TOYOTA |

energy & climate change

Toyota strives to improve fuel economy through fuel-efficient engine and vehicle design, but also considers additional methods to enhance fuel efficiency. Toyota recommends SAE 0W-20 viscosity grade engine oil for an increasing number of models as one way to improve fuel efficiency.

> "Toyota recognizes that climate change is occurring and … is committed to continued action to address climate change and promote greater energy diversity …"
>
> – **Toyota Testimony Before the U.S. House Subcommittee on Energy and Air Quality**

TOYOTA IS COMMITTED to continued action to address climate change and promote energy diversity. Action on both issues must, by definition, be broad in scope and involve a wide range of industries and sectors of the economy, including the motor vehicle industry, as well as consumers. Our part in addressing these issues is integral to The Toyota Way: to find the opportunity in challenges and meet them with courage and creativity, to accept responsibility, to understand the facts with thorough research and by involving multiple stakeholders, to form a long-term vision and plan, and, lastly, to take action.

> TOYOTA'S APPROACH TO ENERGY AND CLIMATE CHANGE

Clean energy — and ensuring its abundant supply to meet the world's future needs — will be one of the defining challenges for the 21st century. Society's energy demands continue to rise, particularly here in North America. Right now, our energy is sourced from carbon-based fossil fuels such as petroleum, coal and natural gas. In North America, 41% of our energy comes from petroleum-based fuels; approximately two-thirds of that petroleum is used for the transportation sector. (Based on International Energy Annual 2004 published by the U.S. DOE Energy Information Administration.) Fossil fuels are essentially nonrenewable, becoming harder to extract, and much of it comes from outside North America. For all these reasons, petroleum-based fuel is becoming more expensive, as we have seen as the price of gas has risen at the pump. When we drive a vehicle, it consumes fossil fuels and emits CO_2, a major contributor to climate change. So neither the feedstock of the conventional car — fossil fuels — nor the consequences of its use — climate change — are sustainable models for vehicles in the future. We need to design transportation solutions that overcome our reliance on fossil fuels.

Energy needs and climate change are complex issues. They will require societal action — the combined efforts by governments, policymakers, corporations and individuals — to address them. There is no single "silver bullet" solution — a multi-prong strategy is needed. The auto industry can accelerate the availability of fuel alternatives; we can improve the energy efficiency of our business operations; we can offer more fuel-efficient technologies and products. However, the broad commercialization of these ideas will require commitment from groups outside of the auto industry. Energy providers will need to provide energy from renewable sources. Fuel providers will need to make new fuels available and provide the necessary distribution infrastructure. Government will need to establish incentives that spur development and the purchase of new technology and low carbon energy. Consumers will need to push market demand. In short, our success will be dependent on change from all sectors.

Toyota recognizes the growing need to take action to promote energy diversity and address climate change. We are not waiting for others to act before we take action ourselves. We are conducting a broad North American Greenhouse Gas inventory to understand the current GHG footprint of our operations and products. We are investing time, funding and our experience in collaborative and policymaking efforts to respond to climate change and help to diversify energy sources. We are developing cars and trucks that can travel farther on a single tank of fuel and operate on a variety of clean energy sources. We are becoming more efficient in how we design, build, distribute and sell our products. Our goal is to develop innovative technologies for the future while continuously improving the mainstream technologies of today in a way that meets customer needs and brings us closer to sustainable mobility.

Toyota has five environmental goals to help mitigate our energy and greenhouse gas (GHG) footprint: improve fuel efficiency; promote fuel diversification; develop advanced vehicle technologies; promote advanced transportation solutions; and reduce our energy and GHG emissions across our operations. This chapter describes activities in these areas.

> VEHICLE FUEL EFFICIENCY

The most direct, immediate measure the auto industry can take to help meet the challenges posed by energy demand and climate change is to improve the fuel economy of its products. In the U.S., fuel efficiency of new cars and trucks is regulated through the Corporate Average Fuel Economy (CAFE) standards. Today, the CAFE standard is 27.5 miles-per-gallon (mpg) for cars and 22.2 mpg for trucks. Toyota has a global goal to promote the development of technologies to achieve the highest fuel efficiency level in each country/region where we market vehicles. We have a strong track record of offering fuel-efficient vehicles in a broad range of vehicle classes throughout North America.

With growing concern over climate change and energy demands, pressure for increasing and reforming U.S. fuel efficiency standards has been rising. Toyota expects CAFE standards to increase over the next few years and supports raising both car and truck fuel economy standards.

In Canada, Toyota has joined with the rest of the auto industry to voluntarily meet a Corporate Average Fuel Consumption (CAFC) goal of 8.6 and 10.6 liters of fuel burned per 100 kilometers traveled for cars and trucks, respectively. **For the 2007 model year, we will exceed CAFE standards and CAFC voluntary goals for both passenger cars and light-duty trucks.**

U.S. EPA's 2007 Fuel Economy Guide lists the Toyota Prius as the most fuel-efficient passenger car sold in the U.S. The Natural Resources Canada's 2007 EnerGuide named the Toyota Yaris the most fuel-efficient subcompact, the Toyota Prius the most fuel-efficient midsize, and the Toyota Sienna the most fuel-efficient minivan. To promote the purchase of fuel-efficient vehicles, the Canadian government instituted a performance-based rebate program. Canadians who buy fuel-efficient vehicles are eligible for a federal rebate of up to CAN$2,000. Toyota/Lexus have more eligible vehicles than any other manufacturer, six in all: Toyota Prius, Toyota Camry Hybrid, Toyota Yaris, Toyota Corolla (manual transmission only), Toyota Highlander Hybrid and Lexus RX 400h.

The fuel efficiency performance of Toyota's overall fleet is a reflection of our efforts at the model level. For example, the all-new 2007 Toyota Tundra comes with a 6-speed automatic transmission (available standard on the 3UR-FE 5.7L V8 engine). This sixth gear allows for a lower total gear ratio and improved highway fuel economy. Dual independent VVT for both the intake and exhaust camshafts increases efficiency through continuous optimized valve timing. Additionally, the 3UR-FE engine includes a unique cooling system that optimizes temperature and consequently permits enhanced engine control and further fuel efficiency improvement.

The 2007 Toyota Tundra 3UR-FE 5.7L V8 has improved fuel efficiency, thanks to a number of design elements.

With growing energy demand and concern over climate change, pressure is increasing to reform U.S. fuel economy standards. Toyota supports raising both car and truck fuel economy standards and expects CAFE standards to increase over the next few years. We believe that more stringent standards can be attained through continued technological advancements. For the auto industry to remain economically viable, new CAFE requirements must provide appropriate lead time and stability so that technology and product development can occur within existing cycles and produce cost-effective results that meet consumer needs. Toyota looks forward to working with the federal government to raise CAFE standards as a key method of reducing vehicle CO_2 emissions and fuel use.

Lower Viscosity Oil Improves Fuel Economy

Toyota strives to improve fuel economy through fuel-efficient engine and vehicle design, but also considers additional methods to enhance fuel efficiency. Low viscosity SAE 0W-20 multigrade gasoline engine oil, shown in the main photo on page 10, enables increased fuel economy performance over traditional, higher viscosity oils like SAE 5W-20, SAE 5W-30 and SAE 10W-30. Lower viscosity oils reduce friction while maintaining the necessary lubrication in the engine. SAE 0W-20 multigrade gasoline engine oil is now specified (for certain engines) in the following Toyota, Lexus and Scion 2007 model year vehicles:

- Toyota Camry
- Toyota Camry Hybrid
- Toyota Camry PZEV
- Toyota RAV4
- Toyota Tundra
- Toyota Highlander
- Toyota Tacoma
- Scion tC
- Lexus LS 460

Toyota plans to introduce low-viscosity SAE 0W-20 multigrade engine oils to additional vehicle models in the future.

Engine Design and Fuel Efficiency

Toyota's progress in fuel efficiency has come through continued advancements in vehicle and internal combustion engine design; examples include four intake valves per cylinder, variable valve timing, and low friction materials. Our latest engine design innovation is called "Valvematic." It is a next-generation engine valve mechanism that can improve the fuel efficiency of gasoline-powered vehicles by 5% to 10%, depending on driving conditions. The system is a variable valve

Figure E

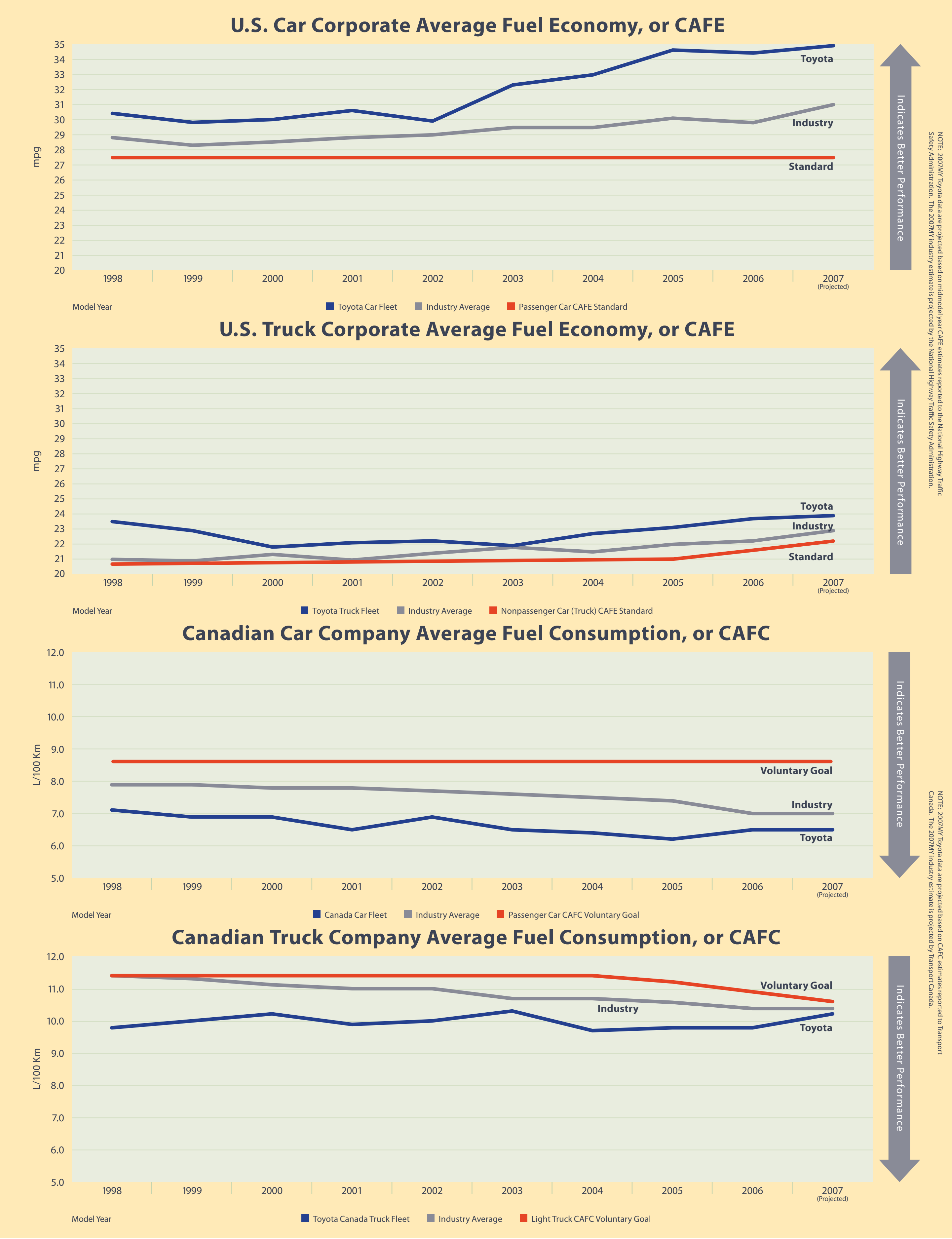
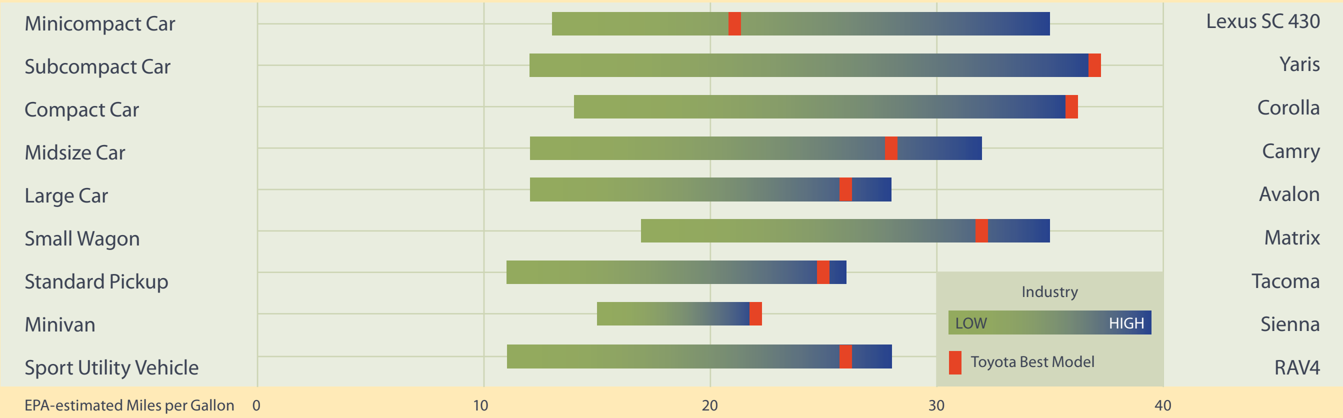

U.S. Car Corporate Average Fuel Economy, or CAFE
mpg
Toyota
Industry
Standard
Model Year
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007 (Projected)
Toyota Car Fleet
Industry Average
Passenger Car CAFE Standard
Indicates Better Performance
U.S. Truck Corporate Average Fuel Economy, or CAFE
mpg
Toyota
Industry
Standard
Toyota Truck Fleet
Industry Average
Nonpassenger Car (Truck) CAFE Standard
Indicates Better Performance
NOTE: 2007MY Toyota data are projected based on midmodel year CAFE estimates reported to the National Highway Traffic Safety Administration. The 2007MY industry estimate is projected by the National Highway Traffic Safety Administration.
Canadian Car Company Average Fuel Consumption, or CAFC
L/100 Km
Voluntary Goal
Industry
Toyota
Canada Car Fleet
Industry Average
Passenger Car CAFC Voluntary Goal
Indicates Better Performance
Canadian Truck Company Average Fuel Consumption, or CAFC
L/100 Km
Voluntary Goal
Industry
Toyota
Toyota Canada Truck Fleet
Industry Average
Light Truck CAFC Voluntary Goal
Indicates Better Performance
NOTE: 2007MY Toyota data are projected based on CAFC estimates reported to Transport Canada. The 2007MY industry estimate is projected by Transport Canada.

Figure F

Toyota Gasoline Vehicles Are Among the Most Fuel Efficient in Their Class



NOTE: United States only. Data and classes are based on EPA adjusted combined fuel economy ratings from the Model Year 2007 Fuel Economy Guide available at **www.fueleconomy.gov**. Categories are defined according to interior volume. Thus, some categories include a wide variety of vehicles. For example, minicompact car includes both true minicompact vehicles and performance vehicles. Diesel and hybrid electric vehicles are excluded. The chart shows only those classes where Toyota offers products. This chart includes Lexus and Scion models.

lift mechanism which combines VVT-i (Variable Valve Timing-intelligent), which continuously controls intake valve opening/closing timing, with a new mechanism that continuously controls the intake valve lift.

While conventional engines control air intake using a throttle valve, Valvematic adjusts the volume of air taken in by continuously controlling the intake valve lift volume and timing of valve opening and closing. This helps ensure optimal performance based on the engine's operational condition, thus helping vehicles achieve both high fuel efficiency and dynamic performance. The system is planned for introduction with a new 2.0 liter engine currently under development.

Fuel Efficiency and CO_2 Emissions

The chemistry of combustion directly links fuel efficiency and CO_2 emissions. More fuel-efficient vehicles generate fewer CO_2 emissions over the same distance traveled. Figure G shows that CO_2 emissions from Toyota's new vehicles are well below that of the industry average in both the U.S. and Canada, for both cars and light-duty trucks.

Based on our estimates, the past 10 model years of Toyota vehicles sold in the U.S. will consume 11 billion fewer gallons of gasoline (nearly 265 million fewer barrels of oil) over their lifetime than if we had merely met fuel economy standards. These same vehicles will emit over 100 million metric tons less of CO_2.

> VEHICLE FUELS DIVERSITY

Toyota is investing in alternative-fuel vehicle technologies that will use a more diversified portfolio of energy and fuel sources. We are excited by the promise these alternative fuels offer to help meet the challenges posed by increasing energy demand and the threat of climate change. However, that excitement is tempered by the knowledge that continued advances are needed before these fuels can be broadly commercialized and reach their full potential. Therefore, we are not focusing on a single path away from conventional fuels; instead, we are exploring many alternatives, including biofuels from cellulose and renewably-generated hydrogen. Below we describe some of the leading alternative fuels and some of the challenges we are working to overcome.

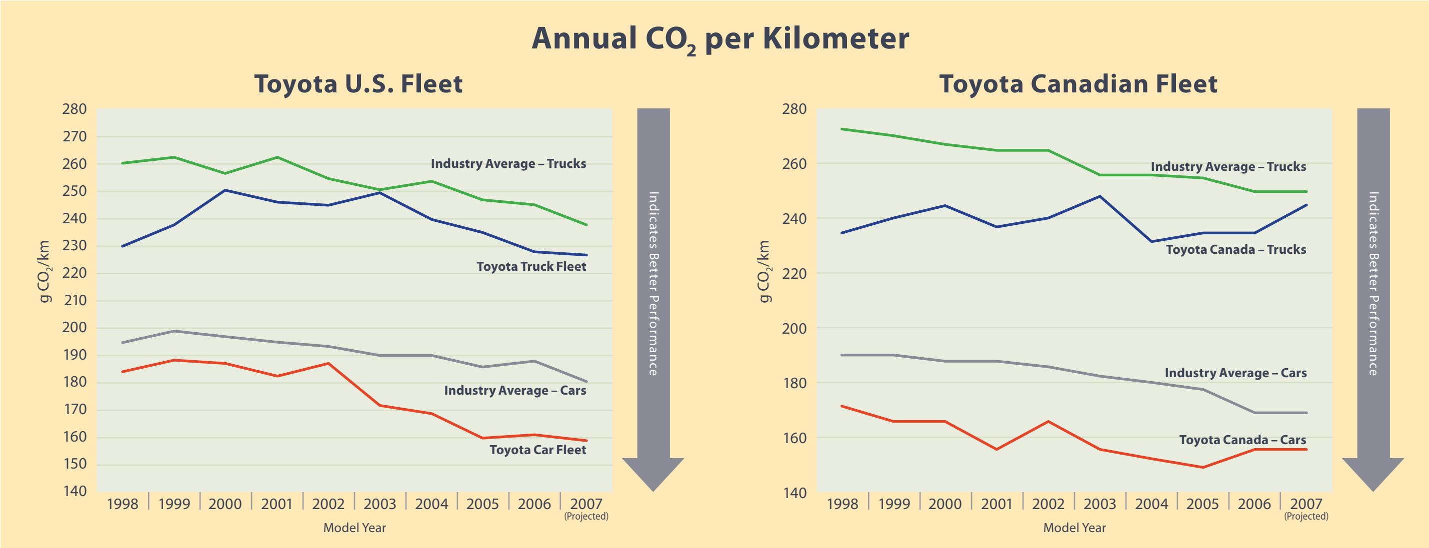
Biofuels

Biofuel is any fuel made from organic matter such as plants, animals or their by-products. The most common biofuels are ethanol and biodiesel. In the U.S., ethanol is typically produced from fermentation of corn and mixed with gasoline. In North America, biodiesel is made primarily from soybeans and blended with diesel fuel.

Toyota believes biofuels have large market potential because they can displace conventional fuels with only minor modifications to the traditional gasoline or diesel engine. For example, all Toyotas since 1970 are capable of operating on E10, a blend of 10% ethanol and 90% gasoline. Next year, select 2009 Tundra models will offer flexible fuel capability on E85. This allows the vehicle to operate on fuels containing up to 85% ethanol. The FFV (flexible fuel vehicle) Tundra will be available primarily in the midwestern U.S., where the majority of E85 stations are located. This is because despite their potential, biofuels are still not readily available.

In the U.S. today, nearly 10 million vehicles are equipped to run on E85; but E85 is sold at less than 1% of fueling stations and accounts for less than 0.2% of fuel sold nationwide. Distribution is a challenge as most of the ethanol is produced in the Midwest and must be shipped via rail, because it is incompatible with oil pipelines. Vehicle range and cost competitiveness are also concerns. Because E85 contains only three-fourths the energy of gasoline, users experience a range reduction — up to 30% fewer miles per tank of fuel — and at current prices, an increase of 10-25% in fuel costs.

Figure G



CO_2 emissions from Toyota's new vehicles are below that of the industry average in both the U.S. and Canada, for both cars and light-duty trucks.

While most ethanol produced in the U.S. is made from corn, which can reduce overall CO_2 emissions by up to 20% compared to gasoline on an energy basis, there are concerns that further corn ethanol production increases will drive up the cost of food, lead to over farming of marginal lands and consume massive amounts of water. These issues will likely prevent traditional corn-based ethanol from displacing more than 15% of U.S. gasoline consumption.

As with E85, biodiesel is sold in extremely small volumes and at few retailers. Additionally, biodiesel fuel standards for finished blends do not exist today which presents a challenge for engine design and consistent engine performance. Toyota is working with ASTM International to set appropriate fuel quality standards that will ensure consistent fuel quality.

For biofuels to significantly reduce petroleum consumption, production technologies must be perfected to make fuel from all types of plants and plant materials. In both Japan and the U.S., Toyota is investigating these technologies. We hope that breakthroughs in these areas will lead to low-cost biofuels that can be produced in large quantities with minimal environmental impacts.

Synthetic Fuels

There are two primary types of synthetic fuels, gas-to-liquid (GTL) and coal-to-liquid (CTL). Both are produced by gasifying the base fuel, natural gas or coal and rearranging the hydrogen and carbon atoms in the gasified mixture to form either gasoline or diesel. Since the product fuels are "assembled," it is possible to optimize specific properties — such as eliminating sulfur or increasing the cetane level in diesel fuel. Synthetic-fuel technology has been proven in specialty applications. However, the high cost of production facilities, the large quantity of carbon emissions generated during production, and the high cost of the fuel remain hurdles that must be overcome before synthetic fuels are widely used and displace significant amounts of petroleum.

Hydrogen

Hydrogen is viewed by many as the ultimate fuel. It can fuel both conventional engines and fuel cells, can be produced from many base fuels (energy diversity), and when used in a fuel cell, the only vehicle emission from combustion is water. Depending on how the hydrogen is produced, low GHG production emissions are also possible. These potential benefits have led all major auto manufacturers to develop and field a variety of hydrogen fuel-cell vehicles. Toyota currently has a fleet of nine fuel-cell vehicles on the road today logging real world miles (see page 18 for additional details).

Extensive real world testing of these vehicles has highlighted the challenges of using hydrogen as a fuel. Because hydrogen's energy density is low, storing an adequate amount of fuel on-board a vehicle is difficult. Currently, even with 10,000 psi tanks, manufacturers are struggling to realize a real world driving range of over 300 miles, while a typical gasoline powered vehicle enjoys a range of 400 miles or more.

The Canadian Automobile Association presented the Pyramid Award™ for Environmental Initiatives to Toyota Canada for the 2007 Camry Hybrid. The Automobile Journalists Association of Canada also named the Camry Hybrid its top passenger car for 2007. Since the Camry Hybrid went on sale in May 2006, it has accounted for about 20% of all Camrys sold in Canada.

Driving range is critically important to users, and there are very few hydrogen fueling stations — approximately 20 exist in the U.S. This number is expected to grow to support small fleets of fuel-cell vehicles in California. But beyond California, further growth is uncertain, as costs to upgrade existing fueling stations for hydrogen can exceed $1,000,000 and a station may struggle to recoup costs with few hydrogen vehicles on the road. Therefore it is critical that energy providers, auto manufacturers and regulators work together to assure hydrogen infrastructure growth is proportional to the number of hydrogen fueled vehicles on the road.

Electricity

Electricity, when used to recharge electric vehicles, is an alternative to gasoline or diesel fuels. Its advantages are: A variety of fuels are used to generate electricity (energy diversification); the "refueling" infrastructure exists (household and garage outlets are a potential source); and it is relatively low cost (assuming off-peak charging). Among its disadvantages are that there is no improvement in CO_2 emissions versus gasoline if coal (without GHG capture and sequestration) is used to generate the electricity, and the cost of charging during peak times is high.

As with hydrogen, on-board storage of electricity is currently problematic. High performance, long-life batteries are extremely costly, heavy, and can be difficult to package on a vehicle in a quantity to support full function electric vehicles. To mitigate these issues, auto manufacturers are studying ways to incorporate off-board charging into today's hybrid vehicles. These Plug-in Hybrid Vehicles (PHVs) use a larger battery pack than a hybrid (but much smaller than an electric vehicle) and are designed to be charged using grid electricity. During vehicle operation, the energy in the on-board battery is used, reducing the PHV's fuel consumption. Toyota researchers in North America and around the world are looking for ways to improve battery technology to make PHVs commercially viable (please see page 17, including Figure H, for additional details).

CNG

A number of manufacturers have experimented with compressed natural gas (CNG) as a vehicle fuel. But interest has waned as gasoline vehicles have become cleaner and the price of natural gas has increased. Additionally, for the individual consumer CNG has many of the same issues as hydrogen: limited refueling infrastructure, reduced vehicle range, and higher fuel cost. In contrast, CNG has been very successful in transit fleets. Centralized refueling and long-term fuel contracts minimize the disadvantages, while CNG engines offer significant improvements in emissions over traditional diesel bus engines.

The fuels described above have great potential, but obstacles must be overcome before they can make a large-scale contribution. Toyota will work in collaboration with energy producers and government to overcome the challenges posed by alternatives to conventional petroleum fuels and vehicles, so they can play a meaningful role in our future transportation system.

Highway to the Future: Mobile Hybrid Experience **is a state-of-the-art interactive trailer touring the U.S. to educate consumers about alternative fuels, hybrid technology and the environment. It features hands-on displays and exhibits that highlight ways to make a positive impact on the environment. Please visit www.highwaytothefuture.com for more information.**

> ADVANCED VEHICLE TECHNOLOGIES

It is likely that a variety of alternative fuels will play a role in addressing the world's energy and climate change challenges. **In anticipation of the diverse automotive fuels of the future, Toyota is investing in a variety of advanced vehicle technologies so that our future products will be ready to operate on the most promising of these fuels as they become available.**

Hybrid Vehicles

Hybrid vehicles are here today. Toyota sees hybrid technology as a key component for improving the efficiency and minimizing the environmental impact of gasoline-powered vehicles, as well as an essential and enabling element of future powertrains. Toyota has sold more than one million hybrids worldwide, with more than half of these sales in North America — over 557,276 units through April 2007. We have steadily increased our hybrid product offering since the Prius was first introduced in North America in 2000. We now have three Toyota hybrids (Prius, Highlander Hybrid and Camry Hybrid), and three Lexus hybrids (RX 400h, GS 450h and LS 600h L). We anticipate combined sales of Toyota and Lexus hybrids of a quarter million units in North America during calendar year 2007.

Toyota runs a number of campaigns and sponsors events aimed at building awareness and understanding of our hybrid technology. These events promote the development of clean-energy vehicles and help ensure wider market acceptance. Some of the events from the past year include:

- Lexus Hybrid Drive, Lexus Owner Events and Taste of Lexus Events have been conducted across the U.S. These events increased awareness of the Lexus Hybrid Drive and highlighted ways to decrease our environmental footprint. Lexus has also created a new Web site to explore ways that consumers can minimize their impact on the environment without sacrificing comfort and luxury. Please visit **www.lexus.com/hybridliving** for more information.

Toyota has confirmed FCHV startup and operation at temperatures as low as minus 30 degrees centigrade. This was both a thrilling experience and critical milestone for the Toyota FCHV program.

- Toyota was a contributing sponsor of The Green Living Show, Toronto's first consumer show dedicated to all things green. Visitors were able to test drive hybrid vehicles. We also sponsored the EPIC (Ethical Progressive Intelligent Consumer) Sustainable Living Expo in Vancouver in March 2007.
- Toyota dealers held over 80 hybrid seminars in communities and schools to build awareness of climate change and increase understanding of Toyota hybrid vehicles.

For the fifth year, Toyota provided chauffeured hybrid vehicles to celebrities and movie industry professionals who attended the annual Academy Awards®, Independent Spirit Awards and Golden Globe ceremonies. This is another way that Toyota promotes wider market acceptance of hybrid vehicles.

For more information on Toyota hybrids, please visit **www.toyota.com/HSD** and **www.hybridsynerdrive.ca**.

For more information on Lexus hybrids, please visit **www.lexus.com/hybriddrive** and **www.lexushybriddrive.ca**.

Plug-In Hybrid Vehicles

As the global leader in hybrid vehicles, it was fitting that in July Toyota became the first vehicle manufacturer to certify a Plug-In Hybrid Vehicle (PHV) for road use in Japan. As previously discussed, a PHV offers all the advantages of a conventional hybrid vehicle, plus has the potential to recharge the on-board battery pack from home or any location providing a PHV outlet. Depending on the driving profile, regular recharging can significantly reduce gasoline consumption and potentially reduce both mobile source GHGs and criteria pollutants. Additionally, PHVs offer fuel diversity, as the vehicle can use gasoline or electricity (which itself comes from a variety of sources).

Toyota's first PHV prototype is based on the current Prius and designed to demonstrate the flexibility of the Hybrid Synergy Drive as compared to a conventional vehicle. With primarily software modifications and a larger nickel-metal hydride (NiMH) battery pack, it can accelerate briskly and is capable of reaching 60 MPH on electric propulsion alone. If higher speeds are needed or the battery is depleted, the engine starts and the vehicle operates like a conventional Prius.

Two of these first-generation PHV Prius will arrive in the U.S. during fall 2007 and will participate in the Clean Mobility Partnership program at the University of California campuses in Berkeley and Irvine. This multiyear project will evaluate vehicle, infrastructure and marketability issues of different advanced vehicle technologies — hybrid, fuel cell and PHV.

These PHV prototypes will provide data to help Toyota understand the benefits and limitations of the technology and to advance our development of a next-generation vehicle. Real world information such as fuel and electrical consumption, overall vehicle efficiency and consumer acceptance are invaluable to creating a commercially viable vehicle.

As with all electric vehicles, the primary technical challenge for PHVs is the battery. Current battery technology is inadequate for a commercial PHV product. Power and energy density must increase significantly, while cost must decrease and battery life remain similar to current hybrid batteries. These are extremely challenging targets and will likely require scientific breakthroughs to achieve.

Figure H

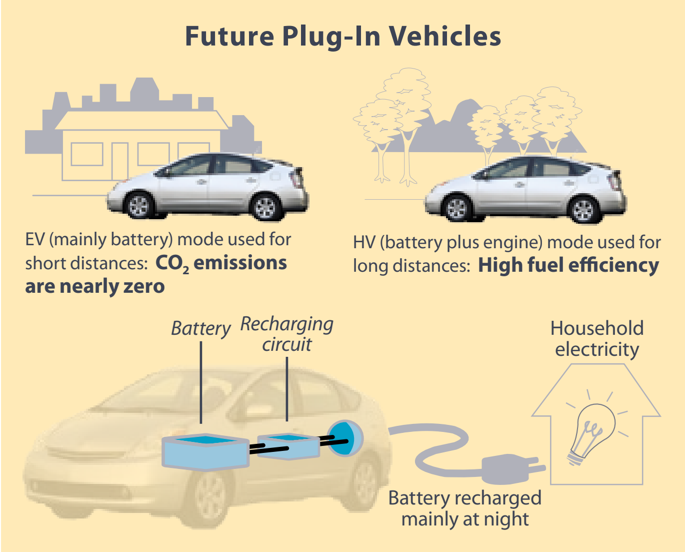
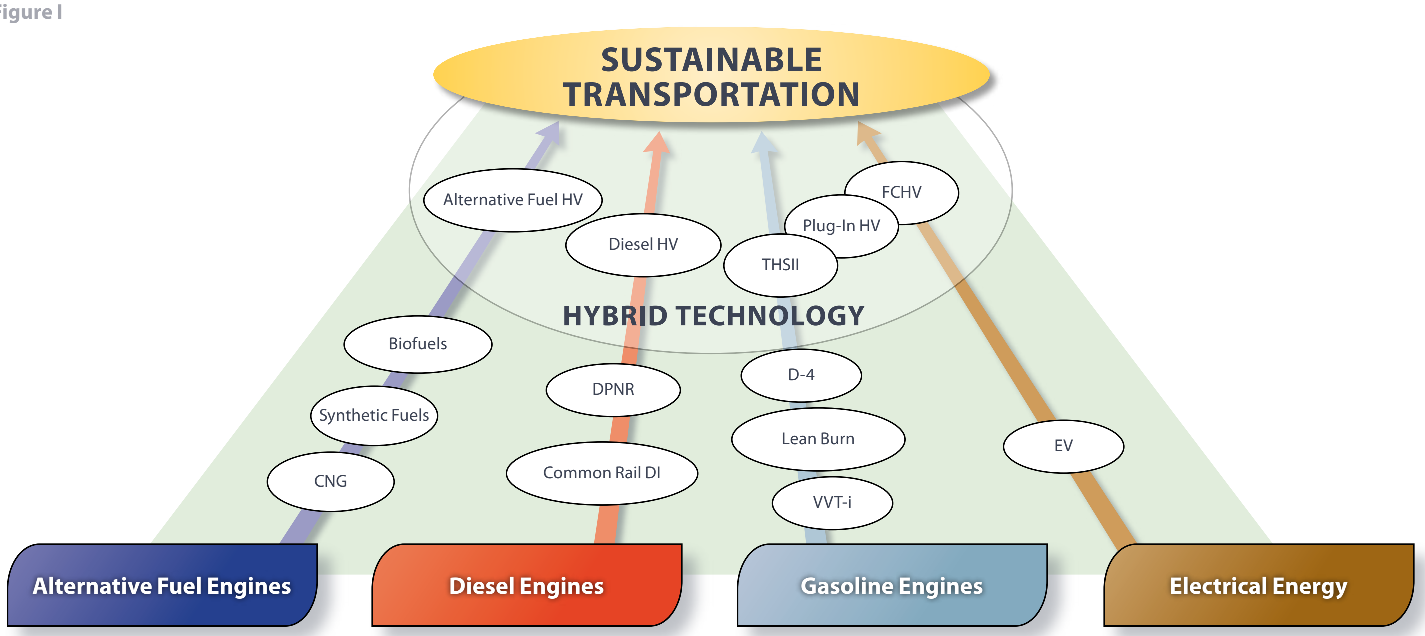


Figure I



Fuel-Cell Vehicles

As part of our previously mentioned fuel-cell technology program, Toyota maintains a group of development vehicles that allows us to continuously refine our fuel-cell hybrid vehicles (FCHVs), including vehicle durability and reliability. In addition, we continue our FCHV lease program, implemented in 2002, with universities and corporate customers. These vehicles and our fleet of development vehicles have accumulated over 140,000 real world driving miles and allowed thousands to experience the thrill of driving a vehicle that only emits water.

At this time, our primary FCHV is based on the Toyota Highlander sport utility vehicle platform. It features four 5,000-psi hydrogen fuel tanks. Hydrogen gas feeds into the Toyota fuel-cell stack where it is combined with oxygen, generating a peak of 90 kw of electricity. The electricity from the fuel cell is used to power the 121-hp (194 lbs-ft of torque) electric motor and to charge the vehicle's NiMH batteries. The battery pack harnesses energy during the braking process, and feeds power on-demand to the electric motor.

The latest generation of FCHV was introduced in 2005. The vehicle features many design improvements over the previous generation, making it more reliable, durable and easier to maintain. Toyota improved FCHV efficiency, extending its range to over 200 miles on a fill-up of hydrogen.

The Toyota FT-HS hybrid sports concept car made its debut at the 2007 North American International Auto Show. The design team for this concept car was tasked with creating a mid-priced sports car that integrates environmental considerations, safety and driving pleasure.

This past year two exciting and important achievements occurred in our FCHV development. First, the FCHV was tested in cold temperature conditions. Cold temperature operation is challenging for several reasons. Water is present in the system both as a byproduct and also as a humidifying agent for the cells, thus the potential exists for it to freeze. Additionally, the fuel cell itself must reach certain temperatures for optimal operation. Toyota has confirmed FCHV startup and operation at temperatures as low as minus 30 degrees centigrade. The successful operation of the FCHV was both a thrilling experience and critical milestone for the progression of the fuel cell program.

Last year, Toyota also had the opportunity to participate in California Governor Arnold Schwarzenegger's gubernatorial inauguration "Green Dream" event. Celebrities, dignitaries and other inauguration attendees were all transported in fuel-cell vehicles including Toyota's Highlander FCHV. This real world taxi service went off without a hitch.

We utilize each success as motivation to face the remaining challenges for fuel cell commercial introduction. Hydrogen storage is one of the greatest challenges for the commercial introduction of fuel-cell vehicles. The current driving range of fuel-cell vehicles does not meet customer expectations. Toyota is addressing this by developing high pressure hydrogen storage tanks, improving fuel-cell and vehicle efficiency, and researching advanced hydrogen storage materials.

Though not yet ready for commercial introduction, Toyota believes fuel-cell technology is needed to help reduce the automobile's impact on the environment. Therefore, it plays a key role in our technology strategy toward sustainable transportation.

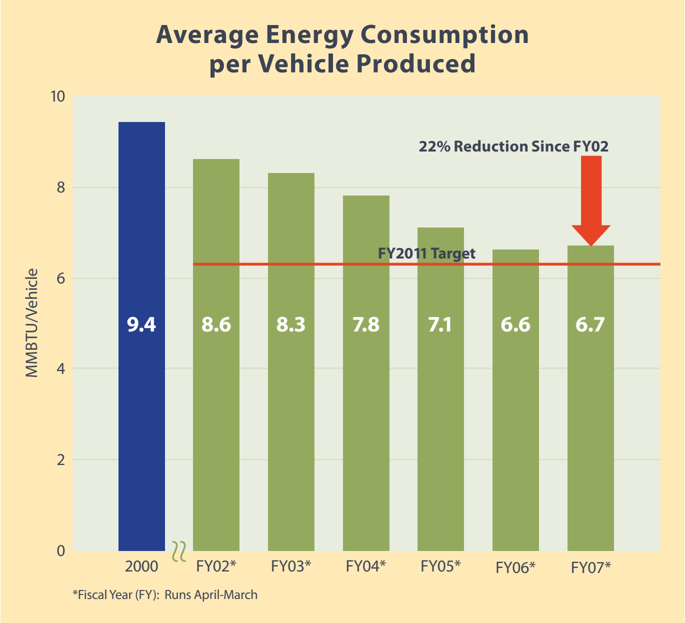
Toyota had natural gas piped to its plant site in Baja California, Mexico. Using natural gas instead of electricity helped reduce CO_2 emissions from our energy use.

> ADVANCED TRANSPORTATION SOLUTIONS

Toyota worldwide promotes initiatives to reduce traffic congestion. Advanced transportation solutions can ease traffic congestion and help reduce fuel consumption and CO_2 emissions. This is one reason why **Toyota is pursuing on-vehicle Intelligent Traffic System (ITS) technology, which allows drivers to communicate with public information systems, as part of its portfolio to address energy and climate change challenges.**

The Orange County Great Park is a master-planned development in southern California that will include over 1,300 acres of public space, including a 2.5 mile canyon, a 20-acre lake, a 974-acre nature preserve, a botanic garden, a performing arts venue, a museum and a sports park. The surrounding community will consist of residential housing and retail and commercial space, all part of a pedestrian-oriented 378-acre Transit Oriented Development with easy access to public transportation. Toyota is working with the Advanced Power and Energy Program at the University of California, Irvine on smart parking, automated routing, and other ITS solutions to minimize traffic and encourage the use of public transit at the Great Park.

Figure J



> ENERGY AND GREENHOUSE GASES IN OUR OPERATIONS

We work to reduce energy consumption and greenhouse gases throughout all aspects of our business. Described below are our targets in these areas and some of our projects at our manufacturing plants and at our sales and logistics operations.

Manufacturing

The majority of CO_2 emissions associated with our manufacturing facilities is related to our energy usage. Our facilities consume more than $100 million worth of energy annually, resulting in 1.4 million metric tons of CO_2 emissions per year. It is sound business practice to seek ways to reduce the financial and environmental costs of our energy use.

Energy

Using FY2002 as a base year, our target is to reduce total energy use in our manufacturing operations in North America by 27% per vehicle produced, to 6.3 MMBTU/vehicle produced, by FY2011. In this first year of our new Action Plan, we increased production at our nonassembly plants in Alabama and West Virginia, and expanded our nonassembly plants in Delta, British Columbia, and Troy, Missouri. Due to these production increases and facility expansions, our overall energy use per vehicle slightly increased. **Nevertheless, we are still on track to reach our target, and continue to implement pilot projects and *kaizens* to reduce energy use.**

Toyota has been an Energy Star partner since 2003. For the third year in a row, Toyota Motor Engineering and Manufacturing, North America, was awarded the 2007 Energy Star Award for Sustained Excellence in their U.S. manufacturing operations. In addition, the U.S. EPA recognized Toyota vehicle assembly plants in Indiana, Kentucky and northern California with Energy Star Plant Awards. To be eligible, a plant's energy performance for the past 12 months must be in the top 25% of its industry, and the information used to calculate the plant's energy performance score must be certified by a professional engineer. Toyota's three plants have installed energy-efficient fluorescent lamps, reduced the operational time of their paint shops by 10%, and reduced energy use by 5%.

"Toyota's energy management program is a sought-after textbook for many U.S. companies that want to benchmark themselves against the automaker."

– **Kathleen Hogan, Director, Climate Protection Partnerships Division, U.S. Environmental Protection Agency**

Pilot Project Reduces Energy Use at Plant in Cambridge, Ontario

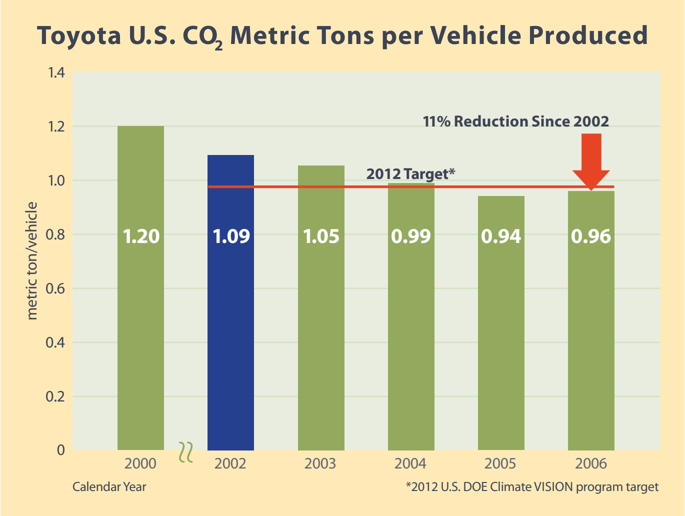
One of the ways we reduce energy use is to pilot energy reduction projects. The projects must have a payback of less than three years, and must be able to *yokoten* (be implemented) at other manufacturing plants. These projects can involve either a new technology, or a new application of an existing technology.

Implementation of a pilot project is almost complete at our plant in Cambridge, Ontario, that will use waste heat from an air compressor unit to preheat the city water before it is processed by reverse osmosis. The project is planned to improve the efficiency of the reverse osmosis system, with an estimated combined electric and natural gas reduction of 5,000 MMBTUs per year and a water reduction of six million gallons per year.

Greenhouse Gas Emissions

Energy use is the main source of greenhouse gases from our manufacturing plants. Figure K shows our GHG emissions from energy use at our U.S. plants. For Toyota's worldwide production, we are committed to a 20% GHG reduction per sales unit, by 2010, against a 2001 baseline. In the U.S., Toyota, along with other members of the Alliance of Automobile Manufacturers, participates in the U.S. Department of Energy Climate VISION program. Member companies have committed to reducing the level of GHGs emitted from manufacturing operations by 10% per vehicle produced by 2012, compared to a 2002 baseline. **We are exceeding this U.S. commitment.**

Figure K



Energy Reduction *Kaizens* at our Northern California Plant Add Up

Our assembly plant in northern California has implemented over 250 *kaizens* in the last few years to reduce energy use. While the total savings from each *kaizen* has been small, they contribute to significant overall savings.

Plastics shop converts to waterborne prime paint: This allowed the plant to decommission the carbon desorption unit (an air pollution abatement device) for the prime booth, and to eliminate electric fans supplying the carbon desorption unit and the natural gas-fired heated air loop. Natural gas used by the prime oven was also reduced (waterborne prime requires less cure time and temperature). In addition, this project saved $40,000 per year in the cost of filters, plus we no longer have to deal with the disposal of these filters. Estimated savings:

- Natural gas usage reduced by 0.1 therms/vehicle.
- Electricity usage reduced by 1.3 kwh/vehicle.

Truck paint shop modifies paint spray equipment by switching to titanium bell applicators: This change reduced the cleaning cycles in the paint spray equipment from six per day to one per day. Estimated savings:

- Natural gas usage reduced by 2.0 therms/vehicle.
- Electricity usage reduced by 2.5 kwh/vehicle.

Passenger paint shop eliminates an air makeup unit for its prime paint booth: This also eliminated several fans and reduced total natural gas used by the prime ovens and incinerators. Estimated savings:

- Natural gas usage reduced by 1.5 therms/vehicle.
- Electricity usage reduced by 5.6 kwh/vehicle.

(For more about *kaizens*, please see the Recycling and Improved Resource Use chapter.)

Sales and Logistics

Just as we do in manufacturing, we strive to improve energy efficiency and reduce greenhouse gas emissions in our logistics operations and sales offices.

Energy

Across North America, Toyota's logistics operations and sales offices are working to reduce energy consumption. **At our U.S. sales and logistics sites, we exceeded our target of 18% reduction in energy consumption (per square-foot) by FY2011, from a FY2001 baseline.** We have reduced total energy consumption per square foot by 23% (please see Figure L). With the early achievement of this target, we will be setting a new target and look forward to reporting our progress next year. Our energy efficiency investments of over $6.5 million have led to almost $11 million in avoided costs. These investments have led to cumulative savings of over 41 million kwh of electricity, 2.4 million therms of natural gas, and the avoidance of 73 million pounds of CO_2 emissions, since 2001.

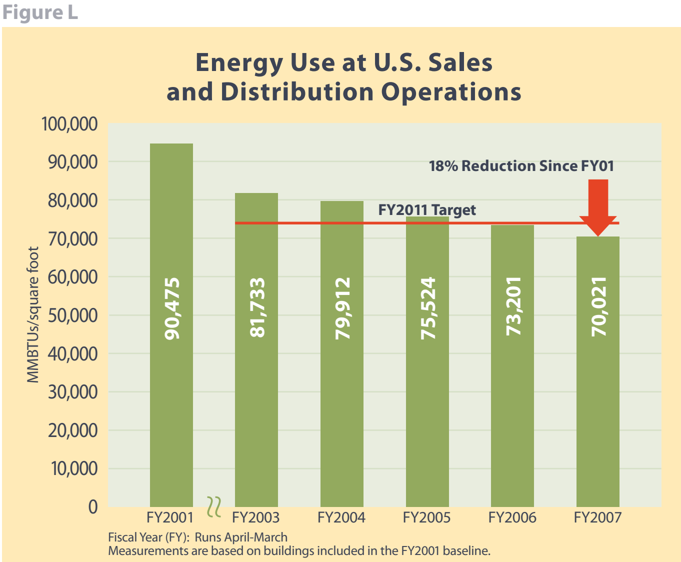
In FY2007, we completed five lighting retrofit projects at our logistics sites in Massachusetts, Illinois, Ohio and Kentucky. We switched from high pressure sodium (HPS) lights to T-8 and T-5 fluorescent lamps and installed motion sensors to automatically switch off lights in unused areas. These projects combined for an annual electricity savings of over three million kwh, and over six million metric tons of CO_2 emissions avoided.

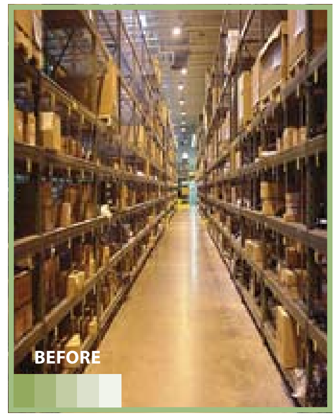
In Canada, we established a five-year target for our logistics facilities and office campus to reduce energy consumption by 10% by 2010, from a baseline of 2004. **A team has been assembled to review and analyze energy reduction opportunities.**

U.S. Sales and Logistics GHG Inventory

Toyota's U.S. sales and logistics division has been tracking GHG emissions since 2000, using *The GHG Protocol* developed by the World Resources Institute and the World Business Council for Sustainable Development. The scope of the inventory includes GHG emissions from purchased electricity, natural gas use, business travel, employee commuting, and logistics and supply activities (including our third-party logistics providers).

Figure L





These before and after photos of the parts distribution center in Boston reveal better visibility after switching to more efficient fluorescent lights.

We use the GHG inventory to help us evaluate logistics-related emission reduction methods. Much of our parts and vehicle transport is conducted by third parties. Because our activities influence the emissions of these third parties, we work with them to find ways to reduce GHG emissions. Some of the emission reduction measures put in place by one of our largest service part logistics partners include:

- Converting truck shipments to rail shipments.
- Reducing empty miles run between each shipment hauled.
- Reducing total miles run by calculating the most direct path from origin to destination.
- Training drivers via simulators to drive in the most fuel-efficient manner.
- Activating automatic engine shutdown technology on 3,100 day cabs.

ENERGY & CLIMATE CHANGE HIGHLIGHTS

- Climate change and energy diversification are two of the most daunting challenges Toyota and our stakeholders will face in the next century.
- We are addressing our current CO_2 footprint by conducting a broad North American Greenhouse Gas inventory of our operations and products.
- For the present, we are continuously improving the fuel efficiency of our full-line vehicle fleet, and we are committed to hybrid technology as a key component for improving fuel efficiency and environmental impact.
- For the future, we are investing in a more diversified portfolio of energy and fuel sources that may reduce our reliance on fossil fuel, and in advanced vehicle technologies that can operate on the most promising of these fuels.