As a leader in environmental issues, we are aggressively pursuing ways to make our products and operations more energy efficient. This is key to our vision for sustainable mobility.

– James Lentz, President & Chief Operating Officer
Toyota Motor Sales, U.S.A., Inc.
AT TOYOTA, TECHNOLOGY INNOVATION remains at the core of our vision for sustainable mobility, as well as a critical component of our five-year Environmental Action Plan (EAP). Our hybrid technology forms the foundation for our fuel cell, plug-in and electric vehicle development programs. Hybrid vehicles are helping us achieve better fuel efficiency and lower tailpipe emissions, both for carbon dioxide and criteria pollutants. This reduces the environmental impacts of driving — a key to making mobility more sustainable, particularly in urban areas where smog levels are most significant.

But for vehicle technology to continue to evolve, research is required into nonpetroleum energy sources that power a vehicle. Many of our advanced technology vehicles are designed to be powered by nonpetroleum fuels such as hydrogen, biofuels, and electricity. Each of these renewable fuels is truly sustainable only when produced in a manner that minimizes greenhouse gas (GHG) emissions. Therefore, Toyota conducts research and participates in partnerships that not only evaluate and advance the state of alternative fuel sources, but also consider the prerequisites for building a new fueling infrastructure such as that required by hydrogen. Solving these challenges toward full-scale commercialization of advanced technology vehicles is crucial to achieving a more sustainable mobility system.

Beyond the technology driving the next generation of mobility, we continue to make progress toward the goals and targets in our EAP that challenge us to decrease energy use and GHG emissions from our operations. While we were not able to implement as many capital projects because of the decrease in North American vehicle sales, we are still making reductions. By changing our attitude about how we use energy, we have found ways to scale back usage that will benefit us even when production volumes rise again. The challenge of making our products, manufacturing and distribution more energy efficient is considerable, but we are meeting it head on.

Our targets in the areas of fuel efficiency, advanced vehicle technologies, and energy and greenhouse gases are listed above, and described in this chapter.

NEW FUEL ECONOMY AND GHG EMISSIONS STANDARDS

Climate change and energy security are complex issues that require the combined efforts of governments, policymakers, corporations and individuals working together. These partnerships are particularly essential in establishing GHG emissions and fuel economy standards that are effective, feasible, and fair. For its part, Toyota strives to bring credible engineering and policy analysis to the standard-setting process. We see regulations as a challenge that can be met with advanced technology solutions.

Over the last year there has been significant regulatory action surrounding GHG emissions and energy efficiency. Most notably for auto manufacturers, the National Highway Traffic Safety Administration (NHTSA) proposed updates to the U.S. Corporate Average Fuel Economy (CAFE) standards for the first time in 20 years. Shortly thereafter, the U.S. Environmental Protection Agency (EPA) initiated the regulatory process for developing the first-ever GHG vehicle emissions standards. EPA also granted a long-standing request for California and 13 other states to regulate GHG emissions from vehicles.

Toyota supports the intent behind each of the above actions which are consistent with our corporate goals for improving energy efficiency and reducing GHG emissions. The problem for Toyota is that, when implemented together, these programs presented the auto industry with a potential myriad of overlapping and inconsistent requirements administered by different levels of state and federal government.

Such a patchwork of requirements would have required a unique design for the same vehicle model depending on where it was sold in the U.S. As a manufacturer that distributes and sells the same full lineup of vehicles across the country, and indeed across much of North America, this would create serious complications for our vehicle distribution.
**U.S. Car Corporate Average Fuel Economy, or CAFE**

**U.S. Truck Corporate Average Fuel Economy, or CAFE**

**Canadian Car Company Average Fuel Consumption, or CAFC**

**Canadian Truck Company Average Fuel Consumption, or CAFC**

*Based on NHTSA projections using latest publicly available data.*

NOTE: Unlimited use of flex-fuel vehicle (FFV) credits inflates reported CAFC results compared to actual fuel consumption.
Acknowledging that the same technology is used to address both energy efficiency and GHG tailpipe emissions, Toyota and its partners in the auto industry, federal government, and California have agreed to work toward a One National Program (ONP) approach for fuel economy and GHG emissions standards. The ONP agreement calls for compliance with the most stringent numeric standards of the CAFE, EPA and California programs, but offers flexibility so that compliance with one program will result in compliance with all three. Such an approach is designed to achieve the overall goals among the various programs while enabling manufacturers to maintain one technology development and deployment plan for future products in the United States.

The ONP will cover model years 2012 through 2016. Toyota looks forward to working with EPA and NHTSA and the rest of the auto industry in crafting post-2016 standards.

**VEHICLE FUEL EFFICIENCY**

Currently, fuel efficiency of new cars and trucks is regulated through the CAFE standards in the U.S. Today, the CAFE standard is 27.5 miles per gallon (mpg) for cars and 23.1 mpg for trucks. The Energy Independence and Security Act of 2007 increased the CAFE standard to at least 35 mpg by 2020 for the U.S. new vehicle fleet.

Under the One National Program mentioned above, NHTSA and EPA issued a proposal for new fuel efficiency and GHG emissions standards for which the new requirement has been accelerated to an equivalent of 35.5 miles per gallon by 2016.

Transport Canada continues to set voluntary Corporate Average Fuel Consumption (CAFC) targets of 8.6 and 10.45 liters of fuel burned per 100 kilometers traveled for cars and trucks, respectively. In Canada, manufacturers are able to use an unlimited (“uncapped”) amount of ethanol credits to meet the light-duty truck CAFC requirement of 10.45 liters per 100 kilometers despite the fact that E85 is only available at four service stations in Canada. Toyota currently does not use flex-fuel credits for reporting of fuel consumption. As seen in Figure E, unlimited ethanol credit usage can inflate the fuel consumption reductions reported under the CAFC program compared to the on-the-road consumption likely to be achieved with a limited supply of E85. For this reason, Toyota supports a flex-fuel vehicle credit cap for E85 vehicles in Canada similar to the current caps used in the U.S.

As shown in Figure E, we will exceed CAFE standards and CAFC targets for both passenger cars and light-duty trucks for the 2009 model year. (Target 1.1)

The most direct, immediate measure the auto industry can take to help meet the challenges posed by energy demand and climate change is to offer fuel-efficient products. Toyota offers the most fuel-efficient fleet of any full-line manufacturer (please see Figure F for more information on our gasoline vehicles). Both the U.S. EPA’s 2009 Fuel Economy Guide and the Natural Resources Canada Fuel Consumption Guide list the Toyota Prius as the most fuel-efficient vehicle available for sale in the U.S. and Canada respectively.

The government of Canada recognized the Toyota Yaris and Toyota Prius as recipients of the 2009 ecoENERGY for Vehicles awards as the most fuel-efficient vehicles in their respective classes.

Last year, we reported how low viscosity SAE 0W-20 multigrade gasoline engine oil enables increased fuel economy performance over traditional, higher viscosity oils by reducing friction while maintaining the necessary lubrication in the engine. We have expanded our lineup of vehicles that use this grade of oil. A lower viscosity differential gear oil is specified in
CO\textsubscript{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. See previous CAFC discussion regarding the unlimited use of flex fuel vehicle credits.

The Sienna, Highlander and Venza (four-cylinder), as well as in the Lexus RX. While the improvements to fuel economy seem minimal, they are representative of Toyota’s philosophy toward continuous improvement.

We also help to meet the challenges posed by energy demand and climate change by developing technologies that improve fuel economy. (Target 1.2) We are continuing to revamp all of our conventional engines and transmissions to achieve increased fuel economy, improved air quality and reduced CO\textsubscript{2} output (please see Figure G). Toyota is considering several technologies for continued or new introduction including direct injection gasoline engines, forced induction systems and diesel engines.

Finally, we consider how material choices may impact fuel economy. When it comes to materials, lighter is better, but strength is needed for safety. The use of high strength steels meets this criteria and leads to a reduction in the number of parts needed to build a vehicle because the same properties can be achieved with fewer or lighter parts. The reduced mass leads to improved fuel efficiency. Toyota currently uses ultra high strength steel grades in 2009 model year vehicles.

Biofuels are one example of this promise and challenge. Much of the activity in biofuels stems from the Renewable Fuels Standards (RFS) passed by Congress as part of the Energy Independence and Security Act of 2007. The RFS requires 36 billion gallons (136 billion liters) of biofuels to be produced by 2022 and also requires the fuels to meet certain life cycle GHG emissions criteria.

In 2007 and 2008, Toyota conducted studies with a pair of leading universities to examine the current state of biofuels research being conducted by academia and national laboratories. This work has helped Toyota better understand the direction of biofuel research and gauge the potential for biofuel commercialization to reach the levels needed to meet the RFS requirements.

Not surprisingly, much of the research is being directed toward producing biofuels from nonfood sources and reducing the energy and GHG emissions associated with their production. For example, in addition to corn and sugarcane, ethanol can be produced from the inedible portion of plants — cellulose. The process for producing “cellulosic” ethanol, though promising, has yet to be demonstrated at scale and proven economical.

This plus the costs and complexity of upgrading the fueling infrastructure to handle higher ethanol blends (above 10% ethanol) has resulted in the Department of Energy and many researchers taking a closer look at “drop-in” replacement biofuels. These “advanced biofuels” can be produced from biomass or algae and look very similar to petroleum. They are called “drop-in” because researchers are investigating ways to upgrade these fuels to allow them to be fed into existing oil refineries where they can be blended with other petroleum streams. Like cellulosic ethanol, production processes for these bio-hydrocarbon fuels have not been scaled up or proven economically viable. Other issues such as the logistics for
transporting the feedstock from the field to the factory and biomass storage to allow the production facilities to run 24/7 also need to be addressed.

Adding to these technical and economic challenges, biohydrocarbon fuels have to contend with the RFS requirement that “advanced biofuels” reduce life cycle GHG emissions by at least 50% compared to petroleum fuels. This necessitates innovative production processes that burn some of the biomass feedstock for process heat, which adds further complexity and cost to the production facility. Biofuel production will continue to grow, though it appears unlikely to meet the volumes required by the RFS without a technological breakthrough.

**ADVANCED VEHICLE TECHNOLOGIES**

We are continuing to invest in a variety of advanced vehicle technologies so that our future products will be ready to operate on the most promising of alternative fuels as they become available (please see Figure H). This includes an accelerated rollout of conventional hybrids across our entire lineup, hydrogen fuel cells, plug-in hybrids and pure electric vehicles. We are also researching advanced battery technologies beyond lithium-ion.

**Toyota is working with industry and government to solve the challenges surrounding full-scale commercialization of these vehicles.** *(Target 2.2)* Some of the programs we are involved with include the Society of Automotive Engineers’ (SAE) working groups to develop codes and standards for hydrogen infrastructure and electric vehicle charging standards, and vehicle demonstration and evaluation programs with three University of California campuses: Irvine’s National Fuel Cell Research Center, Berkeley’s Institute of Transportation Studies and Davis’ Institute of Transportation Studies for fuel-cell hybrids and plug-ins.

The University of California at Berkeley is evaluating consumer use and acceptance, infrastructure issues and environmental benefits of three advanced vehicle technologies — hybrid, plug-in hybrid, and fuel-cell hybrid. The campus has one plug-in hybrid, one fuel-cell hybrid and one 2008 Prius. Users fill out surveys about their experiences driving each of these vehicles. We expect to start seeing results in late 2009.

**Evaluation programs, along with Toyota and Lexus ride-and-drive events featuring our hybrids, demonstrate the feasibility of these advanced technologies, as well as ensure wider market acceptance of our advanced technology vehicles.** *(Target 3.1)*

**Hybrid Vehicles**

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 that will run on a diverse array of fuels such as hydrogen and electricity. Toyota and Lexus combined have seven full hybrid vehicles on the market.

Worldwide, our goal is to sell one million hybrids a year by mid-next decade and offer a hybrid version of all our vehicles by the early 2020s. Toyota globally has sold more than two million hybrids worldwide since the first Prius was introduced in 1997.

In the spring of 2009, we launched the third generation Prius (2010 model year). Prius is available with a tilt and slide moonroof that has a solar panel built into the roof. The power generated by the solar panel powers a fan to ventilate the parked Prius on hot days. This feature is tied with the world’s first remote air conditioning system that allows the vehicle to be further cooled by the hybrid battery alone. Together, these
features reduce the load on the gasoline engine, which saves fuel and reduces GHG emissions. The 2010 Prius has an EPA emissions rating of AT-PZEV/Federal Tier 2 Bin 3 (the same as the 2009 Prius). The estimated combined fuel economy has improved to 50 mpg (3.8 liters per 100 kilometers) from 46 mpg (4.1 liters per 100 kilometers) for the second generation.

The 2010 Prius is available with an optional moonroof that has a solar panel built into the roof. The power generated by the solar panel powers a fan to ventilate the parked Prius on hot days.

In 2009, we also launched the 2010 Lexus HS 250h, the world’s first dedicated luxury hybrid vehicle. The HS 250h is Lexus’ fourth hybrid and has the best combined fuel mileage rating of any luxury car in the U.S. and Canada. The HS 250h sedan’s combined fuel efficiency rating is more than 30% better than the most fuel-efficient model currently in the Lexus lineup, while earning a SULEV emissions rating utilizing regular 87-octane gasoline. The exhaust heat recovery system reduces engine warmup time, thus allowing it to stop earlier, more often, and for longer periods. A windshield with infrared-ray (IR) reduction properties, which helps keep the interior more cool, decreases the amount of air conditioning needed to lower the cabin temperature. In addition to the exhaust heat recovery system and the IR windshield, available power-saving LED headlamps also contribute to improved fuel efficiency and emissions.

For more information on Toyota hybrids, please visit www.hybridsynergydrive.com and www.hybridsynergydrive.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 is vital that Toyota explore expansion of our hybrid drive technology. A pathway that shows promise to reduce fuel consumption and emissions (including CO₂) is the plug-in hybrid vehicle (PHV).

Toyota’s PHV offers all the advantages and utility of a conventional hybrid vehicle, plus gives the consumer the ability to recharge the on-board battery pack from home or any location with an electrical outlet. Depending on the driving profile, regular recharging can significantly reduce gasoline consumption and potentially reduce both mobile source GHGs and criteria pollutants. To maximize the vehicle’s overall environmental benefits, clean electricity sources (wind, solar, nuclear, etc.) are required.

Our first PHV prototype is based on the 2008 Prius and designed to demonstrate the flexibility of our Hybrid Synergy Drive (HSD). With only software modifications and a second nickel-metal hydride (NiMH) battery pack, it can accelerate briskly and is capable of reaching 60 miles per hour (97 kilometers per hour) 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. This intelligent “blending” of the gas and electric power by the HSD system benefits the user and the environment, while not requiring costly development of new vehicle powertrains or platforms that could limit mass marketability of the technology.

Beginning in late 2009, Toyota will start global delivery of 500 Prius PHVs based on the all-new 2010 Prius and using lithium-ion batteries. Of these initial vehicles, 150 will be placed with North American fleet customers who will monitor the vehicle performance and durability while offering feedback on how future customers might respond to the plug-in process.

Our PHV prototype is based on the 2008 Prius and designed to demonstrate the flexibility of our Hybrid Synergy Drive (HSD). It can accelerate briskly and is capable of reaching 60 miles per hour on electric propulsion alone.

The lithium-ion (Li-ion) batteries powering these PHVs will be built in conjunction with PEVE (Panasonic EV Energy Company, LTD), a joint venture in which Toyota owns 60% equity. The Li-ion battery technology is similar to what Toyota has been using in the Japanese-market Vitz mild hybrid for approximately four years. These stop/start hybrids make use of a 42V Li-ion battery to instantly restart the engine whenever the driver touches the throttle.
Although Toyota has more in-use experience with Li-ion batteries than most of our competitors, we are approaching deployment cautiously. Because of its superior energy density compared to NiMH chemistry, Li-ion technology is a leading contender for the PHV application. But the PHV duty cycle (regular deep discharges) is much harder on a battery than the frequent mild discharges traditional hybrid batteries must endure. Consumers have come to expect their hybrid vehicle battery will last the life of the vehicle and are unlikely to accept anything less from a PHV. This more aggressive duty cycle and Li-ion’s sensitivity of temperature extremes are some of the reasons Toyota wants to confirm durability and reliability of the new battery technology with a modest fleet demonstration.

Over the last ten years our hybrids and their batteries have met or exceeded our customers’ expectations for durability and reliability. As a result it is vital that any new technology be thoroughly tested before widespread deployment. This way our customers can be assured that they will not have to sacrifice dependability for new technologies.

**Electric Vehicles**

Toyota announced recently that we will introduce a production electric vehicle (EV) in the 2012 time frame. This vehicle will likely be similar to Toyota’s FT-EV concept. This concept car was designed for an urban dweller who drives less than 50 miles (80 kilometers) a day or a suburbanite who has a short drive to public transportation. Toyota’s approach is to reduce vehicle size and range, thereby requiring a smaller and less costly battery. This lower cost will increase the number of potential customers.

The environmental benefit of any new vehicle technology should be measured on a “well to wheel” basis, that is, the emissions generated during production of the fuel plus those generated while driving the vehicle. An EV produces no emissions while operating, but emissions generated during power production can vary greatly depending on fuel source. “Environmental success” of electric vehicles will depend in large part on the fuel — the source of the electricity used to power the vehicle. Electricity allows energy diversity, but from a CO₂ perspective, the benefits of electricity are largely dependent on the source (e.g., coal versus hydropower).

**Fuel-Cell Hybrid Vehicles**

Toyota believes that fuel-cell hybrid vehicles (FCHVs) are another important part of our transportation future, and we have been actively developing this technology for over 15 years. In 2002 we began leasing the FCHV to customers in the U.S. and Japan. The experience gathered from over one million miles (1.6 million kilometers) of on-the-road operation has been applied to our latest generation fuel cell vehicle, the FCHV-adv, which we began delivering to limited test customers late last year.

This latest generation of technology overcomes two of the technical hurdles to commercialization, cold startability and vehicle range. By using innovative design solutions and minimizing the thermal inertia of the fuel-cell stack, we have succeeded in creating a system that can reliably start at temperatures below -30° C. We have also increased vehicle range between hydrogen refuelings by moving to in-house built 700 bar (10,000 psi) carbon fiber cylinders and improving fuel-cell system efficiency.

Last year, we described the seven-day trek along the Alaska-Canadian Highway. The prototype used for this trip is now our FCHV advanced production vehicle. To demonstrate the in-use driving range of this latest vehicle, we conducted a range and fuel economy evaluation with engineers from the National Renewable Energy Lab and the Savannah River National Laboratory. Two FCHV-advanced production vehicles were instrumented, filled with hydrogen and driven during rush hour from Torrance, California, to San Diego and back. Both FCHVs completed the 332-mile trip with enough hydrogen left in the tanks to keep going an estimated 100 miles.
FCHVs have been deployed to the University of California’s Irvine and Berkeley campuses to understand customer behavior. We are also deploying FCHVs to New York with some of these vehicles going to New York’s Port Authority to be used at John F. Kennedy and LaGuardia airports. New York is moving ahead with hydrogen infrastructure; two new hydrogen stations opened in the Bronx and at John F. Kennedy airport.

Toyota is also partnering with Shell to build a new hydrogen-only retail station near Toyota’s U.S. sales headquarters in Torrance, California. Although this is a significant accomplishment, Toyota views the current lack of hydrogen infrastructure as one of the greatest threats to fuel-cell vehicle commercialization. Existing hydrogen stations are closing as fast as new ones are being built. Without additional stations, the consumer’s ability to conveniently refuel will be reduced, resulting in overall dissatisfaction with fuel-cell technology.

We are confident that we can overcome the key remaining vehicle challenges of reducing the fuel-cell system cost and increasing the durability. Both have been improved significantly from our initial 2002 vehicles, and our engineers see a clear path to achieving cost and durability targets by 2015. We are targeting 2015 as the time frame for commercial introduction of the FCHV.

Toyota continues to participate in and support SAE’s Committee on Safety Standards. Safety is a critical aspect of market readiness for the FCHV. We contributed to the drafting of two technical papers on FCHV safety in 2008. The first paper, SAE J2578 (Recommended Practice for General Fuel Cell Vehicle Safety, January 2009), provides introductory mechanical and electrical system safety guidelines that should be considered when designing fuel-cell vehicles for use on public roads. The second paper, SAE J2579 (Technical Information Report for Fuel Systems in Fuel Cell and Other Hydrogen Vehicles, January 2009), defines design, construction, operational and maintenance requirements for hydrogen storage and handling systems in on-road vehicles.

Fuel-cell hybrid vehicles continue to be an important part of our technology strategy in the pursuit of sustainable mobility.

ADVANCED TRANSPORTATION SOLUTIONS

A key for the future of transportation safety and congestion management is the increased sophistication and proliferation of technologies that enable communication among vehicles and also between the vehicles and the roadway infrastructure. Such an approach is in harmony with the tenants of sound urban planning and sustainable mobility. At the 15th World Congress on Intelligent Transport Systems in November 2008, Toyota demonstrated applications of these technologies that were designed and developed by our engineers in Ann Arbor, Michigan. One of these applications was the Green Wave Advisor that works by the vehicle receiving phasing information from traffic signals. The vehicle interprets the information and displays a suggested range of vehicle speeds that will enable the driver to pass through a series of green lights. This advanced transportation solution is an example of our engineers developing networking technology that allows drivers and their vehicles to communicate with public information systems. (Target 4.1)

ENERGY AND GREENHOUSE GASES IN OUR OPERATIONS

We work to reduce energy consumption and greenhouse gases throughout all aspects of our business. Toyota’s manufacturing and sales divisions were jointly presented with the 2008 Corporate Energy Management of the Year Award by the Association of Energy Engineers. We received the award for our accomplishments in developing, managing and implementing an outstanding corporate energy management program.

Last year we completed our first North America-wide greenhouse gas inventory. While various parts of our organization have been conducting GHG inventories for some time, the exercise facilitated communication across our various divisions and fostered institutional learning. Across our operations, this process helped us gain a better understanding of our GHG footprint and we are now looking for ways to further reduce our impacts.

Below, we describe our targets in energy consumption and GHG emissions.

Manufacturing

Toyota’s North American manufacturing facilities consume more than $147 million of energy annually, resulting in 1.1 million metric tons of CO₂ emissions per year. Reducing the environmental impact of our energy use is a sustainable business practice because it also reduces the cost of operation at our manufacturing facilities.

Energy

Toyota has been an Energy Star partner since 2003. In 2009, Toyota earned its fifth straight Energy Star Award from the U.S. Environmental Protection Agency and the U.S. Department of Energy. (Toyota earned the 2005 Energy Star Partner of the Year Award, then four Energy Star Sustained Excellence Awards.)

Our plant in Georgetown, Kentucky, and our joint venture plant in Fremont, California, earned Energy Star Plant awards, bringing the number of plant awards received since 2006 to 14. To be eligible for the plant awards, 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. Energy improvements at Toyota’s U.S. plants have reduced CO₂ emissions by almost 150,000 metric tons since our FY2002 base year and saved over $18 million annually.
Our manufacturing plant in Delta, British Columbia, is partnering with their local utility company to implement a Sustainable Energy Management Program. Through this program, the plant committed to a one million kilowatt-hour reduction in electricity usage per year for the next two years.

Using FY2002 as a base year, we have a target to reduce total energy use in our manufacturing operations in North America by 27% per vehicle produced by FY2011. Over the past year, our overall energy use per vehicle increased (please see Figure I). (Target 5.1) This is largely due to the economic downturn and the resulting decreased production across North America. If production volumes remain low, we may not reach our per vehicle energy target by FY2011 because much of the energy necessary to operate a plant is fixed and remains constant regardless of production fluctuations.

**FIGURE I**

Average Energy Consumption per Vehicle Produced

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<td>7.6</td>
</tr>
</tbody>
</table>

*Fiscal Year (FY): Runs April-March

The increase in energy consumption per vehicle in FY2009 is largely due to the economic downturn and the resulting decreased production across North America. FY2009 production volume in North America decreased 19% from FY2008.

We have responded to this challenge by focusing on the implementation of Toyota’s “just-in-time” concept beyond parts delivery to energy consumption. Just-in-time energy delivery means using the amount of energy needed only when it is needed. This year we took advantage of the production downtime by utilizing available maintenance, production and quality resources to work together to identify and implement fixed energy reductions. Benefits from these activities will continue when production volumes increase (please see Figure J). We provide a number of examples of these activities here.

**FIGURE J**

Fixed Energy Reduction Impact

![Diagram showing fixed energy reduction impact](image)

**Just-in-Time Energy Delivery in California**

Our Long Beach, California, facility implemented several kaizens that reduced energy consumption:

- Lowering the temperature and reducing the speed of the conveyor in the electro-deposition curing oven reduced natural gas consumption by 12.5%.
- Reducing the amount of time between equipment startup and start of production start times saved over 1,600 therms per year.
- Reducing the number of agitators used in the coating process saved over 172,000 kilowatt-hours.

**Kentucky’s Race for the Green**

Our Georgetown, Kentucky, plant held another competition this past year to encourage employees to find ways to reduce energy consumption throughout the plant. The plastics shop was the winner of this year’s “Race for the Green” competition, which was themed around NASCAR. While the competition was close throughout the year, during the December shutdown (a one-week period when a number of preventive maintenance and cleaning activities occur) the plastics shop reduced their energy use by 83% from the previous shutdown. This allowed them to win the competition. In total, the plant reduced its absolute energy consumption by 16% compared to fiscal year 2008.

The plastics shop at our Georgetown, Kentucky, plant was the winner of this year’s “Race for the Green” competition. During the December shutdown, the plastics shop reduced their energy use by 83% from the previous shutdown, allowing them to win the competition.
The following activities contributed to the plant’s overall energy reduction:

- The heat recovery system in one of the paint shops generates steam which is now fed back into the main plant steam system, allowing the facility to shut off the main steam boilers between the second and first shift periods.
- Air flows in the paint shop have been reduced; therefore, it takes less energy to condition the air.
- Fans and lights are turned off when no one is in the area.
- The parking lot, roadways and walkway lights were converted from high-pressure sodium to compact fluorescents. This reduced energy consumption by more than 711,000 kilowatt-hours (10,242 metric tons per year of CO₂ reduction).

**Alabama Installs Solar Panels**

Our plant in Huntsville, Alabama, was the first Toyota plant and the first in the area to install a photovoltaic system. The new five kilowatt solar panel generates enough energy to light four bays (over 16,000 square feet or 1,486 square meters) of floor space; the equivalent of 80 60-watt light bulbs. Throughout the project the plant has worked with their local energy provider to make the project a success. With the continued success of the project and the knowledge that has been gained, the plant will look to expand the project with the addition of new photovoltaic panels in coming years.

**Greenhouse Gas Emissions**

Energy use is the main source of greenhouse gases from our manufacturing plants. Worldwide, Toyota is committed to a 20% reduction in GHG emissions per unit sold by 2010, against a 2001 baseline.

Toyota in the U.S., along with other members of the Alliance of Automobile Manufacturers (AAM), 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 (please see Figure K). (Target 5.2)

**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. In 2007, we reported that our U.S. sales and logistics sites achieved our target to reduce energy consumption (per building square foot) by 18% from a FY2001 baseline. (Target 5.3a)

We set a new target to reduce energy consumption by 26% by FY2011, from a FY2001 baseline. (We revised this target down from a 35% reduction to 26% as a result of the elimination of capital projects due to the current economic climate.)

As of the end of FY2009, we have reduced total energy consumption per square foot by 25% (please see Figure L). (Target 5.3b) A significant portion of the reductions over the past year are due to recommissioning and improving the HVAC systems at the U.S. sales headquarters complex in Torrance, California.

Five of our facilities were recognized last year by the U.S. EPA for improved energy efficiency. Efforts to optimize building performance and reduce energy consumption earned Energy
Our parts center in Ontario, California, installed a photovoltaic array that came online in October 2008. The 2.3 megawatt system is the second largest single-rooftop solar array in North America. It is expected to produce more than 3.7 million kilowatt-hours per year, providing up to 58% of the electricity needed at the facility. The system contains over 10,400 panels and covers a surface area of 242,000 square feet (22,400 square meters).

We use the GHG inventory to help us evaluate logistics-related emission reduction methods. ([Target 5.5]) By restructuring routes and increasing load density, we reduced the mileage traveled by trucks transporting Toyota parts and accessories by over 2.5 million miles (four million kilometers) over the previous year. Toyota Logistics Services, our vehicle distribution arm, joined the SmartWay℠ Transport Partnership as a shipping partner. The SmartWay program is an innovative collaboration between EPA and the freight industry to increase energy efficiency while significantly reducing greenhouse gases and air pollution. Through this partnership, Toyota has committed to increase the percentage of freight shipped by SmartWay carriers.

**Aerodynamic Improvements Reduce GHGs From Trucking**

Our logistics carriers drive over one million miles (1.6 million kilometers) per day, transporting parts and vehicles across North America. Working with our carriers, we conducted research on ways to improve the fuel efficiency of the trucks by adding aerodynamic improvement equipment such as boat tails and side skirts. In October 2008, we tested this equipment at our Arizona Proving Ground and on actual road routes, and found that between currently available aerodynamic improvements, as well as some additional in-house developed parts, an 11% improvement in fuel economy is possible. Some of our third-party carriers are already implementing some of this equipment on their fleet.

Our in-house vehicle delivery truck operation has tested additional aerodynamic improvement equipment such as removable mesh side tarps and belly pans. We have installed these on 18 trucks that run our longer routes, yielding a 6% improvement in fuel economy.

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 growing number of employees and conversion of storage space to office space may be contributing to increased energy usage. **We are currently not on track for meeting our target, but we continue to look for opportunities to reduce our usage. ([Target 5.4])**

**Greenhouse Gas Emissions**

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).

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.

**LOOKING AHEAD**

Over the next two years, the biggest challenge we continue to face in meeting our action plan targets is to find ways to make our products and our manufacturing operations more energy efficient, both in response to climate change legislation and consumer demand.