouse gas emissions, as discussed in the U.S. Climate Change Legislation section.
- Working closely with BP to explore vehicle technologies and low-carbon fuel technologies.
- A founding member of the Carbon Mitigation Initiative at Princeton University to study the fundamental scientific, environmental and technical issues related to carbon management.
- A charter member of the Sustainable Transportation Energy Pathways Program at the University of California, Davis Institute of Transportation Studies, which aims to compare the societal and technical benefits of alternative sustainable fuel pathways.
- A member of the Massachusetts Institute of Technology's Joint Program on the Science and Policy of Global Climate Change.

Our participation in these and other partnerships helps us to formulate improved strategies for products and policies that will in turn help to address climate change and energy security. The following are links to the above organizations and others with which we cooperate on climate change issues:

- 25x'25 (Energy Future Coalition)
- BP
- Center for Clean Air Policy's Climate Policy Initiative
- Diesel Technology Forum
- Governors' Ethanol Coalition
- Harvard University, Belfer Center for Science and International Affairs
- MIT Joint Program on the Science and Policy of Global Change
- Growth Energy
- Princeton University's Carbon Mitigation Initiative
- United States Climate Action Partnership
- University of California at Davis, Institute of Transportation Studies Sustainable Transportation Energy Pathways Program
- Worldwide Business Council for Sustainable Development
- World Resources Institute

Emissions Trading

Emissions trading is a key tool in both voluntary and mandatory greenhouse gas emissions-reduction programs. Ford was an early participant in carbon markets, with a goal of gaining experience that will be valuable in an increasingly carbon-constrained world.

For example, Ford, along with 11 other companies and the City of Chicago, founded the Chicago Climate Exchange (CCX) in 2003. The CCX is a GHG emissions-reduction and trading program for emission sources and projects in North America. It is a self-regulated, rules-based exchange designed and governed by CCX members. Ford is the first and only auto manufacturing participant in the Exchange.

Through the CCX, we committed to reducing our North American facility emissions by 6 percent between 2000 and 2010. The Exchange marks the first time in the United States that major companies in multiple industries have made a voluntary binding commitment to use emissions trading to reduce their North American GHG emissions. The Exchange enables participants to receive credit for their reductions and to buy and sell credits to find the most cost-effective way of achieving reductions.

Ford was also one of the original companies to join the UK Emissions Trading Scheme, the first government-sponsored, economy-wide, cross-industry GHG trading program. Ford Motor Company Limited (UK) entered the program in March 2002, committing to and achieving a 5 percent CO_2 reduction for eligible plants and facilities over five years.

Ford now participates in the EU Emission Trading Scheme, which commenced in January 2005 and is one of the policies being introduced across Europe to reduce emissions of carbon dioxide and other greenhouse gases. The second phase of this program runs from 2008 to 2012 and coincides with the first Kyoto Commitment Period. Additional five-year phases are expected to follow.

Despite Ford facilities' low-to-moderate CO_2 emissions (compared to other industry sectors), the EU Emission Trading Scheme regulations apply to eight Ford and Volvo facilities in the UK, Belgium, Sweden and Spain. The trading scheme requires us to apply for emissions permits, meet rigid emissions monitoring and reporting plans, arrange for third-party verification audits and manage tax and accounting issues related to emissions transactions.

Ford is actively involved in an ongoing evaluation of the EU Emission Trading Scheme at both EU and member-state levels. We have used the experience gained from participating in the market-based mechanisms described above to ensure that we operate in compliance with the scheme's regulatory framework. Ford anticipated the start of the EU Emission Trading Scheme and established internal business plans and objectives to maintain compliance with the new regulatory requirements.

Comprehensive reporting forms the foundation for all emissions trading. We voluntarily report GHG emissions in Australia, Canada, China, Mexico and the Philippines. This reporting, which has won several awards, is discussed in the Environment section.

RELATED LINKS

External Web Sites:
- Chicago Climate Exchange
- EU Emissions Trading Scheme

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Vehicle Web Sites:

Ford Fusion

Ford Escape

Ford Focus

Ford Transit Connect

Mercury Milan

Mercury Mariner

During 2009, most major global automakers, including Ford, announced plans to make all-electric vehicles. Utilities are also working to understand how to provide power to plug-in electric vehicles in a way that is effective in meeting consumer needs, efficient for electricity providers and environmentally sound.

Why the rise in interest and activity? The electrification of vehicles could cut greenhouse gas (GHG) emissions from vehicles, increase the use of domestic energy sources, decrease pressure on petroleum stocks and reduce urban air pollution. With the benefit of information technologies and "smart grids," electrified automobiles could also improve the efficiency of the power grid – thereby lowering electricity costs – and facilitate the use of renewable energy sources, such as wind and solar.

But many challenges remain. For example, to fulfil their potential to cut lifecycle GHG emissions from automobiles, low-carbon electric generation must make up a greater part of the total supply, and electric vehicles must become functioning parts of "smart grids." Battery technologies are still evolving, and the cost of new-generation batteries remains high. Securing adequate supplies of lithium, rare earth metals and other materials may also pose social and environmental challenges.

This section provides an overview of Ford's electrification strategy. It also explores electrification technologies and their environmental benefits, and discusses how Ford is addressing key challenges and opportunities related to vehicle electrification. For more details on our electric vehicle technologies and other fuel-efficiency, advanced powertrain and alternative fuels technologies, please see the Sustainable Technologies and Alternative Fuels Plan.

Ford's Electrification Strategy

Ford's electrification strategy foresees a future that includes different types of electrified vehicles, depending on customers' needs. There will not be a one-size-fits-all approach, but a more diverse, smart application of different types of electrified vehicle technologies. Our strategy includes the following.

Bring a Range of Electric Vehicles to Market

Ford already offers four hybrid electric vehicles (HEVs): The Ford Escape Hybrid, Mercury Mariner Hybrid, Ford Fusion Hybrid and Mercury Milan Hybrid. These HEVs are ideal for customers who drive a range of distances in varied driving conditions. Their most significant benefits come under urban stop-and-go driving conditions.

In 2009, we announced plans to introduce two battery electric vehicles (BEVs) in North America. We will introduce a BEV version of the Transit Connect utility van, targeted at commercial markets, in 2010. We are developing this vehicle in partnership with Azure Dynamics Vehicles, a leading electric adapter of commercial vehicles. In 2011, we will introduce a Focus BEV, called the Focus Electric, developed with our strategic supplier Magna International. Both of these BEVs will be ideal for customers who routinely travel relatively short distances (e.g., 80–100 miles) between charges.

Below is a detailed look at the components that will make up the new electrified vehicles.

FORD ALL-ELECTRIC VEHICLE

1. Motor Controller and Inverter
2. High Voltage Electric HVAC Compressor
3. Electric Water Pump
4. Traction Motor
5. Electric Power Steering

6. Gearbox
7. Modular Powertrain Candle
8. Electric Vacuum Pump
9. High Voltage PTC Electric Coolant Heater and Controller
10. Vehicle Control Unit
11. Battery Pack and Battery Cells
12. AC Charger
13. DC-DC Converter

* Image based on prototype, not production vehicle.

1 Motor Controller and Inverter

The motor controller monitors the motor's position, speed, power consumption and temperature. Using this information and the throttle command by the driver, the motor controller and inverter convert the DC voltage supplied by the battery to three precisely timed signals used to drive the motor.

2 High Voltage Electric HVAC Compressor

The high voltage air conditioning system is specifically designed for hybrid vehicle applications, drawing electrical energy directly from the main battery pack. An inverter is included in the compressor.

3 Electric Water Pump

The electric drive water pump circulates coolant for the traction motor, inverters, battery and heater.

4 Traction Motor

The traction motor performs the conversion between electrical and mechanical power. Electric motors also have efficiencies three times higher than that of a standard gasoline engine, minimizing energy loss and heat generation.

5 Electric Power Steering

Electro-hydraulic steering pump was installed to assist a retuned steering rack. A production vehicle would be designed with electric power steering.

6 Gearbox

The transmission has the identical role as in a conventional vehicle; however, it has different design considerations due to the higher RPM range available from the electric motor and increased emphasis on efficient and silent operation. The transmission is a single-speed unit with a 5.4:1 reduction.

7 Modular Powertrain Cradle

A structure for monitoring all engine compartment EV components and providing isolation from the vehicle body through traditional engine mounts.

8 Electric Vacuum Pump

The vacuum pump supplies vacuum to the brake system for power assist.

9 High Voltage PTC Electric Coolant Heater and Controller

Heating systems are specifically designed for hybrid vehicle applications. Energy efficient PTC technology is used to heat the coolant that circulates to the passenger car heater. Heat also may be circulated to the battery.

10 Vehicle Control Unit

The VCU communicates with the driver as well as each individual vehicle system to monitor and control the vehicle according to the algorithms developed by the vehicle integration team. The VCU manages the different energy sources available and the mechanical power being delivered to the wheels to maximize range.

11 Battery Pack and Battery Cells

The battery pack is made up of 7 battery modules of 14 cells, 98 cells total for 23 kWh of power. The batteries are air cooled using existing vehicle cabin air. The pack includes an electronic monitoring system known as the BMS that manages temperature and state of charge of each of the cells.

12 AC Charger

Power electronics are used to convert the off-vehicle AC source from the electrical grid to the DC voltage required by the battery, thus charging the battery to its full state of charge in a matter of hours. The current charger is air cooled. The production design will accommodate both 110 and 220 voltage sources.

13 DC-DC Converter

A DC-DC converter allows the vehicle's main battery pack to charge the on-board 12V battery, which powers the vehicle's various accessories, headlights, etc.

In North America, we are also planning to introduce a Plug-in Hybrid Electric Vehicle (PHEV) commercially in 2012, along with our next-generation HEV technology. All of these will use lithium-ion batteries. We already have a test fleet of Ford Escape PHEVs on the road in partnership with a number of utility companies.

We recently announced plans to expand our electrified vehicle lineup to Europe. We will launch the Transit Connect Electric light commercial utility van in 2011 followed by the Ford Focus Electric in 2012. We also plan to introduce two next-generation gasoline HEVs and a PHEV in Europe in 2013. In preparation for the launch of these vehicles, Ford will participate in BEV test trials in the UK and Germany with Transit commercial vehicles equipped with a pure electric powertrain, as well as battery electric prototype passenger cars, to test the technology's suitability in real-world situations.

Use Global Platforms

Because the platforms on which these future Ford products will be based are our highest-volume global platforms, they offer tremendous opportunities for production economies of scale. The Focus Electric, for example, will be based on Ford's next-generation Focus model. It is one of up to 10 vehicles that will be developed from the Company's new global "C-car" platform, which is expected to deliver as many as 2 million vehicles annually. We will be producing the vehicles on flexible manufacturing lines capable of producing a BEV, HEV, PHEV or efficient gasoline- or diesel-powered vehicle. We also share many of the electrified components between the different vehicles. These strategies are key to making electrified vehicles affordable.

Collaborate

Gearing up for the development and diffusion of these new technologies will be a global challenge. Major advances have already been made on the electrical technology at the core of the next-generation electrified vehicles, and there's more to come. In Ford's vision, a coalition of automotive manufacturers and other stakeholders will work together to develop technologies, standards and cost efficiencies to commercialize electrified vehicles. It will take a collaborative approach of automakers, battery producers, suppliers, fuel producers, utilities, educators and researchers, as well as policy makers and opinion shapers, to help us make the transition and realize the full benefits of electrification.

Traditional automotive suppliers transforming themselves for electrification are being joined by new suppliers adapting electronics to the automotive environment. Significant possibilities exist for innovation in battery technology, power electronics and the development of motors, generators, high-voltage systems and other components.

Ford's plan calls for strategic partnering with key suppliers who bring technical expertise, financial solidity and collaborative spirit. We believe that working with a range of partners will allow us to gain greater understanding of the connectivity of vehicles to the electric grid, promote the necessary infrastructure and bring down the costs of the technology to make it more accessible for consumers.

Comparing Electrification Technologies

RELATED LINKS

This Report:

Ford's Sustainable Technologies and Alternative Fuels Plan

Electricity plays a role in all current vehicle technologies. In the early 1900s, for example, conventional gasoline and diesel vehicles began using a lead-acid battery to provide power to start the vehicle instead of a hand crank. Recently, in the quest for better fuel economy and lower greenhouse gas emissions, automakers have begun to design a variety of vehicles that use electric power for more functions, including providing some or all of the power necessary to move the vehicle.

A range of vehicle types, from conventional gasoline to pure electric, is shown in the table below. In the near- and mid-term, the largest volume of electrified vehicles will likely be hybrid electric vehicles, which use both a gas engine and a battery electric motor but do not plug into the electric grid. In 2009, approximately 700,000 HEVs were sold globally. In the United States, HEVs make up approximately 3 percent of the market for new vehicles.

In the longer term, electrified vehicles that get some or all of their energy directly from the electric grid, including plug-in hybrid electric vehicles and battery electric vehicles, are likely to play an increasingly significant role. The table below provides a generalized overview of the relative benefits and impacts of these different electrified vehicle technologies, based on an average compact or "C-car" sedan like the Ford Focus. The numbers in the table represent approximations based on Ford's testing and modeling research; they are not precisely representative of any current or future Ford products.

	Internal Combustion Engine	Micro-Hybrid[1]	HEV	PHEV	BEV
Technology Overview	Traditional gas or diesel engine.	Traditional gas or diesel engine and powertrain with stop/start capability, which shuts down the engine when the vehicle is stopped and automatically restarts it before the accelerator pedal is pressed to resume driving. Regenerative brake recharging improves fuel economy.	Uses both a gas or diesel engine and an electric motor. Can run exclusively on battery power, exclusively on gas power or on a combination of both. Also has stop/start capability and regenerative braking – a key to efficiently recharging the battery.	Uses a high-capacity battery that can be charged from an ordinary household 110 volt outlet. When the battery is depleted, the PHEV runs like a regular HEV[2].	Uses only a battery-powered electric motor, no gas or diesel engine. Runs entirely on electricity from batteries, which can be charged from household outlets or specialized charging stations.
Ideal Driving Conditions	Flexible for a wide range of uses.	Flexible for a wide range of uses. Improved fuel economy in urban driving.	Flexible for a wide range of uses. Excellent urban fuel economy. Improved highway fuel economy.	Flexible for a wide range of uses. Dramatically improved fuel economy in city driving. Suitable for customers who have access to a plug for overnight recharging and drive a combination of urban and longer commute distances.	Ideal for customers with access to a plug at home or work who have shorter, predictable daily trips of less than 80 miles total.
Technology Benefits/Costs based on Compact or "C-sized" Sedan[3]					
Fuel Economy[4] (Roughly real-world fuel economy for a compact sedan)	˜ 30 mpg	˜31–32 mpg	˜45 mpg[5]	Not applicable. Similar to HEV when running on gasoline. No gasoline used when running on electricity from the grid.	Not applicable.

Range on Tank/Charge[6]	˜405 miles/tank	˜425 miles/tank	˜610 miles/tank	An all-electric equivalent operating range of 10–40 miles, depending on battery size. A minimum 800-mile range when combining electric and gas. Range could be much greater than 600 miles/tank based on the number of times the battery is charged.	Up to 80 miles on a charge.
Fueling/Charging Time	Minutes	Minutes	Minutes	2–4 hours with a 220-volt outlet and 4–8 hours with a 110-volt outlet.	6–8 hours with a 220-volt outlet and 12–16 hours with a 110-volt outlet.
CO_2 emissions[7]					
Well to Tank	˜35 g/km		˜23 g/km	Current Grid:[8] ˜91 g/km	Current Grid:[8] ˜114 g/km
Tank to Wheels	˜150 g/km		˜101 g/km	Current Grid:[8] ˜26 g/km	Current Grid:[8] 0 g/km
Well to Wheels[9]	˜185 g/km		˜124 g/km[10]	Current Grid:[8] ˜117 g/km[11]	Current Grid:[8] ˜114 g/km[12]
Purchase Price Premium	$0	$300–$500	$2,500 to $5,000	$10,000 to $20,000	$15,000 to $25,000
Annual Fuel Cost	˜$1,200 annual fuel costs[13]	˜$1,150 annual fuel costs[14]	˜$800 annual fuel costs[15]	˜$450 annual fuel costs[16]	˜$350 annual fuel costs[17]
Payback Period[18]	NA	˜4 to 7 years	˜9 to 12 years	˜19 to 26 years	˜28 to 34 years

1. Some automakers consider this a form of hybrid vehicle. However, Ford views and is implementing these technologies as part of our strategy to improve the fuel economy of conventional internal combustion engine vehicles.
2. Another type of PHEV, often called an Extended Range Electric Vehicle, runs entirely on battery power until the battery is depleted, and then the onboard gas-powered engine runs to recharge the battery. The wheels are driven only by the electric motor, and the engine's sole purpose is to recharge the battery.
3. These numbers are for comparison purposes only. They are based on modeling and testing calculations and do not necessarily represent the numbers that would be achieved in real-world driving conditions, nor do they represent actual products that Ford currently makes or may produce.
4. The internal-combustion engine fuel economy estimate is based on the calculation used by the U.S. Environmental Protection Agency to develop Combined Fuel Economy (city/highway) values for the labels affixed to new vehicles. The Combined Fuel Economy value is intended to represent the approximate fuel economy that most consumers can expect based on a typical mix of city and highway driving. Estimates for the other technologies are based on the metro-highway drive cycle used for the U.S. fuel-economy regulations. Fuel economy calculations for all of the technologies are based in U.S. gallons and on U.S. drive cycles.
5. In general, HEVs deliver approximately 40–50 percent better fuel economy than comparably sized non-hybrids.
6. All estimates are based on a 13.5-gallon tank except for the BEV, which has no fuel tank.
7. In vehicles using internal combustion engines, the fuel feedstock is assumed to be petroleum. In micro-hybrid vehicles, the fuel feedstock is also assumed to be petroleum.
8. "Current grid" assumes average current emissions from U.S. power generation.
9. "Well to wheels" carbon dioxide (CO_2) includes all CO_2 emissions generated in the process of producing the fuel or electricity as well as the CO_2 emissions created by burning the fuel in the vehicle itself. It is useful to break this down into "well to tank" emissions, which measure the CO_2 emissions generated by excavating the feedstocks and producing and distributing the fuel or electricity, and "tank to wheels" emissions, which include the CO_2 generated by burning the fuel in the vehicle. "Well to tank" emissions are based on the GREET v. 1.8a model developed by the Argonne National Lab. "Tank to wheels" calculations are based on Ford's own calculations using the metro-highway drive cycle and energy use for electric vehicles. However, official methods for calculating CO_2 emissions from PHEVs and BEVs have not yet been defined.
10. In HEVs, the fuel feedstock is assumed to be petroleum.
11. In PHEVs, the "well to tank" emissions are based on the percentage of emissions from petroleum fuel production and distribution and electric power generation, and the "tank to wheels" emissions are based on the percentage of time the vehicle is driven using petroleum-based fuel.
12. In BEVs, "well to tank" emissions include emissions related to electric-power generation, and "tank to wheels" emissions are zero, because no CO_2 is produced by running the vehicle on batteries charged with electrical power.
13. Based on 12,000 miles/year, 30 mpg and $3/gallon.
14. Based on 12,000 miles/year, 32 mpg and $3/gallon.

15. Based on 12,000 miles/year, 45 mpg and $3/gallon.

16. Based on 12,000 miles/year, 75 percent in electric mode at 3.6 miles/kWh and 10 cents/kWh, and 25 percent in gasoline-engine mode at 45 mpg and $3/gallon.

17. Based on 12,000 miles/year, 3.6 miles/kWh and 10 cents/kWh.

18. Based on the purchase price without any possible government incentives such as tax credits.

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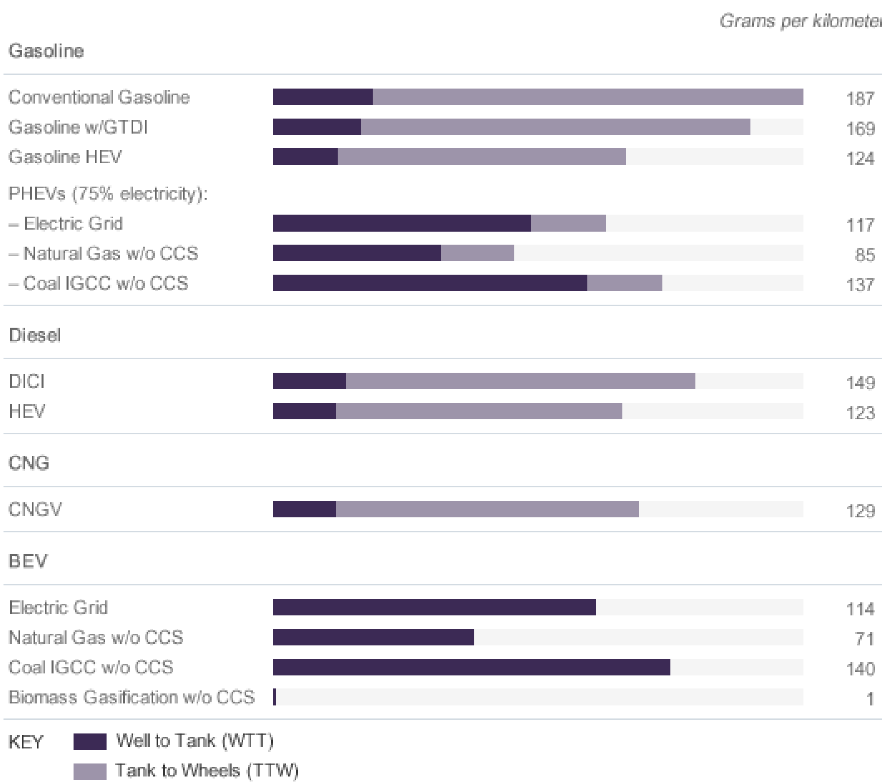
Environmental Benefits of Electrified Vehicles

Full BEVs are considered "zero emission" because they don't release greenhouse gases or other pollutants during use. But that term can be misleading. Operating an electric vehicle can cause emissions, but the location of the emissions is shifted from the vehicle to the power plant. Electric vehicles do reduce pollutants generated by burning petroleum fuel in the vehicle in proportion to the reduction in vehicle fuel consumption. However, replacing gasoline with electricity generated from coal, for example, could result in emissions at the power plant, including carbon dioxide, nitrous oxides, sulfur dioxide, volatile organic compounds, carbon monoxide and particulate matter. As a result, the environmental benefits of PHEVs and BEVs depend largely on the fuels used to power the electrical grid. Operating a PHEV or BEV on the current average U.S. electrical grid, which relies heavily on coal power, has only a small emissions advantage over an HEV.

Plug-in vehicles could help reduce overall CO_2 and other emissions if the electricity used to charge them was generated from cleaner fuels, and ideally renewable resources, which produce significantly fewer emissions than the coal or natural gas that are often used for power generation. In addition, "smart grids" that include grid-to-vehicle communications would enable utilities to make more efficient use of electricity supplies, thereby potentially reducing emissions and electricity costs.

WTW Fossil CO_2 Emissions for 2010 Compact-Size Vehicle



Grams per kilometer

	WTT	TTW	WTW
Gasoline			
Conventional Gasoline	35	152	187

Gasoline w/GTDI	31	137	169
Gasoline HEV	23	101	124
PHEVs (75% electricity)			
– Electric Grid	91	26	117
– Natural Gas w/o CCS	59	26	85
– Coal IGCC w/o CCS	111	26	137
Diesel			
DICI	26	123	149
HEV	22	101	123
CNG			
CNGV	22	107	129
BEV			
Electric Grid	114	0	114
Natural Gas w/o CCS	71	0	71
Coal IGCC w/o CCS	140	0	140
Biomass Gasification w/o CCS	1	0	1

Note that the numbers are not precise and are shown for directional purposes only.

Abbreviations: GTDI – gasoline turbo with direct injection, or EcoBoost™; CCS – carbon capture and storage; IGCC – integrated gasification combined cycle; DICI – direct injection and compression ignition; CNGV – compressed natural-gas vehicle; HEV – hybrid electric vehicle; PHEV – plug-in hybrid electric vehicle; BEV – battery electric vehicle. In this table, "well to tank" CO_2 emissions are based on the GREET v. 1.8a model developed by the Argonne National Lab. "Tank to wheels" calculations are based on Ford's own calculations using the metro-highway drive cycle and energy use for electric vehicles, However, official methods for calculating CO_2 emissions from PHEVs and BEVs have not yet been defined.

Using renewable energy: Recharging using electricity generated by renewable energy sources (such as solar, wind, hydropower or biomass) can cut CO_2 emissions dramatically, but production from these sources can be variable and unpredictable. Smart vehicle-to-grid communication can help utilities better use renewable energy sources. For example, it can allow vehicles to recharge at times that wind power is most available (usually at night) or during the day from solar arrays, depending on the renewable source available and its output. As the power-generation sector continues to improve its fuel mix and explore technologies such as carbon sequestration (i.e., collecting CO_2 emissions from power generation and storing them), the environmental impact of driving a plug-in vehicle will diminish substantially – perhaps even toward zero.

"Smart grids:" The development of "smart grid" technologies, which can provide utilities and customers with real-time information on energy use and energy prices, is a key enabler of efficient integration of electric vehicles and grids.

Smart charging would allow utilities to control the current going into the vehicle battery and thereby help to ensure that electric vehicles generate as little incremental CO_2 as possible. Armed with the knowledge of how much energy is needed and by when, a smart grid would be able to use the batteries in electric vehicles to store excess electricity or to shut off the current when there is a sudden demand elsewhere. This control would help to smooth the peaks and valleys of supply and demand at both the micro and macro level. Vehicles could also be taken off the grid completely, by charging with electricity from small individual generation units, such as household solar electric and wind power systems.

Smart grids will also help make the electrical grid and electrical vehicle charging more efficient by channelling vehicle recharging to times when electrical grid resources are currently underutilized. Since demand for electricity fluctuates (generally peaking in the afternoon and dropping off at night), utilities typically use a mix of fuels and power plant types to meet demand. That means that the environmental impacts of electric vehicle use will vary depending on where and when the vehicles are charged. During certain seasons and particularly at night, utilities generally have excess generation capacity – unused resources that create financial inefficiency. Charging PHEVs and BEVs during these off-peak hours, when this excess capacity is available, can increase the overall efficiency of the electric grid – potentially reducing CO_2 emissions, as well as the cost of electricity. But if PHEVs and BEVs are charged at peak times, that could create increased CO_2 emissions from power generation and also create demand for additional power plants. Utilities have a role to play in educating electrified-vehicle users and providing them with incentives to charge their vehicles at the most beneficial time.

With all these variables, utilities will be key partners in defining and developing electricity supply systems for electric vehicles that are efficient, affordable and environmentally sound. That's why Ford has partnered with several utilities throughout the United States and Canada, as well as the U.S. Department of Energy for its PHEV pilot program.

Electrification Challenges and Opportunities and Ford's Response

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Ford's Green Energy Partnerships with Federal and State Governments

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Ford Focus

To realize the potential benefits of vehicle electrification, a range of issues must be addressed, including the significant issues of cost and customer convenience. Vehicle and fuel technologies interact in a complex system that includes vehicle technologies, battery technologies, fuel types and energy-generation technologies, all of which determine potential impacts on the environment and energy security.

Costs and Savings

The current cost to make plug-in vehicles is substantially higher than that of conventional vehicles, largely due to the cost of batteries. Depending on electricity costs, however, the energy cost to operate an all-electric car is in the range of 2 to 3 cents per mile, compared to about 8 to 10 cents[1] per mile for a conventional gasoline-powered vehicle. So, lower operating costs can help offset the higher initial purchase costs of electric vehicles (EVs).

Automakers will need to invest billions of dollars to develop next-generation electrification technologies and electrified vehicles. Utilities will need to invest to increase electricity generation and transmission capacity, with generally higher costs for green electricity sources. Governments will also need to invest by encouraging and facilitating the development of technology and infrastructure and providing incentives for consumers to buy EVs.

FORD'S RESPONSE

Ford is working with a range of battery suppliers and other partners to develop next-generation battery technologies that will help to bring costs down. In addition, we have been working with utilities and other partners to understand how to make vehicle recharging as efficient as possible.

For example, we recently announced that we are collaborating with Microsoft on new energy-management software that will help customers determine when and how to most efficiently and affordably recharge battery electric and plug-in hybrid electric vehicles, while giving utilities better tools for managing the expected changes in energy demand. Ford is the first automaker to announce the use of this new technology, called Hohm™, which will be used in the Focus Electric starting next year. Hohm is an Internet-based service designed to help customers avoid unnecessary expense by providing insight into their energy usage patterns and suggesting ways to increase conservation. With Ford electric vehicles, Hohm also will help drivers to determine the best time to charge their vehicle and help prevent the need for infrastructure upgrades to support the added energy demand. Ford and Microsoft plan to continue to work with utility partners and municipalities to help further develop systems to maximize the effectiveness of electric vehicles and their interaction with the electricity grid.

In addition to this work with partners, we are also planning our electric vehicle strategy based on our highest-volume, global platforms, which could also help reduce the costs of electric vehicles by creating economies of scale.

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Battery Technology

Current-generation HEVs run on nickel metal hydride batteries, which offer significant improvements over traditional lead-acid batteries. For example, nickel metal hydride batteries deliver twice the power output for the weight (energy density) compared to lead-acid batteries. Nickel metal hydride batteries have worked well in non-plug-in hybrids, which are designed to allow for constant discharging and recharging and are not expected to store and provide large amounts of energy. These batteries are reaching the end of their advancement potential, however, and new battery technologies are needed to improve on the current generation of HEVs.

PHEVs and BEVs make significant additional demands on battery technology. Unlike HEVs, which maintain a relatively constant state of charge, PHEV batteries are to be depleted to a low level when they are the primary energy source for the vehicle. And BEVs are designed to run solely on battery power. The batteries used in PHEVs and BEVs must function well in a wide range of conditions; tolerate running until nearly depleted and then being fully charged; store and provide a lot of power; last a minimum of 10 years or 150,000 miles; and, ideally, be compact and lightweight.

Automakers are moving toward lithium-ion batteries for next-generation HEVs and for PHEVs and BEVs. These batteries have greater energy density and are lighter than nickel metal hydride batteries. However, the technology is still evolving, and costs must drop considerably before they can be widely used (see section on Battery Evolution below).

It is also important to have a plan for recycling batteries at the end of their useful lives to minimize the material going to landfill, and to ensure that critical elements, such as rare earth metals and lithium, are recovered and reused in new batteries.

Battery Evolution

Battery technology is evolving. The following table shows how new battery technology, such as the nickel metal hydride batteries used in today's HEVs and the lithium-ion battery technology of next-generation electrified vehicles compare to the traditional 12-volt lead-acid battery.

	Lead-Acid	Nickel Metal Hydride (Ni-MH)	Lithium-Ion (Li-ion)
First Commercial Use	1859	1989	1991
Current Automotive Use	Traditional 12-volt batteries	Battery technology developed for today's generation of hybrid vehicles	Under development for future hybrid electric and battery electric vehicles; some manufacturers launching in limited volumes in 2010
Strengths	• Long proven in automotive use	• Twice the energy for the weight as compared to lead-acid • Proven robustness	• About twice the energy content of Ni-MH and better suited to future plug-in electrified vehicle applications • By taking up less space in the vehicle, provides far greater flexibility for automotive designers
Weaknesses	• Heavy; its lower energy-to-weight ratio makes it unsuitable for electrified vehicle usage	• High cost (four times the cost of lead-acid); limited potential for further development	• Although proven in consumer electronics, this technology is still under development for automotive applications • Will remain relatively expensive until volume production is reached

Specific Energy (Watt hours per kilogram)	30–40	65–70	100–150
Recyclability	Excellent	Good	Very Good

FORD'S RESPONSE

Ford has been working with battery supplier partners to develop next-generation battery technologies that can improve HEV performance and stand up to the new challenges presented by BEVs and PHEVs. For example, the performance of batteries varies with weather conditions. We are conducting tests of the effects of temperatures and other conditions so we understand and can communicate to customers the impacts on expected range between rechargings.

Ford is also working with researchers at the University of Michigan and the Massachusetts Institute of Technology to develop and test improved lithium-ion battery technology. This research is funded in part by a $55 million tax credit incentive Ford received from the Michigan Economic Development Corporation.

All of Ford's electrified products, including HEVs, PHEVs and BEVs, will use lithium-ion battery cells by 2012.

Ford is also developing a comprehensive strategy to address batteries that can no longer be used in vehicles. Ford engages with all the parties that handle end-of-life batteries, including customers, local authorities, emergency services (e.g., tow trucks), dealerships, independent workshops and garages, and vehicle recyclers. Customers can recycle their batteries with local recyclers or bring them to any Ford or Lincoln dealer for no-cost recycling.

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Recharging

To realize their full all-electric range, plug-in vehicles must be charged regularly. They can be charged using a standard household electric current (e.g., 110 volts in the United States), but they will recharge faster when using a higher-voltage electric service. Since electricity supplies are ubiquitous in developed countries, much of the needed infrastructure already exists, but new charging facilities will be required in public places as well as apartments and homes that lack accessible places to plug in. Other future recharging options, being considered by various entities, might include battery swap stations and inductive charging where batteries are charged without a plug through "wireless recharge." This latter type of recharging could occur in special parking spots or even in "charging lanes" that could be included in roadways in the future.

Another focus of research is rapid-charging technologies. Ideally, an electric vehicle could be charged in the same amount of time it takes to fill a fuel tank, though the electric power needed to perform a rapid charge – and the bulky additional charging infrastructure required to deliver it – remain challenges. In addition, with existing technology, rapid charging typically shortens the life of batteries, but efforts are underway to develop cell technologies capable of rapid recharge without battery degradation in the future.

Developing and agreeing on standard charging connectors between vehicles and the grid and vehicle-to-grid communication protocol are another key challenge. These will be necessary to allow all plug-in vehicles to use a common charging point when they need to recharge.

These and other charging options are all under consideration. Having an understanding of these technologies and how they may develop will be important in making electrified vehicles practical and affordable.

FORD'S RESPONSE

In North America, Ford participated with the Society of Automotive Engineers to successfully align all original equipment manufacturers (OEMs) on a standard charge connector and communication protocol that will enable all plug-in vehicles to use common charge points. This will be a key enabler for adoption in North America; the same connector is under consideration in Europe and China. Further standardization initiatives that will be helpful include fast-charge standards (for DC charging) and vehicle-to-grid standards. Global commonality for these systems will also be needed. Ford is also working with other OEMs and suppliers to provide a common database of charge point locations for display within vehicles' navigation systems.

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Supply Chain Issues

As widespread electrification of automobiles moves closer to reality, a new set of concerns is emerging over the environmental and social impacts of extracting and processing key materials needed to make electric vehicles. In particular, there are concerns about lithium (used to make the lithium-ion batteries that are widely used in consumer electronics and will be used in BEV and PHEV vehicles) and rare earth metals (which are used in electric motors for vehicles, wind turbines and other advanced technologies).

Significantly accelerating the production of electric vehicles is likely to require the use of much greater quantities of lithium and rare earth metals. Production of these resources is concentrated in a few countries, including Chile, Bolivia and China, which has led to questions about the adequacy of the supply of these resources and the potential for rising and volatile prices as demand puts pressure on existing supplies. In addition, there are concerns about geopolitical risks posed by the limited availability of these materials. Could we be trading dependence on one limited resource (petroleum) for another? Attention is also focusing on the possibility of risks such as bribery and corruption and the potential for environmental and human rights abuses. Finally, the processing of lithium, in particular, uses large quantities of water.

FORD'S RESPONSE

We take these concerns very seriously. Ford generally does not purchase raw materials such as lithium and rare earth metals directly – they are purchased by our suppliers (or their suppliers) and provided to us in parts for our vehicles. As described in the Human Rights section of this report, our contracts with suppliers require compliance with the legal requirements of Ford's Code of Basic Working Conditions and the adoption of a certified environmental management system (ISO 14001). We are working in our supply chain to build the capability of our suppliers to provide sound working conditions in their operations, and we assess compliance with our Code of Basic Working Conditions in target markets. We ask the suppliers we work with to take similar steps with their suppliers. We are also working cooperatively with other automakers to extend this approach through the entire automotive supply chain.

As part of our water strategy, we are evaluating the water requirements and impacts of powering vehicles by conventional fuels, biofuels and electricity. This work includes a study of the water requirements of lithium extraction and processing.

We will continue to monitor and assess these issues for their potential impact on our electrification strategy and our sustainability commitments.

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Electric Vehicle–Utility Interaction

Clearly, electric vehicles – which plug into the grid for some or all of their power – will have an impact on electric utilities. If electric vehicles are charged during times of peak electricity demand, they may overstress the current grid and require the construction of additional electricity supply. Furthermore, recharging vehicles during peak demand would significantly reduce the operating cost benefits expected from electric vehicles. In addition, "smart grid" technology that allows communication between recharging vehicles and the electrical grid will be required to maximize recharging efficiency and minimize stress to the grid. Automakers and utilities will have to work together to develop this "smart" vehicle-to-grid communication system. Overcoming these challenges will require significant collaboration between automakers, electric utilities and governmental regulatory agencies and legislators.

Because utilities and automakers have not had to work together in the past, effective collaboration requires developing new relationships and learning about each other's business and regulatory challenges. For example, utilities and automakers have very different business models: utilities operate regionally and have little to no direct competition within their markets, while automakers operate and compete globally. Further, automakers are primarily regulated at the national level, while utilities face more local and state regulations, which increases the difficulty of establishing a national strategy for vehicle-to-grid interaction. It will be important for automakers and utilities to understand and address these kinds of differences as they work together on vehicle electrification issues.

FORD'S RESPONSE

In 2007, we initiated the Ford Plug-in Project, a collaborative project with the U.S. Department of Energy, the Electric Power Research Institute, the New York State Energy Research and Development Authority, and 10 utilities (Southern California Edison, American Electric Power, ConEdison of New York, DTE Energy, National Grid, New York Power Authority, Progress Energy, Southern Company-Alabama Power, Pepco Holdings and Hydro Quebec). In this project we are road testing our Escape PHEV prototypes that are equipped with vehicle-to-electric "smart grid" communications and control systems that will enable plug-in electric vehicles to interface with the electric grid, and will allow the vehicle operator to determine when and for how long to recharge the vehicle. This will potentially enable the user to take advantage of lower, off-peak utility rates.

Ford is also working with DTE Energy on a solar energy and battery energy storage project, using vehicle batteries to store energy from a solar array. For more information on this project, please see Ford's Green Energy Partnerships with Federal and State Governments.

This collaboration continues to yield important lessons for both automakers and utilities. Some of the key learnings we have gained so far include the following:

- Electric vehicles provide additional impetus to develop smart communication systems between the vehicle and the grid. This communication will allow the consumer to know if and when lower electricity rates are available (as some utilities will offer lower rates during the night when energy demand is low), and help prevent additional loads on the infrastructure. Providing utilities the ability to control when vehicles are charged, or assurances that vehicles will not be charged during peak demand time, could prevent costly infrastructure upgrades, some of which may be passed back to the customer by the utility (e.g., if a transformer needs to be upgraded).
- Smart vehicle charging will require that utilities and automakers develop a common standard for vehicle-to-grid and grid-to-home meter communications. Currently, utilities tend to operate regionally, but electric vehicles will increase the need for common national and even international standards.
- Widespread use of electric vehicles will likely require that vehicle power consumption be measured separately from home electricity use, requiring either additional meters or "smart" meters. Additionally, the pooling of electrified vehicles in a particular region may require upgrades to the transformers and/or substations that form the electrical grid in that area.
- There are interesting possibilities for vehicle-to-grid and vehicle-to-home power flow. However, there are significant challenges to making these possibilities a reality. For example, technical, safety, codes/standards compliance, legal, robustness and business case issues need further study prior to commercialization.
- Vehicle owners will likely want to be able to charge their vehicles at any geographic location and – in those cases where another payment method isn't used – have the cost applied to their home energy bill. In addition, vehicle identification and home meter association must be seamless for the customer. This kind of mobile or remote billing for vehicle charging services will require a paradigm shift in the utility industry's current billing processes and tools.
- Automakers and utilities both benefit from working together on outreach to local, state and federal regulators and legislators. Ford and our utility partners are already working with legislators and regulators on national standards for vehicle charging infrastructure and incentives and strategies to bring costs down.
- Utilities and automakers need to work together to educate consumers about the differences between electric vehicles and traditional vehicles so that consumers understand how to make the most of electric vehicles and charging infrastructure.

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1. Assuming an energy consumption of about 3 to 4 miles/kWh at 10 cents/kWh for the electric vehicle, and a fuel economy of 30–40 miles/gallon at $3/gallon for the gasoline vehicle.