



The Boeing Company
2013 Environment Report

Building a Better Planet



At Boeing, we aspire to be the **strongest, best** and **best-integrated** aerospace-based company in the world — for today and tomorrow.



The Boeing Company

Boeing is the world's largest aerospace company and leading manufacturer of commercial airplanes and defense, space and security systems. The top U.S. exporter, Boeing supports airlines and U.S. and allied government customers in more than 150 countries. Our products and tailored services include commercial and military aircraft, satellites, weapons, electronic and defense systems, launch systems, advanced information and communication systems, and performance-based logistics and training. With corporate offices in Chicago, Boeing employs more than 174,000 people across the United States and in 70 countries. In addition, our enterprise leverages the talents of hundreds of thousands of skilled people working for Boeing suppliers worldwide.

Contents

Our Commitment	1
Performance Targets	2
Designing the Future	3
Innovating to Zero	10
Inspiring Global Collaboration	16
Results	21

Cover photo: The innovative Phantom Eye is powered by clean-burning hydrogen and emits only water in the atmosphere. (Boeing photo)

Photo above: The 737 MAX, currently in development, features a 13 percent smaller carbon footprint than today's most fuel-efficient single-aisle airplanes. (Boeing photo)

Five years ago, we set ambitious goals to reduce our environmental footprint while significantly growing our business.



Jim McNERNEY
Chairman,
President and Chief
Executive Officer
The Boeing Company

Kim Smith
Boeing Vice President
Environment,
Health and Safety

Thanks to the dedication and hard work of everyone at Boeing, we met those goals, and are prepared to make further progress in the years ahead.

During a five-year period in which we developed two fuel-efficient new airplanes and increased aircraft deliveries by more than 50 percent, we also significantly reduced CO₂ emissions, energy use, hazardous waste generation and water consumption within our operations. And we did this while opening a major new manufacturing facility, creating more than 13,000 new jobs and increasing annual revenues to a record \$81.7 billion.

As a result of our conservation efforts, the U.S. Environmental Protection Agency recognized our progress and named Boeing an ENERGY STAR® Partner of the Year for 2013—the third consecutive year we earned the recognition.

This is the type of sustainable growth that Boeing is committed to as we look toward our second century.

We are targeting zero-carbon growth over the next five years as our business continues to expand. The goal for our factories and operations is zero absolute growth in CO₂ emissions, water intake

and solid waste sent to landfills, and zero revenue-adjusted growth in hazardous materials, by 2017.

Our environmental performance extends well beyond the walls of our facilities. Boeing is researching and developing new technologies that will help define the next generation of cleaner, quieter and more fuel-efficient airplanes.

The 737 MAX, currently in development, features a 13 percent smaller carbon footprint than today's Next-Generation 737 — which already is the most fuel-efficient airplane in its class.

Our new 787 Dreamliner and the 747-8 aircraft offer a double-digit carbon footprint reduction compared to the airplanes they replace, and we are in discussions with customers on the 777X, a new derivative aircraft that is expected to provide the lowest fuel consumption per seat of any airplane in commercial service.

In September we completed the first round of flight testing in our ecoDemonstrator project, which will help speed development of environmentally progressive products, materials and designs.

Earlier this year the Phantom Eye took to the skies for its third test flight. The unmanned,

high-altitude aircraft runs on clean-burning hydrogen and leaves only water vapor in the atmosphere. We also completed flight testing of the X-48C, a research aircraft that effectively blends body and wing into a single unit that holds the promise of greater fuel efficiency and less noise.

Moving forward, Boeing is continuing its leadership role on global efforts to help the commercial aviation industry achieve the goal of carbon-neutral growth by 2020. We are working with international partners to move the development of sustainable aviation biofuels from testing to production to everyday use. We're engaged with the global industry to reduce hazardous chemicals used in our products and improve the efficiency of the global air traffic network, which will significantly reduce emissions.

We also continuously invest in breakthrough technologies to meet our customers' demand for precision performance coupled with game-changing environmental improvements.

In a time of rapid change, Boeing is committed to responsible environmental leadership and sustainable growth — building a better Boeing and helping build a better planet.

**Our Commitment:
Performance Targets**

In 2007, Boeing unveiled our first-ever five-year environmental performance targets: reducing energy use, carbon emissions, water intake and hazardous-waste generation by 1 percent on an absolute basis in our factories and offices.



Engineers, from left, Marty Bradley, Chris Droney and Zach Hoisington, design a future aircraft with greatly reduced fuel burn and environmental footprint. Boeing considers environmental performance measures throughout a product's life cycle, starting with design and manufacturing, and extending through in-service use and end-of-service recycling and disposal. (Boeing photo)

At the time, we anticipated these goals would equal a 25 percent reduction on a revenue-adjusted basis. As detailed in the Results section, we surpassed the absolute targets. Given the unprecedented growth in our core business, we met the revenue-adjusted goals for reducing carbon dioxide emissions and hazardous waste, but missed the targets for energy use and water intake.

Looking ahead to the next five years, we remain committed to zero-carbon growth by continuing our environmental conservation efforts while ramping up production. Our goal is to achieve zero absolute growth in carbon emissions, water intake and solid waste sent to landfills, and zero revenue-adjusted growth in hazardous waste generation, by 2017.

Our framework for continued progress includes considering environmental performance measures throughout a product's life cycle, starting with design and manufacturing and extending through in-service use and end-of-service recycling and disposal. We call this life cycle approach Design for Environment. It analyzes and

reduces the environmental footprint at each phase of a product's life.

Since most of an aircraft's lifetime carbon emissions occur while in service, it is critical to design and build our products with sustainable technologies to reduce the environmental footprint and increase customer value.

With Design for Environment, engineers making design decisions consider environmental performance measures that will reduce energy use, carbon emissions, water intake, hazardous materials and noise, while increasing the use of sustainable materials.

Aerospace is a complex, interconnected global industry with equally complex environmental challenges. Over the next five years, Boeing will continue to collaborate with industry groups, suppliers and regulators to improve the environmental performance of global aviation.

Boeing is a leader in global efforts to accelerate the development of sustainable aviation biofuels, which offer a cleaner

alternative to petroleum-based fuels, and to improve the efficiency and environmental performance of global air traffic management.

We will continue to work with the aerospace industry to reach the goal of recycling 90 percent of a retired airplane by 2016. Boeing was instrumental in forming the Aircraft Fleet Recycling Association, which has grown to more than 40 members working to develop sustainable solutions to recycling aircraft at the end-of-service.

Innovations in technology and engineering play a key role in continuously improving the environmental performance of our products.



Boeing tests advanced jet engine technology at NASA's Stennis Space Center in Mississippi. Innovative applications of materials such as composite matrix ceramics will make engines quieter, lighter and more efficient. (Boeing photo)

More than 75 percent of Boeing's commercial airplane R&D efforts contribute to advancing environmentally progressive innovations.

Designing with the environment in mind means our engineers "design in" greater efficiency in energy and water use and sustainable materials and "design out" carbon emissions, hazardous materials and community noise. We call the strategy Design for Environment. It analyzes and reduces a product's environmental footprint over its life cycle, starting with design and manufacturing and extending through in-service use and end-of-service recycling and disposal.

In 2012 we successfully met key milestones in research and development programs that will bring to market the next generation of more fuel-efficient airplanes and accelerate the market readiness of advanced materials and environmentally progressive technologies.

EcoDemonstrator

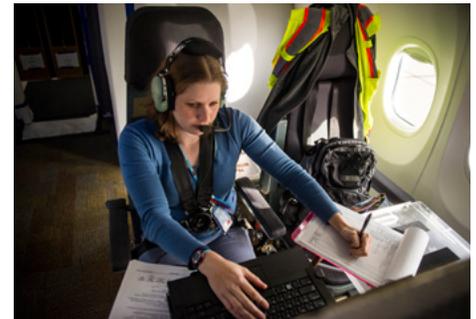
Boeing's ecoDemonstrator Program accelerates technology that will improve the environmental performance and sustainability of the aviation industry. Each ecoDemonstrator airplane tests and applies new technologies and materials that make Boeing aircraft cleaner, quieter and more fuel-efficient.

A key part of the ecoDemonstrator Program is a unique partnership with the airlines, aviation industry and the Federal Aviation Administration's CLEEN (Continuous Lower Energy Emissions and Noise) program. Over the next several years, the FAA will help fund parts of the program; for example, testing of airframe and engine technologies designed to increase the reduction of greenhouse gas emissions and community noise.

The ecoDemonstrator program's inaugural flight in 2012 used a Next-Generation 737-800 in partnership with American Airlines to test a range of innovations, including:

- » Wing-adaptive trailing edges to reduce noise and improve fuel efficiency at takeoff, climb and cruising altitudes.
- » A regenerative hydrogen fuel cell as an alternative source of cabin power with the potential to reduce fuel consumption and carbon emissions.
- » Advanced flight trajectory and in-flight planning technology that enable more fuel-efficient routes and future improvements in air traffic management.

The second ecoDemonstrator, scheduled to fly in late 2013, will use a 787 Dreamliner to test a new suite of emerging technologies. One innovative engine technology selected



Meredith Anderson, flight test engineering analyst, collects data and monitors the performance aboard the inaugural ecoDemonstrator airplane. (Boeing photo)

for the demonstration flight is an exhaust nozzle made of ceramic matrix composite material, designed to make engines quieter, lighter and more efficient. (See 'Taking the Heat' feature article on page 5.)

New-generation high-efficiency jet engines emit hotter exhaust gases and require materials that can withstand higher temperatures than titanium or super alloys, which have been industry standard for decades. Boeing researchers believe ceramic-based material could better support higher performing, more efficient jet engines that will reduce fuel burn and carbon emissions.

Aircraft Recycling

The end of an aircraft's commercial service does not mean the end of use for its components and materials. Recycling airplanes significantly reduces waste and cuts the need for new materials, which helps reduce aviation's overall environmental footprint. Advanced composite carbon fibers and metals such as aluminum are among the materials that can be recycled into new products.

Boeing was a leader in forming the Aircraft Fleet Recycling Association, which has grown to more than 40 members committed to the goal of recycling up to 90 percent of a retired airplane by 2016. Boeing is leading industry efforts to continue researching and developing improved recycling technologies and processes.

Boeing also collaborates with the University of Nottingham, England, on developing carbon fiber recycling processes and technology to process recycled fiber into new applications and products.

Cooling Without Power – New Cabin Technology

Innovative technology that reduces the environmental impacts of air travel isn't limited to the aircraft's fuselage or engines. Boeing has designed an insulated galley cart that will keep food and beverages cold for up to 17 hours without the use of traditional chillers, which are heavy and noisy and require significant maintenance and power.

The lighter cart reduces the aircraft's weight, which also cuts fuel use and carbon emissions. Engineers estimate the insulated cart could save approximately 5 million pounds (2,300 metric tons) of fuel and 15.8 million pounds (7,200 metric tons) of carbon dioxide over the service life of a single 777.

The insulated carts won a 2013 Crystal Cabin Award, an international environmental recognition from the Aircraft Interiors Expo in Hamburg, Germany, which is the largest aircraft cabin interiors show in the world.

Boeing previously won a Crystal Cabin award for co-designing 100 percent recyclable aircraft carpet tiles. Boeing and supplier InterfaceFLOR developed the carpet, which reduces the use of raw materials in production and the amount of waste sent to landfills.



A hydrokinetic turbine is readied for placement in the St. Lawrence River near Montreal, Canada. Boeing and Canadian firm Renewable Energy Research are collaborating on expanding the use of this new source of hydroelectric power. In January 2013, Boeing and RER signed a memorandum of understanding with the government of Quebec to install a six-turbine pilot project in the St. Lawrence River. The turbines provide consistent power without disrupting the river flow or surrounding natural habitat. (Boeing photo)

Taking the heat



Engineer Craig Wilsey inspects an engine nozzle made of composite matrix ceramics. (Boeing photo)

Even for an engineering manager who sees a lot of impressive technology, the engine exhaust nozzle made of ceramic matrix composite (CMC) material is a remarkable feat of engineering.

"The nozzle center body — the tapered part at the aft end of the engine — is nearly 8 feet tall. The outer nozzle that wraps around it is 5 feet in diameter. At the start of the program, before the CMC team fabricated this nozzle, the largest ceramic composite part fabricated was about the size of a notebook," says Craig Wilsey, leader of Boeing's CLEEN program.

"To produce the two largest ceramic composite objects on Earth, following specs that make it perform correctly on a jet engine, is a great team accomplishment."

CLEEN, or Continuous Lower Energy Emissions and Noise, is a five-year joint research-and-development effort with the Federal Aviation Administration. Its purpose is to accelerate the development of new technology that will lead to cleaner and quieter aircraft.

The ceramic matrix composite nozzle is one of the technologies selected to be tested onboard the next ecoDemonstrator flight, scheduled for late 2013. Wilsey said the advanced nozzle can play a big role in the next generation of more fuel-efficient engines.

"To be at peak efficiency, engines need to run extremely hot in their core — as much as 3,600 degrees Fahrenheit. The exhaust reaches over 1,200 degrees. Very few materials can stand up to that harsh environment. Ceramic composites can do the job, and thereby be a key enabler to better, more fuel-efficient engines," Wilsey says.

For the CMC team, the chance to test the nozzle onboard the ecoDemonstrator is a unique opportunity they didn't want to miss. "We are true believers in technology demonstration projects, like the ecoDemonstrator. You have the chance

to learn so much more about your technology when it's integrated onboard a real airplane in a flight test. It greatly improves its chances for a successful transition," he says.

Wilsey sees the CLEEN program's focus on environmentally progressive technology as another big opportunity for Boeing. "What personally appealed to me about this program was the chance to make a real, tangible impact on our products through technologies that reduce fuel burn, emissions and community noise," Wilsey says.

Innovation video series — Cleaner skies ahead



[Click here to learn more.](#)

Boeing continues to be a pioneer in introducing innovative new technology that improves the environmental performance of our products and services.



With innovative winglets, other design enhancements and advanced engines, the 737 MAX will burn 13 percent less fuel and generate fewer emissions with a 40 percent smaller community noise footprint compared to its predecessor. (Boeing photo)

In 2012 we introduced into service the 747-8 Intercontinental, the passenger version of the redesigned 747, with significant environmental improvements over its predecessor. Development continues on the 737 MAX, a new airplane with advanced technology that will create a cleaner, quieter and more energy efficient addition to the 737 family.

737 MAX

The 737 MAX is the newest addition to the already most fuel-efficient single-aisle aircraft on the market — the Next-Generation 737. The MAX will feature substantial environmental improvements, including burning 13 percent less fuel with a corresponding reduction in carbon emissions, and a 40 percent smaller community noise footprint compared to its predecessor.

The better environmental performance comes from a package of design and technology advances, including quieter and more fuel-efficient engines, an aerodynamically improved tail section that reduces drag on the aircraft, and the

Advanced Technology winglet, a “dual-feather” split winglet design, which is more efficient than any other wingtip currently in use on a single-aisle airplane.

787 Dreamliner

The 787 is the environmental benchmark for the aerospace industry. With advanced engines and a composite carbon-fiber fuselage and wings, the Dreamliner is 20 percent more fuel-efficient than other airplanes of comparable size and more environmentally progressive throughout its life cycle. The airplane is manufactured using fewer hazardous materials, consumes less fuel and produces fewer emissions. The Dreamliner is also quieter for airport communities than other twin-aisle airplanes.

747-8

The 747-8 Intercontinental and Freighter incorporate many of the breakthrough technology advances developed for the 787 Dreamliner, the most environmentally progressive aircraft on the market.

With advanced engines, new wing design and light-weight advanced aluminum alloys

and composite materials, the 747-8 reduces fuel consumption and carbon emissions by 14 percent, and has a 30 percent smaller noise footprint than the 747-400 it replaced. The quieter aircraft has earned a rating of “QC2” or better on takeoffs and landings. The rating on the international noise measure allows the 747-8 to use almost any airport without operating restrictions.

Lufthansa took delivery of the first 747-8 Intercontinental in 2012. The 747-8 Freighter entered service a year earlier.

The real thing



Engineer Josh Frommer found childhood aerospace inspiration by designing and building LEGO® airplanes. Frommer today is configuration leader on the 737 MAX. (Boeing photo)

Engineer Josh Frommer has been designing and building airplanes since first grade. “My parents gave me a set of space LEGO blocks when I was six and that was it; I knew what I wanted to do. I’ve been interested in airplanes and aviation ever since,” he says.

Frommer’s love of airplanes led him through graduate school in engineering and to Boeing, where today he is the configuration leader on

the 737 MAX program. “I make sure the design and all of the systems and technology integrate seamlessly on the airplane.”

The design and technology on the MAX are coming together to drive substantial improvements in the aircraft’s environmental performance. Frommer said the MAX will increase fuel efficiency and reduce carbon emissions by 13 percent as well as improve the aircraft’s noise footprint by 40 percent, compared to the Next-Generation 737.

One of the first noticeable changes on the 737 MAX is the Advanced Technology winglet, which combines a curved wingtip with a split “dual-feather” design. “We wanted to see how we could make better winglets on the MAX. The wingtip effectively gives us a longer wing span, which improves the airplane’s aerodynamic performance and, along with advanced design, accounts for 1 percent of the reduced fuel burn and carbon emissions,” Frommer says.

“If you look at a bird or a sail plane, longer, thinner wings are always better for cruising. That’s the effect we’re getting.”

Frommer said Boeing’s experience with developing the 787 Dreamliner is making a difference on the 737 MAX. “What’s great is we

are able to apply a lot of what we learned on the 787 and our understanding of aerodynamics to the 737 winglet.

And it doesn’t stop there. Our experience with the MAX will lead to more efficient designs for future airplanes, not just on winglets, but on wings, tails and engines, too,” Frommer says.

The major contributor to the improved fuel efficiency on the 737 MAX is a new advanced engine—LEAP 1B—from manufacturer CFM, which is a partnership between GE Aviation and Snecma, of France. “The MAX will benefit from technology GE developed for engines used on the 787 and 747-8,” Frommer says.

A redesigned aft body, which includes the horizontal stabilizer and tail cone, accounts for another 1 percent of the improved performance on the MAX, compared to the Next-Generation 737.

Frommer said one of the best parts of working on a new airplane such as the 737 is seeing everyone come together and agreeing on the best path forward. “When we can agree that what we’re doing is best not just for one group or program, but for The Boeing Company and our customers, and it’s worth all the effort; when we all say ‘yes,’ it feels really good.”

Innovation video series — Better wings for a better planet



[Click here to learn more.](#)

Boeing is researching and developing new aircraft designs and propulsion systems that may be the next step in the evolution of aerospace and a big leap forward in sustainable technology.



The Phantom Eye is a long-endurance unmanned vehicle designed to stay airborne for up to four days powered by clean-burning hydrogen, which leaves only water in the atmosphere. (Boeing photo)

In 2012 Boeing reached important milestones in testing two prototype aircraft designs that hold the promise of substantially cleaner, quieter and more efficient flight.

Phantom Eye

The hydrogen-powered Phantom Eye completed its third flight in April 2013 and successfully demonstrated a cleaner burning propulsion system that leaves only water in the atmosphere.

During the flight, Phantom Eye climbed to 10,000 feet (3,050 meters) and remained aloft for two hours and 15 minutes — a significant increase from its second flight in February when the aircraft reached 8,000 feet (2,400 meters) during a 67-minute flight.

Engineers expect test flights to continue in 2013 as the Phantom Eye moves toward the goal of reaching its target altitude of 65,000 feet.

The Phantom Eye is a long-endurance unmanned vehicle designed to stay airborne for up to four days at altitudes of up to 65,000 feet, powered by two, four-cylinder hydrogen engines. The Phantom Eye's first flight test was in June 2012.

Hydrogen has three times the energy content per pound of conventional fuels, which

means more performance out of less fuel. Technology demonstration projects such as the Phantom Eye will help Boeing expand its knowledge of hydrogen's potential for other applications and aircraft.

X-48C

The Boeing X-48C research aircraft completed its 30th flight in early 2013, successfully wrapping up a nearly year-long test program that further explored and validated the aerodynamic characteristics of the blended wing body design concept.

The X-48C research aircraft blends the wing and body in a new design concept that Boeing is testing to determine the aircraft's potential of significantly greater fuel efficiency and reduced noise.

The blended wing body is a departure from the conventional tube-and-wing airplane design in favor of a triangular aircraft that effectively merges the vehicle's wing and body. The blended body helps to generate additional lift with less drag compared to a circular fuselage.

Boeing and its research partners NASA and the U.S. Air Force Research Laboratory are testing to determine if the blended wing body concept offers the potential

of significantly greater fuel efficiency and reduced noise. The X-48C is a scale model of an aircraft with a 240-foot wingspan that possibly could be developed in the next 15 to 20 years for military applications such as aerial refueling and cargo missions.



The X-48C research aircraft blends the wing and body in a new design concept that Boeing is testing to determine the aircraft's potential of significantly greater fuel efficiency and reduced noise. (Boeing photo)

Innovation video series — An eye in the sky



[Click here to learn more.](#)

A flight toward the future



[Click here to learn more.](#)

Over the past five years, Boeing saved enough energy to power 44,000 U.S. homes for a year and reduced enough greenhouse gas emissions to equal removing 87,000 cars from the road for a year.



Daylight fills the renovated Chinook helicopter assembly factory in Philadelphia. Using more natural light and installing new, more efficient boilers have helped the site substantially reduce energy use. (Boeing photo)

We also diverted enough solid waste from landfills to fill 13,000 dump trucks. The reductions are the results of aggressive efforts across the company to meet ambitious five-year goals set in 2007 to reduce the environmental footprint of Boeing operations. The targets were set during a time of unprecedented growth, when production increased by 50 percent. (Specific targets and outcomes are outlined in the Results section.)

The U.S. Environmental Protection Agency recognized our progress by naming Boeing an ENERGY STAR® Partner of the Year for 2013 — the third consecutive year we earned the recognition. By receiving the honor three years in a row, Boeing moves into the award's Sustained Excellence category.

During the next five years — while aircraft production continues to increase — Boeing is committed to zero absolute growth in greenhouse gas emissions, solid waste to landfill and water intake, and zero intensity growth in hazardous-waste generation.

The improvements in Boeing's environmental performance are due in large measure to innovative projects — often led by employee teams — at facilities across the enterprise.

Philadelphia

The renovation of the Chinook helicopter assembly factory — housed in a building originally constructed in 1929 — generated substantial environmental improvements and related cost savings to our Philadelphia site. New windows and skylights throughout the factory let in natural light, reducing energy use.

The site replaced two 1920s-era boilers and one 1970s-era boiler that ran on fuel oil with new, natural gas-fired boilers, which are over 30 percent more energy efficient. The switch will cut the site's carbon dioxide emissions by an estimated 4,200 metric tons annually, a 14 percent reduction. That's equivalent to the amount of carbon dioxide absorbed by a 1 square mile (260 hectares) of pine forest containing more than 100,000 mature trees.

The new boilers also save the site \$1 million a year in lower energy bills. The improvements won the site the 2013 Pennsylvania Environmental Council Governor's award for environmental excellence.

Long Beach, Calif.

An aggressive conservation strategy is reducing waste and earning special recognition for facilities across Boeing's Long Beach, Calif., site.



One of the largest thin-film solar installations in the United States, as measured by production capacity, can be found on the roof of Boeing's newest final assembly building at the North Charleston, S.C., facility. (Boeing photo)

Over the past five years, the Long Beach Douglas Center has cut its electricity use by more than 48 percent, natural gas by 72 percent, and water intake by 25 percent. In 2012, the Douglas Center again earned the EPA's ENERGY STAR Challenge for Industry award, making Boeing the first company to win the honor three times for a single facility. The award is given each time a facility reduces energy intensity by 10 percent over a five-year period.

The Long Beach C-17 Globemaster III final assembly facility also achieved the EPA's Energy Star Challenge for Industry award — one of the first heavy manufacturing sites in Boeing to earn the recognition.

The City of Long Beach recognized the C-17 program with a sustainability award for efforts to reduce energy and water use as well as to increase recycling rates.

Thanks to efforts at each facility, Long Beach joins Boeing sites in Charleston, S.C., Huntsville, Ala., Philadelphia and Salt Lake City in sending no solid waste to landfills. Boeing defines "zero waste to landfill" to include, at a minimum, all solid waste generated by operations. It does not include hazardous waste, which is handled in accordance with applicable regulations.

Everett, Wash.

Direct employee involvement in conservation and waste-reduction efforts played a big role in helping our largest manufacturing facility in Everett, Wash., make big gains in reducing its environmental footprint over the past five years. The site:

- » Eliminated 97.2 million pounds or 4,860 truckloads of solid waste from going to landfills.
- » Increased recycling rate by 17 percent from 42 percent to 59 percent for paper, metal, cardboard, wood, Styrofoam and other materials.
- » Implemented energy conservation projects that saved nearly 33 million kilowatt-hours of energy, enough to power 2,540 homes for one year.

Site employees also eliminated 500 million commuter miles through alternative commuting programs, which reduced vehicle greenhouse gas emissions by 410 million pounds.

St. Louis

By finding creative ways to substantially increase the amount of water it reuses on-site instead of discharging into local storm sewers, the St. Louis site cut its water use by 20 percent since 2007. The main water saving strategy has been to switch from "single-pass" to "closed-loop" cooling systems, which continually reuse and recirculate water through the site's cooling towers.

Energy Use

Boeing relies on carbon-free hydroelectric and renewable energy sources for nearly half of our total electricity consumption. Hydropower provides more than 80 percent of electricity to our facilities in the Seattle area.

One of the largest thin-film solar installations in the United States, as measured by production capacity, can be found on the roof of Boeing's newest final assembly building at the North Charleston, S.C., facility. The system covers 10 acres (4 hectares) and generates 2.6 megawatts at peak production from 18,000 solar panels, or enough electricity to power approximately 250 residential homes.

LEED

Boeing designs all new construction and major renovation projects to meet a LEED Silver rating or higher. LEED, or Leadership in Energy and Environmental Design, provides a rating system based on multiple factors including the energy and water efficiency of a building, improved indoor environmental quality, and the use of sustainable sources during construction.

Boeing has LEED-certified buildings completed or in-work in California, Illinois, Oregon, Pennsylvania, South Carolina, Texas, Utah, Washington and Washington, D.C., in addition to our joint venture composite manufacturing building in Tianjin, China.

ISO 14001

Certification to the internationally recognized ISO 14001 environmental management standard has strengthened our company-wide focus on continuous improvement and enabled a common way of managing environmental processes across the company.

All major manufacturing facilities are certified to ISO 14001 standards, including the following locations:

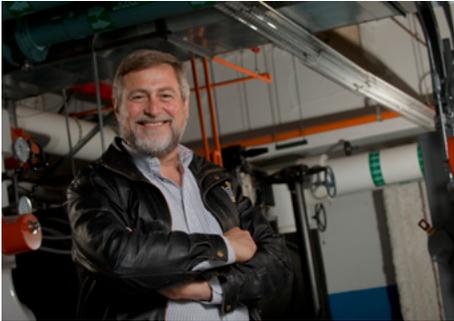
U.S. Locations:

Alabama: Huntsville
Arizona: Mesa
California: El Segundo, Huntington Beach, Long Beach, Palmdale, Seal Beach, Sylmar, San Diego, Taft and Torrance
Georgia: Macon
Illinois: St. Clair
Kansas: Wichita
Missouri: St. Charles and St. Louis
Oregon: Portland
Pennsylvania: Philadelphia
South Carolina: Charleston
Texas: El Paso, Houston and San Antonio
Utah: Salt Lake City
Washington: Auburn, Bellevue, Everett, Frederickson, Kent, Renton, Seattle and Tukwila

International Locations:

Australia: Amberley, Bankstown, Fishermans Bend, Oakey and Williamstown
Canada: Winnipeg
China: Tianjin
Malaysia: Asian Composite Manufacturing, in Bukit Kayu Hitam
United Kingdom: Bristol, Knaresborough and Welwyn Garden City

Award-winning improvements



Facilities engineer Jeff Haberman and a team in Long Beach, Calif., have helped the site cut electricity use in half and water intake by 25 percent. (Boeing photo)

In creating some of the most energy-efficient buildings at Boeing, facilities engineers at the Long Beach, Calif., site wanted to be sure employees could be directly involved in monitoring and managing their work environment.

"Anyone working in the buildings can use their computer or a touch screen monitor near the elevators to graphically see if the building temperature in their area is within the target range," explains Jeff Haberman, facilities engineer. Since equipment is turned off outside of regular business hours to conserve energy, employees can override the system for additional lighting and air-conditioning.

Encouraging employee involvement is one of the strategies that have enabled the Long Beach Douglas Center — the site's main nonmanufacturing facility — to cut its electricity use by almost 50 percent, natural gas use by 72 percent, and water use by 25 percent in the past five years.

In 2012, the Douglas Center again earned the EPA's ENERGY STAR Challenge for Industry award, making Boeing the first company to win the honor three times for a single facility. The award is given to a facility that reduces energy consumption by 10 percent within a five-year period.

Haberman says the site has been relentless in eliminating waste and improving the efficiency of its heating and air-conditioning systems. For example, the site now uses "all-variable" heating and cooling systems, which provide the optimum temperatures and system pressures for specific conditions at any given time.

"The systems used to be programmed to provide temperatures and pressures required to cool a building to match the estimated hottest days of the year. But it only hit the hottest temperature a few hours a year. The rest of the time an enormous amount of energy was being wasted," Haberman says.

Another energy-saving step was to operate the exhaust fans in the underground parking garage only when they were needed, instead of 24

hours a day. "Sensors were installed to energize the fans only when the carbon monoxide levels exceeded a maximum point. The fans operated only a couple of times in the past few years," Haberman says.

Heating, cooling and light levels are also adjusted in the evening to save energy. Haberman says the conservation plan exceeded the most optimistic computer model projections for the amount of energy saving opportunities. "We blew away the computer models. The actual system performance and investment payback are much better than anticipated," he says.

Their success also is due to good teamwork, Haberman says. "We had great collaboration with Andrew Lopez, Southwest Region mechanical expert. A team can accomplish a lot more than any one individual."

For Haberman, the most satisfying part of the site's conservation efforts has been the feedback from employees. "People really like being in this building. They come up and say, 'I want you to know how much we appreciate what you're doing.' It makes them feel good about working at Boeing. That's pretty cool."

Reduce and reuse



Environmental engineer Gary Buford tests water quality at the St. Louis site, which has cut water intake by 20 percent over the past five years. (Boeing photo)

Gary Buford knows water. The environmental engineer has been at Boeing's St. Louis site for 30 years, much of that time testing and monitoring water quality, and managing waste water treatment and discharge. Buford estimates

at one point the site was using more than a million gallons of water a day, with one-third of it going down the drain — being discharged into the local storm sewer.

"Boeing implemented aggressive environmental targets to reduce our use of water, along with energy and hazardous waste. We found solutions that helped us meet the goals and address tougher waste water regulations from the local water district," Buford says. "We thought it was the right time to reduce our water intake and reuse water in as many ways as we could."

A St. Louis team of environmental scientists and facilities leaders designed a water conservation plan that focused on eliminating a huge source of waste at the site: "single pass" uses of water. In a single-pass process, county water is used to cool a piece of equipment and then discharged directly into the storm sewer.

The team found many single-pass water uses and provided a "closed-loop" alternative. In a closed-loop system, water used on-site is sent

to the cooling tower for reuse, instead of being discharged into the storm sewer. Buford says the closed-loop systems and other conservation projects are saving the site millions of gallons of water a year and substantially lowering costs.

The site has reduced water use by 20 percent since 2007, and more conservation projects are planned in 2013. Buford says he feels a lot of personal satisfaction from seeing the improvements the site has already made. "I've got the best job in St. Louis, in my opinion."

Team tackles waste



A team of environmentally active employees has been instrumental in reducing solid waste sent to landfills and boosting recycling at Boeing's massive parts warehouse near Seattle, Wash. Pictured top row, from left, are Desmond Chanez and Joe Schoepfer; bottom row, from left, are Sandy Holtman, Dave Mulhall, and Dae Groseclose. (Boeing photo)

A team of environmentally active employees at the Spares Distribution Center in Seattle started helping the massive warehouse reduce energy use and waste by bringing their personal recycling and conservation habits from home into the workplace.

"I live out in the country and don't have a lot of services. We take care of trash hauling and recycling ourselves. When they started this team, I thought there are things I do at home that we could do here on a larger scale," says Bill Woomer, materials processing facilitator.

Teammate Dave Mulhall agrees. "We got good project ideas from brainstorming: What do you do at home? What do you see in the warehouse?"

The team's brainstorming and conservation ideas have helped make a big difference: the warehouse reduced the amount of trash sent to landfills by 70 percent, from 122 tons annually in 2009 to 38 tons in 2011. The percentage of solid waste recycled has jumped from 77 percent to 93 percent.

The team of volunteers came together in 2009. Their first big project was to tackle the enormous amount of waste being dumped in the trash and sent to landfills.

"When boxes and crates would come into receiving, someone would open the container, inspect the part, and throw away all of the packaging material. But then someone else would use new material to repackage the part for storage. It didn't make sense," says fellow team member Dean Ramert.

"We started saving and reusing the packaging from incoming containers and reducing how much new packing material we bought. It made a huge difference right from the start," he says.

"That project was one of our early successes, and I think it encouraged the team that, yes, we can make a difference," Mulhall adds.

Another tactic for reducing incoming waste has been to work directly with suppliers. "If our employees in receiving see a part arrive with a "packaging discrepancy" — such as four bolts shipped in a huge box stuffed with paper — we'll contact the supplier and recommend different packaging," Ramert says.

Environmentally progressive standards for reducing shipping waste also are part of all supplier contracts, he says.

The team has made it easier for warehouse employees to recycle and reduce waste by adding more recycling bins throughout the facility and reducing the number of garbage cans.

The distribution center's success in reducing waste and improving efficiency is part of Boeing's environmental leadership, Ramert says. "It's part of what we call the Boeing Edge. Protecting the environment and continually improving our operations are core values that help make us a global leader."

In the past year, Boeing has met key milestones and is making steady progress in cleaning up and restoring the environment at sites affected by past business practices.



A biofilter storm water treatment system uses natural processes to capture pollutants before releasing cleaner water back into the watershed at the Santa Susana remediation site. (Boeing photo)

Boeing's remediation program is guided by input from neighborhood and community groups and close collaboration with federal, state and local regulatory agencies. Boeing's community outreach and public education programs received special recognition in 2012 from the U.S. Environmental Protection Agency and the Wildlife Habitat Council.

Remediation is largely performed at former manufacturing sites and facilities where Boeing, or acquired companies, shipped chemicals and other waste for treatment, storage or disposal. In many cases, waste-processing facilities that used treatment methods considered best practices in the past are being cleaned up to meet or exceed current environmental standards.

The Lower Duwamish Waterway

In early 2013 Boeing completed the first phase of removing an estimated 200,000 cubic yards (152,911 cubic meters) of contaminated sediment and replacing it with clean sand along a half-mile stretch of the Lower Duwamish Waterway near its former Plant 2 site in Seattle. Construction also began on the first section of a planned 5-acre (2-hectare) wetland and habitat project that will provide an important ecological resource to improve Puget Sound fish runs.

Dredging the riverbed and restoring the waterway's shoreline and wildlife habitat

are expected to be completed by 2015. Boeing's Plant 2 was demolished in 2011 to make way for the cleanup and restoration project.

This work at the former Plant 2 site is one of several "early actions" in the larger Superfund project to clean-up a five-mile stretch of the industrial Lower Duwamish Waterway. Boeing is one partner — along with the city of Seattle, King County, the Port of Seattle and other businesses along the waterway — in the overall cleanup effort.

Santa Susana

Boeing is using natural processes to help clean up storm water at its Santa Susana site. Engineers installed an innovative biofilter storm water treatment system that uses natural settling, plants, soil processes and specially designed filter media to capture sediment and pollutants before releasing cleaner water back into the watershed.

The newly installed \$600,000 system supports Boeing's overall strategy to use natural processes to treat storm water at Santa Susana and is one component of the company's comprehensive surface water treatment program. This system supplements other state-of-the-art treatment systems the company is utilizing to manage storm water and groundwater at the site.



Boeing completed the first phase of removing contaminated sediment and replacing it with clean sand along a half-mile stretch of the Lower Duwamish Waterway. (Boeing photo)

Since acquiring a portion of the site in 1996 as part of the defense and space businesses of Rockwell International, Boeing's team of geologists, engineers and experts in surface water, ground water and radiation have been working to clean up the 2,850-acre (1,153-hectare) facility.

Other Santa Susana cleanup activities include removing or treating 74,000 cubic yards — enough to fill 4,625 dump trucks — of contaminated soil; installing 400 groundwater monitoring and extraction wells; adding an advanced groundwater treatment system; removing 400 buildings, tanks, test stands and structures; and replanting 900 acres of land with native vegetation and reseeding the area with native plants and grasses. The company's goal is to complete the cleanup and preserve the site as open space park land.

The site is increasingly recognized as a critical bird and pollinator habitat, and in 2012 the national Wildlife Habitat Council awarded Boeing the "Corporate Lands for Learning" certification to honor the company's education programs at Santa Susana.

Chemical Commodities, Inc.

The EPA recognized Boeing's environmental achievements in 2012 with one of its highest honors — the Leading Environmentalism and Forwarding Sustainability (LEAFS) award — for the company's work cleaning up and revitalizing a Superfund site in Olathe, Kan. It was the first time the EPA presented the award in Region 7, which covers several Midwestern states.

The 1.5-acre (0.6-hectare) Chemical Commodities, Inc. site near Kansas City was operated as a chemical brokerage and recycling facility. Rocketdyne, which was briefly part of Boeing, shipped wastes to the site for recycling for a short time in the 1960s.

Boeing completed construction of the final cleanup remedy in 2011, a full year ahead of schedule. In presenting the LEAFS award, the EPA credited much of the project's success to Boeing's extensive outreach to the public and community groups in plans to restore the site and provide pollinator habitat and educational benefits to the community.

The EPA now includes lessons learned from the CCI project in presentations to its

project managers about how other sites can implement similar strategies.

Huntington Beach

An innovative use of treated groundwater to cool buildings at Boeing's Huntington Beach, Calif., site is helping the environment and earning praise for the company's remediation program from state officials.

Instead of discharging treated groundwater from a site remediation project into the storm sewer, engineers instead designed a system that routes the water to the facility's cooling tower. This system reduces the facility's dependence on the city water supply by up to 70 thousand gallons per day, with the overall reuse estimate to be approximately 18 million gallons per year.

Turning the tide



[Click here to learn more.](#)

As the world's leading aerospace company, Boeing plays a major role in helping the commercial aviation industry achieve its goals of carbon-neutral growth from 2020 and a 50 percent reduction in carbon emissions by 2050.



Boeing plays a major role in global environmental research that is helping the commercial aviation industry achieve its goals of carbon-neutral growth from 2020. (Boeing photo)

Effective strategies for maintaining and reducing current levels of greenhouse gas emissions will be critical as demand for worldwide travel continues to increase. By some estimates, the current worldwide fleet of 20,000 in-service aircraft will double by 2030. It's estimated that aviation accounts for between 2 and 3 percent of total global carbon dioxide emissions, and Boeing is committed to making sure that doesn't grow as air travel continues to expand.

To achieve this, Boeing is focusing on building more fuel-efficient airplanes, promoting the development of sustainable aviation biofuels, and improving the efficiency of the global air traffic system.

Sustainable Aviation Biofuels

More than 1,500 commercial and military flights have been powered by sustainable biofuels, successfully demonstrating the alternative fuels' performance on a variety of aircraft without requiring any modifications to the airplanes or engines. A Boeing 747-8 Freighter and 787 Dreamliner were involved in the first transatlantic and transpacific biofuels flights in 2011 and 2012.

Boeing is working with international partners to help biofuels development move from "proof" to production — accelerating the scale-up and commercialization of a sustainable biofuels industry.

Examples of Boeing's biofuels partnerships include:

- » Collaboration with the Sao Paulo Research Foundation and other stakeholders on defining a pathway to a viable aviation biofuels industry in Brazil.
- » In the U.S., collaboration with United Airlines and other stakeholders on the Midwest Aviation Sustainable Biofuels Initiative (MASBI).

The projects' final reports, expected in 2013, will offer recommendations that can guide research, business and policy decisions on developing the aviation biofuels industry in each region.

Boeing also is an active partner in ongoing biofuels research initiatives in China and the UAE.

In a boost to biofuels growth, in April 2013 the U.S. Department of Agriculture announced a five-year extension of its biofuels research program with Boeing, the Federal Aviation Administration and other industry groups. The program's goal is to support the annual production of 1 billion gallons of drop-in aviation biofuel by 2018.

A sustainable aviation biofuel meets or exceeds jet fuel standards, produces lower

carbon emissions over its life cycle, and does not displace food crops or compete with water or other land-use resources. A viable aviation biofuels industry offers an alternative to petroleum-based jet fuel.

Operational Efficiency — Air Traffic Management

The 100,000 daily commercial flights at airports around the world are wasting an estimated 8 percent of their fuel — and generating unnecessary greenhouse gas emissions — because of outdated and inefficient air traffic operations and technology.

The environmental benefits from improving air traffic management and onboard flight technology are substantial: Boeing and the [Air Transport Action Group](#) estimate that updating ATM and onboard technology could reduce annual fuel consumption by 9 million tons and CO₂ emissions by 28 million tons. That's equivalent to the annual CO₂ emissions from 1.44 million average U.S. homes or 5.8 million average vehicles.

Cutting the average flight time by just one minute would save airlines \$1.5 billion a year in fuel and operating costs.

Boeing closely collaborates with industry groups and international regulators working to improve global air traffic efficiency.

In a major step forward in 2012, the [International Civil Aviation Organization \(ICAO\)](#), a United Nations organization, adopted a new vision and framework that will guide global air traffic improvements.

The framework is based on “block upgrades” — or standardized enhancements — that will help ensure that air traffic improvements around the world are coordinated and based on technology and procedures that operate together safely and efficiently.

Boeing is an ICAO advisor and member of the team that developed the upgrades and recommended improvements.

Boeing is working directly with [Commercial Aircraft Corporation of China \(COMAC\)](#) on two joint research projects to improve the

long-term efficiency, safety and environmental footprint of China’s commercial aviation system.

In research funded partially by the U.S. Federal Aviation Administration, Boeing has demonstrated onboard technology that cut fuel consumption and reduced carbon emissions by up to 35 percent during the descent and landing phases of a flight. Boeing also has developed GPS-based precision navigation technology that enables aircraft to fly precisely defined routes that reduce flight miles, save fuel and reduce emissions and noise.

Flying smarter



Engineer Monica Alcabin and a team of avionics engineers evaluate the amount of fuel that can be saved from Boeing-developed technology and strategies. (Boeing photo)

Most air travelers are familiar with the common flight delays that happen as aircraft trying to land are told to stay aloft and circle a busy airport, or as they sit on a runway waiting for clearance to take off into increasingly crowded skies.

Aerospace engineer Monica Alcabin understands those delays don’t just burn time.

“Air traffic controllers follow very detailed procedures to keep airplanes separated correctly and in the proper sequence during takeoff and landing. Anytime an airplane is told to level off and slow down, it burns extra fuel, which means more carbon dioxide in the atmosphere and higher costs for the airline,” she says.

Alcabin and a team of avionics engineers evaluate the amount of fuel that can be saved from onboard technology and strategies Boeing has

developed to improve the operational efficiency of the global air traffic management system. The challenge and opportunity are substantial.

Industry experts estimate that updating onboard and air traffic management technology could reduce annual airline fuel consumption by 9 million tons, with a corresponding cut in CO₂ emissions that is equal to taking 5.8 million average vehicles off the road.

To calculate the potential fuel savings, Alcabin first looks at the data from a scheduled commercial flight to see how the aircraft actually flew while mixed with other flights. “Then we ask, ‘What if we could design an optimal flight?’ We’ll map out the new flight and work with propulsion experts to compute how much fuel the aircraft would save,” she says.

What is an “optimal” flight? “It’s the way the aircraft would fly if it were the only one in the sky. It would have an unrestricted climb after takeoff. Then it would fly at the optimal altitude in the most direct path to its destination,” Alcabin says.

“When it’s ready to descend, the airplane would follow an ‘optimized profile descent,’ which would be like gliding into the runway. The aircraft would not have to make numerous turns or level off and waste fuel to fit in with other traffic.”

The benefits from several Boeing-developed flight deck technologies have already been proved, Alcabin says. In research funded partially by the U.S. Federal Aviation Administration, Boeing has demonstrated onboard technology that cut fuel consumption and reduced carbon emissions by up to 35 percent during the descent phase of a flight.

Boeing also has developed GPS-based precision navigation technology that enables aircraft to fly precisely defined routes that reduce miles flown, save fuel and reduce emissions and noise.

Developing the flight deck technology is one step in the process. “You don’t get the benefit just by putting the equipment on an airplane. The improvements come when the airplane avionics work with infrastructure and technology on the ground and new airspace procedures. That’s why it’s crucial that we work with customers, industry groups and regulators around the globe,” Alcabin says.

To that end, Alcabin was one of the authors of an industry guide, “Accelerating Air Traffic Efficiency – A Call to Industry,” jointly published in 2012 by Boeing and the Civil Air Navigation Services Organization. It’s part of an ambitious plan to improve stakeholders’ understanding of the opportunities in improving global air traffic management.

Second life for Boeing airplanes



[Click here to learn more.](#)

Meaningful progress in reducing the environmental impacts of the aerospace industry will require cooperation among airplane manufacturers, their suppliers and customers, and regulators around the world.



Don Williams, left, and Troy Webster prepare the first Next-Generation 737 beam for processing in the new plating facility at Boeing's Portland, Ore., site. The facility is investigating the possible use of a water-based degreasing system to reduce the use of solvents, along with other chemical-reduction strategies. (Boeing photo)

Boeing is leading global collaboration that is finding solutions for often complex environmental challenges.

International Aerospace Environmental Group

Aerospace companies are required to identify and report chemicals and other substances used in the manufacturing of their products. It can be a daunting task: thousands of suppliers provide parts for airplanes. Boeing's 747 has six million parts.

Boeing led the 2011 formation of the **International Aerospace Environmental Group** to help the industry develop common standards for working with the global supply chain on chemical regulations and other environmental issues. It has grown to 25 members — including Airbus and several jet engine manufacturers — who together represent over half of total aerospace market revenue.

The collaboration on chemical requirements is timely. The European Union, under the chemical regulation called REACH, has published a list of more than 100 chemicals and substances potentially used in aircraft manufacture that aerospace companies must report. To help the industry meet these

requirements, IAEG has created a voluntary, standardized approach for companies to use with suppliers in collecting the data.

The common industry standard improves efficiency, reduces costs by eliminating the need for each company to develop its own system, and encourages the industry to identify environmentally responsible ways to replace these chemicals.

Later this year, the IAEG will release a common standard for collecting and reporting greenhouse gas emissions. The group also is developing a standard environmental vocabulary to replace multiple forms of jargon used throughout the supply chain.

Hazardous Materials

Boeing is leading industry efforts to find alternatives for hazardous materials used in manufacturing and operating aircraft. A major focus of research and development is on finding replacements for halon, used in aviation for fire protection.

Halon alternatives are available or undergoing testing to meet stringent requirements for use in the passenger cabin and flight deck. Two new industry

collaborations launch in 2013 to find halon replacements for wider use in the engine, auxiliary power units and cargo compartments.

Boeing is helping to establish an industry research consortium to accelerate the development of an industrywide non-halon solution for propulsion systems fire protection. Boeing is also leading an industry working group to establish a time frame for developing cargo halon replacements for the **International Civil Aviation Organization**, a United Nations organization that promotes global aviation safety.

Building trust



Environmental Director Christer Hellstrand leads Boeing's global collaboration to help the industry meet environmental regulations. (Boeing photo)

It starts with trust. Convincing aerospace companies who are often rivals to work together on areas of mutual interest and benefit isn't necessarily easy. The formation of the International Aerospace Environmental Group (IAEG) is a good example.

"That was a big hurdle when we first came together in 2010. At the time there was little trust among the founding companies," explains Christer Hellstrand, Boeing's director of environmental capabilities and compliance. Hellstrand was instrumental in the IAEG's launch.

"We had Boeing and Airbus, Bombardier and Embraer, along with engine manufacturers Rolls-Royce, GE and Pratt & Whitney, and other major drivers in aerospace trying to work together on something entirely new. I'm happy to say that after two years, I think we have built together a high level of trust, which has been critical to the group's success."

The IAEG began with 11 companies and has grown to 25 members who represent 60 percent of the aerospace industry's total revenue.

Hellstrand says a foundation for the companies' successful collaboration is a regular pattern and rhythm of working together. It is a simple but effective process for the group to build and maintain momentum.

"For example, when you're leading a team in a company, you always have what we call a morning 'standup,' or a time when the whole team comes together. What is the plan for the day? What help do you need?"

Hellstrand says it's more complicated with a global team such as the IAEG, but company representatives maintain a schedule of weekly teleconferences, semiannual in-person meetings, and quarterly board meetings. "A regular cadence of coming together is critical, especially for a group of this scope and geographic diversity, if we're going to make progress."

And in the past year the IAEG has made good progress. It created a voluntary, standardized approach that aerospace companies can use with their suppliers in collecting required chemical data. Later this year, the group will release a common industry standard for the collection of greenhouse gas emissions data.

There is another key ingredient in the IAEG's success, Hellstrand says. "I think the key was to not give up. It would have been easy to say this is too difficult. Tenacity was critical, and it paid off."

While growing our business, increasing production and hiring more than 13,000 new employees, Boeing has steadily reduced its environmental footprint.

Summary of Environmental Performance

2007–2012

	2007	2008	2009	2010	2011	2012	Percent Improvement Absolute	Percent Improvement Normalized
Revenue (U.S. dollars in millions)	\$66,387	\$60,909	\$68,281	\$64,306	\$68,735	\$81,698	N/A	N/A
Employment (year end)	159,313	162,191	157,073	160,537	171,175	174,429	N/A	N/A
Deliveries (commercial airplanes and defense new-build production aircraft)	552	474	602	577	592	745	N/A	N/A
CO₂ emissions (in millions of metric tons)	1.29	1.25	1.21*	1.17*	1.20*	1.17	9%	26%
Energy consumption (in millions of MMBTUs or trillions of British Thermal Units)	12.97	12.71	12.67	12.27	12.87	12.64	3%	21%
Hazardous waste (in thousands of U.S. tons generated)	8.99	7.71	8.15	6.94	7.50	7.40	18%	33%
Water intake (in billions of U.S. gallons)	1.83	1.81	1.71	1.63	1.66	1.80	2%	20%
Solid waste diverted from landfills (as a percentage of total nonhazardous solid waste generated)	58%	64%	68%	73%	76%	79%	36%	N/A
Environmental fines (U.S. dollars in millions)	\$0.472	\$0.024	\$0.028	\$0.647	\$0.226	\$0.079	N/A	N/A

*2009–2011 CO₂ emission totals have been adjusted to reflect updated U.S. EPA eGRID factors.

» *2009–2011 CO₂ emission numbers are adjusted to reflect the use of updated U.S. EPA regional eGRID factors.

With the close of 2012, the company concluded its first-ever five-year goal to improve companywide environmental performance: to reduce greenhouse gas emissions, energy use, hazardous-waste generation and water intake by 25 percent on a revenue-adjusted basis and by 1 percent on an absolute basis.

On an absolute basis, Boeing reduced CO₂ emissions by 9 percent, energy use by 3 percent, hazardous waste by 18 percent, and water intake by 2 percent since 2007.

On a revenue-adjusted basis, Boeing reduced CO₂ emissions by 26 percent, energy use by 21 percent, hazardous waste by 33 percent, and water intake by 20 percent since 2007. In 2012, 79 percent of the solid waste we generated was

diverted from landfills — a 36 percent improvement since 2007.

Data reported in this section reflects environmental performance at the following sites, which represent the vast majority of Boeing’s operations in the United States:

- Alabama:** Huntsville
- Arizona:** Mesa
- California:** Anaheim; El Segundo; Huntington Beach; and Boeing Defense, Space & Security operations in Long Beach
- Kansas:** Boeing Defense, Space & Security operations in Wichita
- Missouri:** St. Charles and St. Louis
- Oregon:** Portland
- Pennsylvania:** Philadelphia
- Texas:** Houston and San Antonio
- Washington:** Auburn, Developmental Center, Everett, Frederickson, Kent Space Center,

Boeing plays a major role in global environmental research that is helping the commercial aviation industry achieve its goals of carbon-neutral growth by 2020. (Boeing photo)

Moses Lake, North Boeing Field, Plant 2, Renton and Thompson

In some cases, data from additional sites and office locations are included. When that occurs, it is indicated in the footnotes accompanying data tables and graphs.

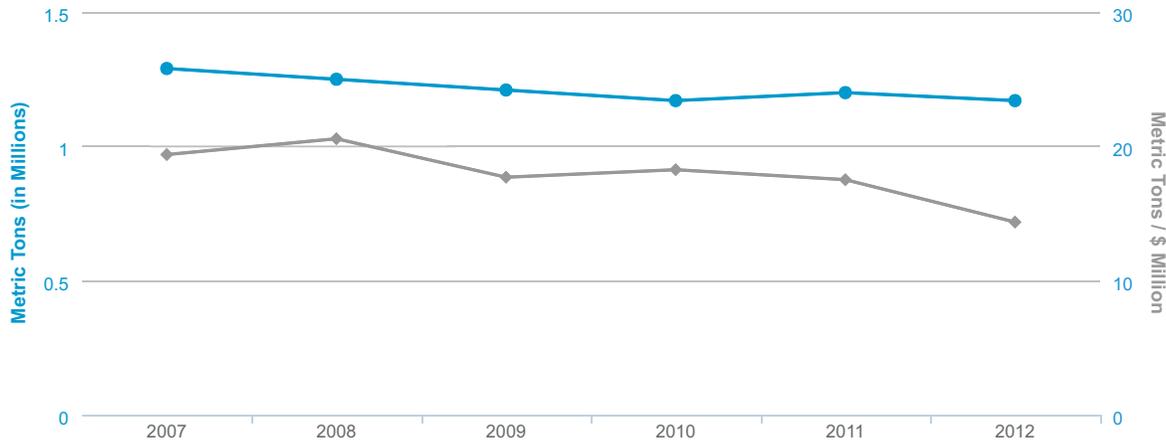
The graphs in this section are labeled with information rounded to the nearest decimal place. However, graphs throughout this Environment Report are calculated using whole values. Consequently, some slight variation may occur for the purpose of creating visual presentations.

**Our Results:
CO₂ Emissions**

Since 2007, Boeing's CO₂ emissions have decreased by 9 percent on an absolute basis, 26 percent revenue-adjusted. During this five-year period, cumulative reductions total 420,000 metric tons, which equals taking 87,000 cars off the road for one year.

Carbon Dioxide Emissions

- **Absolute** Improved by 9% since 2007
- ◆ **Revenue Adjusted** Improved by 26% since 2007



- » In addition to data from Boeing's 23 Core Metric Sites, also includes data from Bellevue, Wash., South Park, Wash., Longacres Park, Wash., Spares Distribution Center, Wash., Duwamish Office Park, Wash., Chicago Corporate Headquarters, Boeing Commercial Airplanes' operations in Long Beach, Calif., Seal Beach, Calif., PDX (Portland), Ore. and Boeing South Carolina.
- » 1 metric ton = approximately 2,204.62 pounds.
- » CO₂ emissions are calculated based on consumption of electricity, natural gas and fuel oil. (Our facility in Philadelphia is the only major U.S. site that uses fuel oil for heating.) Consumption of other fuels is not represented.
- » 2007–2008 emissions from purchased electricity are calculated using U.S. EPA regional 2010 eGRID electricity CO₂ factors (representing 2007 energy profile); 2009–2012 emission are calculated from 2012 eGRID electricity CO₂ factors (representing 2009 energy profile).
- » Emissions from natural gas, fuel oil and on-site generated electricity are calculated using the emission factors provided in US EPA GHG Mandatory Reporting Rule.
- » Comparing with numbers reported last year, 2009–2011 totals have been adjusted to reflect use of U.S. EPA regional 2012 eGRID factors.
- » Boeing South Carolina has made arrangements to purchase Renewable Energy Credits (REC), and has offset around 23,000 metric tons of CO₂ emission. Portland also purchased RECs to offset around 3,000 metric tons of its CO₂ emission.

Det Norske Veritas provided third-party verification of the greenhouse gas emissions data Boeing submitted to the Carbon Disclosure Project using the guidance provided in ISO 14064 with limited assurance.

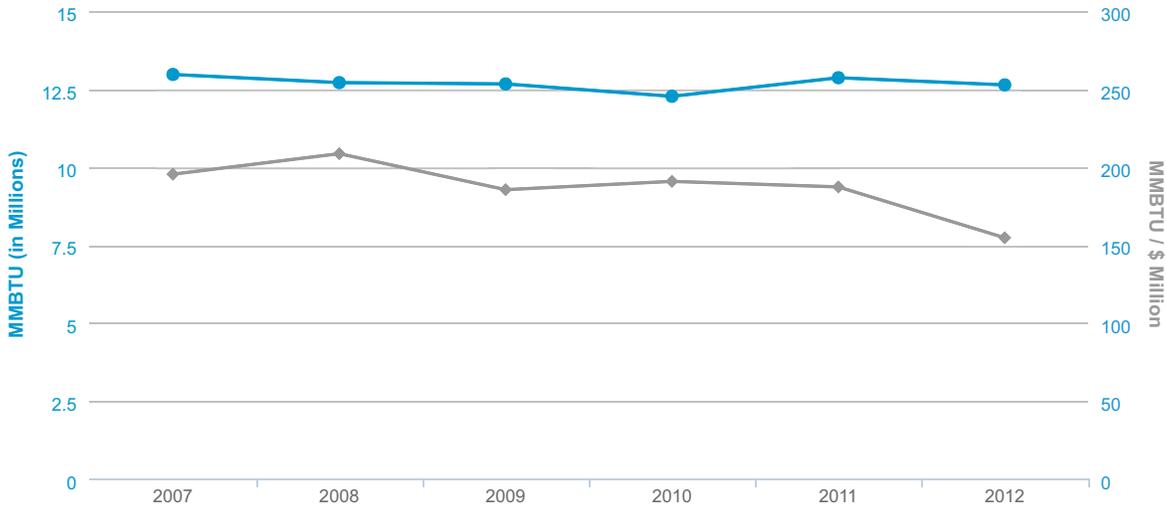
**CUT CO₂
EMISSIONS BY
9%
Emissions reductions
EQUAL TO TAKING
87,000
CARS
OFF THE ROAD
FOR A YEAR**

**Our Results:
Energy Use**

Since 2007, Boeing's energy use decreased by 3 percent on an absolute basis, 21 percent revenue-adjusted.

Energy Use

- **Absolute** Improved by 3% since 2007
- ◆ **Revenue Adjusted** Improved by 21% since 2007



- » Also includes data from Bellevue, Wash., South Park, Wash., Longacres Park, Wash., Spares Distribution Center, Wash., Duwamish Office Park, Wash., Chicago Corporate Headquarters, Boeing Commercial Airplanes operations in Long Beach, Calif., Seal Beach, Calif., PDX (Portland), Ore., and North Charleston, S.C.
- » Energy use is calculated from consumption of electricity, natural gas and fuel oil. Our facility in Philadelphia is the only major U.S. site that uses fuel oil for energy. Consumption of other fuels is not represented.

During this five-year period, cumulative reductions in energy use equal enough energy to power 44,000 U.S. homes for a year.

CUT ENERGY USE BY

3%

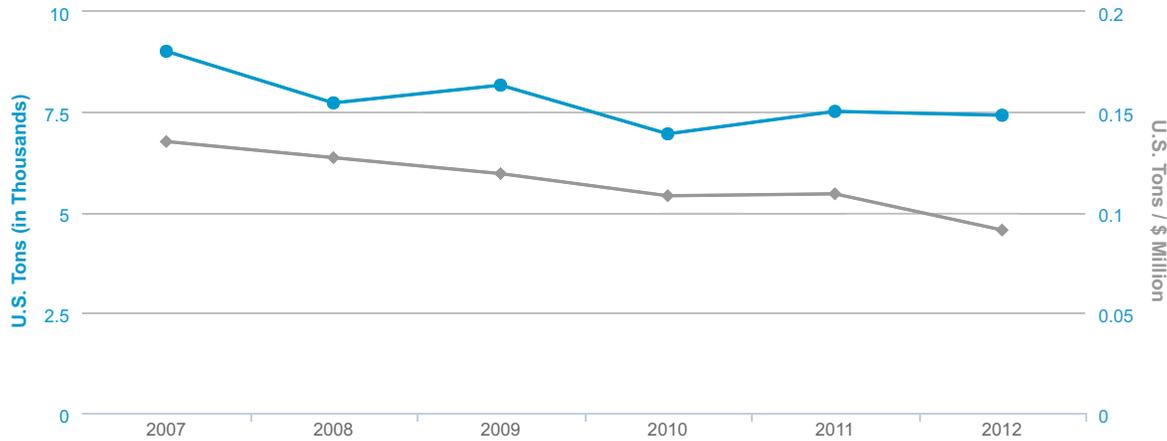
ENOUGH ENERGY
TO POWER
44,000
U.S. HOMES
FOR A YEAR

**Our Results:
Hazardous Waste**

Since 2007, Boeing's hazardous waste generation decreased by 18 percent on an absolute basis, 33 percent revenue-adjusted.

Hazardous Waste

- **Absolute** Improved by 18% since 2007
- ◆ **Revenue Adjusted** Improved by 33% since 2007



- » Also includes data from El Paso, Tex., Heath, Ohio, Macon, Ga., Palmdale, Calif., Salt Lake City, Utah, Sylmar, Calif., PDX (Portland), Ore., and North Charleston, S.C.
- » 1 U.S. ton = 2,000 pounds.
- » Hazardous waste data does not include waste derived from construction or remediation activities.

During this five-year period, those reductions equal the weight of 180 fully loaded semi-trailer trucks*.

CUT HAZARDOUS
WASTE BY
18%
EQUAL TO
THE WEIGHT OF
sixteen
747-400s

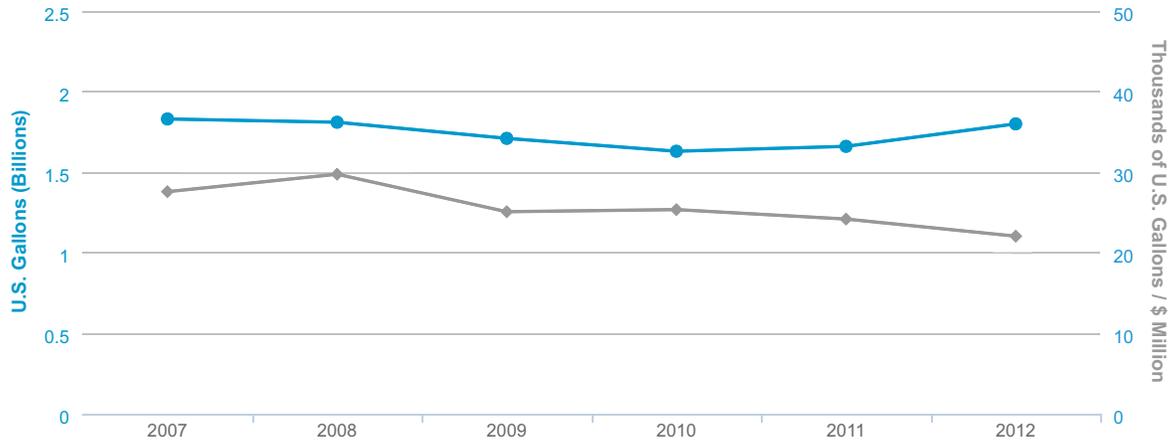
*Based on the maximum loaded vehicle weight for U.S. highways (80,000 lbs).

**Our Results:
Water Intake**

Since 2007, Boeing's water intake decreased by 2 percent on an absolute basis, 20 percent revenue-adjusted. During this five-year period, we saved 538 million gallons of water, enough to fill 800 Olympic-sized swimming pools.

Water Intake

- **Absolute** Improved by 2% since 2007
- ◆ **Revenue Adjusted** Improved by 20% since 2007



- » Also includes data from Bellevue, Wash., South Park, Wash., Longacres Park, Wash., Spares Distribution Center, Wash., Duwamish Office Park, Wash., Chicago Corporate Headquarters, Boeing Commercial Airplanes operations in Long Beach, Calif., Seal Beach, Calif., PDX (Portland), Ore., and North Charleston, S.C. (Interiors Responsibility Center only).
- » 1 U.S. gallon = approximately 3.79 liters.

In 2012, Boeing's absolute water intake increased by 8 percent compared with the previous year.

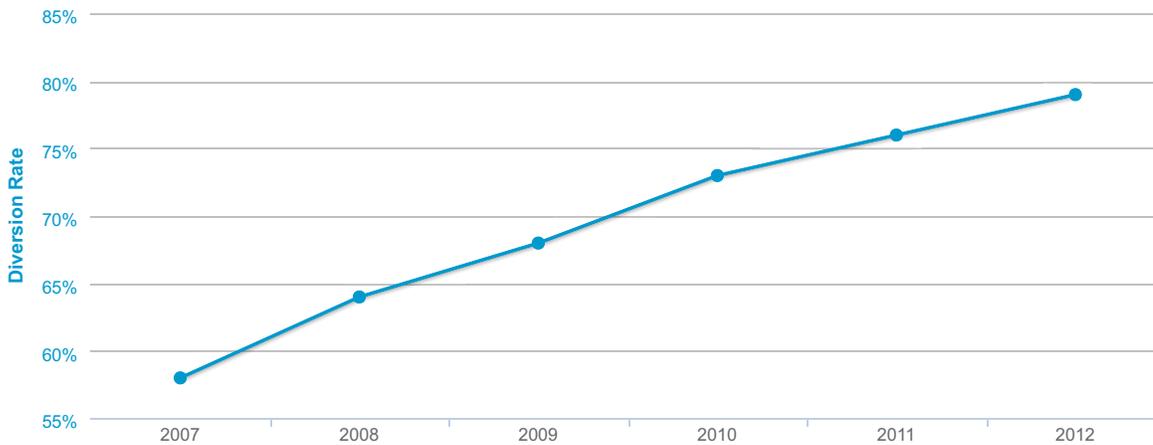
CUT WATER USE BY
2%
SAVING ENOUGH
WATER TO FILL
800
Olympic-sized
SWIMMING POOLS

**Our Results:
Solid Waste Diverted
From Landfills**

By year-end 2012, 79 percent of the solid waste we generated was diverted from landfills. Over the past five years, we diverted 130,000 tons more trash from landfills, enough to fill 13,000 garbage trucks.

Solid Waste Diverted From Landfills

● Improved by 36% since 2007



» Also includes data from Bellevue, Wash., South Park, Wash., Longacres Park, Wash., Spares Distribution Center, Wash., Duwamish Office Park, Wash., Boeing Commercial Airplanes operations in Long Beach, Calif., Seal Beach, Calif., and North Charleston, S.C. (Interiors Responsibility Center only).

» 1 U.S. ton = 2,000 pounds.

» Performance is calculated by dividing the amount of nonhazardous solid waste diverted from landfill by the total amount of nonhazardous solid waste generated.

Waste is diverted from landfills through a combination of reducing, reusing, recycling, composting and energy recovery programs.

Boeing measures nonhazardous solid waste generated by our operations. This includes waste streams such as metals, wood, paper, cardboard, plastics and organic materials. It does not include hazardous waste, construction waste, remediation waste or waste from asbestos abatement activities.

DIVERTED
130,000
TONS
OF WASTE FROM
LANDFILLS
ENOUGH TO FILL
13
THOUSAND
GARBAGE TRUCKS

**Our Results:
Toxic Release Inventory/
National Pollutant
Release Inventory**

Boeing reports toxic releases to both the U.S. Toxic Release Inventory (TRI) and to Canada's National Pollutant Release Inventory (NPRI), an inventory of pollutant releases and recycling, on an annual basis.

Toxic Release Inventory/National Pollutant Release Inventory

Release	2007 (U.S. & Canada)	2008 (U.S. & Canada)	2009 (U.S. & Canada)	2010 (U.S. & Canada)	2011 (U.S. & Canada)
Total release (millions of lb)	0.25	0.21	0.24	0.26	0.26
Percentage change	0.0%	-17.8%	-4.4%	0.4%	2.3%
Normalized to revenue (lb/million \$ rev.)	3.8	3.4	3.6	4.0	3.8
Percentage change from normalized	0%	-10%	-7%	4%	-1%
Transfer					
Total transfers (millions of lb)	24.07	2.57	2.74	2.60	2.98
Percentage change	0%	-89%	-89%	-89%	-88%
Normalized to revenue (lb/million \$ rev.)	363	42	40	41	43
Percentage change from normalized	0	-88%	-89%	-89%	-88%
Release and Transfers					
Total release and transfers (millions of lb)	24.32	2.78	2.98	2.86	3.24
Percentage change	0%	-89%	-88%	-88%	-87%
Normalized to revenue (lb/million \$ rev.)	366	46	44	44	47
Percentage change from normalized	0	-88%	-88%	-88%	-87%

- » 13 sites report TRI and NPRI releases and transfers: Auburn, Wash., El Paso, Texas, El Segundo, Calif., Everett, Wash., Frederickson, Wash., North Boeing Field, Wash., Plant 2, Wash., Portland, Ore., Renton, Wash., St. Louis, Mo., Sylmar, Calif., Wichita, Kan., and Winnipeg, Canada.
- » 2012 data will be submitted to the U.S. and Canadian governments after the publication of this report. Boeing will provide 2012 data in next year's report.
- » Total release and transfers percentage change for 2007, 2008 and 2009 were made to correct formula errors referring back to a 2002 baseline from previous year reporting and now refer to the 2007 baseline year.
- » Total release and transfers percentage change from normalized in 2008 were made to correct formula errors referring back to a 2002 baseline from previous year reporting and now refer to the 2007 baseline year.

Boeing has reduced toxic releases by 1 percent since 2007, while overall transfers of chemicals to offsite facilities have decreased 88 percent during the same period. Transfers peaked in 2007, largely as a result of a transfer of old tooling and scrap metal to a recycler from our Wichita facility.

Data for 2012 will be submitted to the U.S. and Canadian governments after the publication of this report and will be included in Boeing's 2014 Environment Report.

Boeing reduced toxic releases and the overall transfer of chemicals to offsite facilities.

Boeing employees work on every continent, with 18 international offices around the globe. Our largest operations outside the United States are based in Australia, Canada and the United Kingdom.



Dancers perform a ceremonial lion dance to welcome delivery in 2013 of a 737-800 to China Eastern Airlines — the 1,000th Boeing jetliner delivered to China. Boeing collaborates with Chinese partners on biofuels and air traffic management research and development projects. (Boeing photo)

Australia

Boeing Australia represents the company's largest operational footprint outside the United States. Boeing is part of the aerospace and defense fabric of Australia with nearly 3,000 employees at 27 sites and a heritage stretching back 85 years.

In September 2012, Boeing Australia filed its fourth National Greenhouse and Energy Report, detailing greenhouse gas emissions, energy consumption and energy production data. This comprehensive report must be completed by registered corporations who meet specified energy use and greenhouse gas emission thresholds. For the 2011–2012 reporting period, the Australian Government's Clean Energy Regulator released data for companies emitting more than 50,000 metric tons of equivalent carbon dioxide (CO₂-e). Boeing Australia's CO₂-e emissions were calculated at 60,804 metric tons.

Overall, Boeing Australia has achieved 8 percent reduction in CO₂-e emissions since

the first reporting period in 2008–2009, while simultaneously increasing production rates of high-end aerostructure components.

Canada

Boeing reports to Canada's National Pollutant Release Inventory (NPRI), an inventory of pollutant releases, off-site disposal and treatment, on an annual basis. Since 2007, NPRI reporting increased significantly because of an increase in airplane production rates, resulting in the triggering of additional threshold reporting requirements. For more information, see the TRI/NPRI page in this Environment Report.

United Kingdom

The Carbon Reduction Commitment Energy Efficiency Scheme (CRC), under the U.K. Department of Energy and Climate Change, is a mandatory emissions trading scheme aimed at reducing CO₂ emissions in the United Kingdom. The CRC aims to raise awareness of energy use and incentivize energy efficient operations.

For the reporting period, April 1, 2011, through March 31, 2012, CRC-regulated emissions were 4,549 metric tons (5,014 tons) of CO₂. Boeing operations in the U.K. consist of multiple units and subsidiaries. Boeing U.K. Training and Flight Services Ltd. operates flight simulators for training on Boeing aircraft at several locations throughout the U.K. Boeing Defence U.K. Ltd. has employees located at multiple locations throughout the U.K. supporting Ministry of Defence and U.S. military programs.

Additionally, CO₂ emissions from Boeing subsidiary Jeppesen U.K. Ltd. are included in the Boeing U.K. CRC report.

Boeing received environment awards and recognition from a number of local, national and international organizations in 2011.



Boeing's C-17 Globemaster III final assembly facility in Long Beach, Calif., achieved the EPA's Energy Star Challenge for Industry award — one of the first heavy manufacturing sites to earn the recognition — for reducing energy use. (Boeing photo)

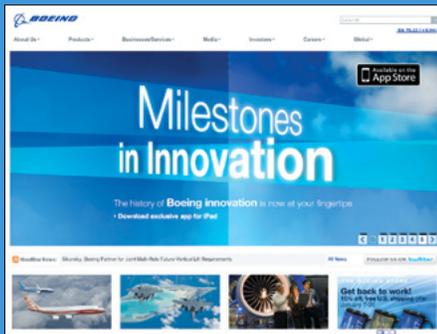
These included the following:

- » **ENERGY STAR** Partner of the Year from the U.S. Environmental Protection Agency.
- » Corporate Lands for Learning certification from the Wildlife Habitat Council.
- » Leading Environmentalism and Forwarding Sustainability award from the U.S. Environmental Protection Agency.
- » The 2012 Excellence in Corporate Responsibility Award from the South Carolina Manufacturers Association, presented to the Charleston, S.C., site.
- » The 2012 Outstanding Business/Industry Recycling Award from the Carolina Recycling Assoc., presented to the Charleston, S.C. site.
- » The 2013 Pennsylvania Environmental Council Governor's Award for Environmental Excellence, presented to the Philadelphia site.
- » The Gold Award from the King County, Wash., Department of Natural Resources for perfect compliance with the industrial wastewater discharge permit, presented for the 15th consecutive year to the Rent on site, the 16th consecutive year to the North Boeing Field site, and for 2012 to the Auburn site.
- » The Five-Star Water Quality Award from Pierce County, Wash., for exemplary stormwater management, presented for the second consecutive year to the Frederickson site.
- » Local water quality awards presented by water treatment districts and other environmental recognitions in multiple locations, including Mesa, Ariz., El Paso, Texas, El Segundo, Calif., Kent, Wash., Long Beach, Calif., Portland, Ore., Seattle, Wash., St. Louis, Mo., Wichita, Kan., Frederickson, Wash., Auburn, Wash., Nye County, Nev., and Charleston, S.C.



The Boeing Company
100 North Riverside
Chicago, Illinois 60606
www.boeing.com/environment

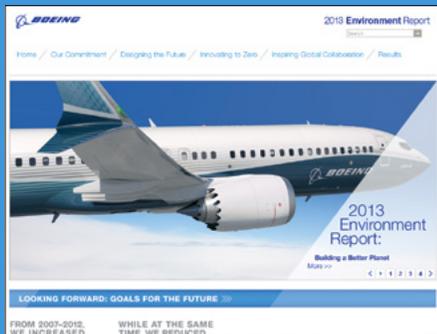
Boeing is a **responsible partner, neighbor and citizen** to the diverse communities and customers we serve. We are building a better future with innovative products that are cleaner, more efficient and set a new standard for performance. Boeing follows responsible business practices and promotes positive changes in the lives of people around the world while growing shareholder and customer value in a competitive global marketplace.



Visit us at boeing.com to learn more about Boeing and how extraordinary innovations in our products and services are helping solve the world's toughest problems.



Visit us at boeing.com/investorrelations to view our annual reports and to find additional information about our financial performance and Boeing business practices.



Visit us at boeing.com/environment to view our current Environment Report and information on how the people of Boeing are developing ways to protect the planet and create a better tomorrow.



Visit us at boeing.com/community to view our Corporate Citizenship Report and other information about how Boeing is working to improve communities worldwide.