



The Boeing Company
2014 Environment Report

Build 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 168,000 people across the United States and more than 65 countries. In addition, our enterprise leverages the talents of hundreds of thousands of skilled people working for Boeing suppliers worldwide.

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Cover photo:

Boeing is building a better planet thanks to innovations such as the world's first all electric propulsion satellite. The all-electric propulsion design of the 702SP (small platform) satellites gives customers new flexibility and next-generation technology for increased performance, more affordable launch options and the ability to nearly double payload capacity. (Boeing image)

Photo above:

With all-new engines and composite wings, the 777X will be the largest, most efficient twin-engine jet in the world.

Our Approach:
Leadership
Message



Jim McNerney chairman and chief executive officer, The Boeing Company, and Ursula English, vice president, Environment, Health & Safety (Boeing photo)

Every day, Boeing employees find new and innovative ways to serve our global customers, and they are also committed to responsible environmental leadership—both in our products and in how we manufacture, deliver and support them. As we look forward to our second century, we see continued business growth in markets we intend to lead. We are building a bigger and better Boeing across the breadth and depth of our businesses and our communities, and we are focused on helping build a better planet.

Last year, we expanded our modern and fuel-efficient family of commercial airplanes with the launch of the 787-10 and the new 777X—airplanes that will fly passengers farther, in more comfort and with significantly reduced emissions than the airplanes they replace. We are also investing in a cleaner future through our research into lightweight materials, advanced aerodynamics, sustainable new fuel sources, and hybrid-, solar- and electric-powered aircraft (all delivering greater efficiency with reduced or no greenhouse gas emissions).

For example, our Phantom Eye liquid hydrogen-powered unmanned aircraft, which produces only water as a byproduct, earlier this year earned its experimental status—a major milestone in bringing this capability to market. In developing technology innovations that dramatically improve our products' fuel efficiency, we have increased revenues and earnings by approximately 35 percent over the past four years and secured a backlog of customer orders valued at nearly half a trillion dollars.

And within the walls of our factories and offices, we continue to accelerate improvements in environmental performance. After achieving our first five-year set of absolute-reduction targets, we are committed to zero growth in water consumption, greenhouse gas emissions, hazardous waste and solid waste to landfill—even as our business continues to grow.

Every day, as Boeing employees are exploring new ways to build a bigger, better Boeing, we are also striving to build a better planet—by improving the environmental performance of our company, our industry and our communities worldwide.

**Our Approach:
Environmental
Policy and
Strategy**

Innovation and technology are at the heart of what we do at Boeing, and they are fundamental to continual environmental improvement. As a company, we understand that environmental responsibility is crucial to our long-term success and our second century in business.

Air travel is an essential and inspirational part of modern life: it helps drive economic growth and prosperity, brings people around the world closer together and opens the door to new life experiences. And our industry continues to grow. According to the International Air Transport Association (IATA), every day more than 8 million people fly to their destinations, and thousands of cargo and defense aircraft also take to the skies. Boeing expects this trend to continue over the next 20 years, with world passenger traffic [projected](#) to grow 5 percent annually and the commercial airplane fleet expected to nearly double by 2032.

We are committed to responsible environmental leadership as we serve our customers and as our business and industry grows. Our strategy to achieve this is made up of three tenets: Designing the Future, Innovating to Zero and Inspiring Global Collaboration.

Boeing is committed to offering the most advanced and fuel-efficient family of airplanes and services to our customers and to:

- ✈ Conducting operations in compliance with applicable environmental laws, regulations, and Boeing policies and procedures.
- ✈ Preventing pollution by conserving energy and resources, recycling, reducing waste and pursuing other source reduction strategies.
- ✈ Continually improving our environmental management system.
- ✈ Working together with our stakeholders on activities that promote environmental protection and stewardship.

We are continually researching new, innovative technologies to improve our company's and our industry's environmental performance. That includes improving operational efficiency for our customers with digital tools; using advanced, lightweight materials and improved aerodynamics to reduce our products' fuel consumption; developing and commercializing new sustainable fuel sources; developing hybrid, solar and electric-powered aircraft; accelerating the efficiency of our facilities; and working with institutions, governments and stakeholders to build cleaner communities worldwide.

**Our Approach:
Governance**

Our company's environmental strategy and policies are guided by the Environment, Health & Safety (EHS) Policy Council, which is composed of Boeing's [Executive Council](#) and is led by the chairman and chief executive officer. The Policy Council ensures that strategy and [performance targets](#) are set and monitored. Climate change issues and environmental performance targets and programs are reviewed within the context of Boeing's business, product and process policies.

Reviews of the company's environmental policies and strategies are conducted twice a year with the EHS Policy Council, in addition to other internal executive reviews conducted across the company on an ongoing basis. One council meeting is focused on target setting, aligned with corporate long-range business planning; the other meeting is focused on detailed planning and performance review.

Environmental initiatives are embedded into every organization and function within Boeing. The EHS organization works with our business units and operational leaders to drive an integrated, enterprisewide strategy that includes our products, services, processes and operations. The EHS organization also contains functions focused on workplace safety and health, environmental performance and regulatory compliance.

The continual improvement of the environmental performance of our products and operations is the result of this highly integrated and coordinated approach.

**Our Approach:
About this Report**

This report reflects the company's environmental activities and progress to our targets over the past year.

We highlight our objectives, results, accomplishments and business relevancy in the following four areas: Design the Future, Innovate to Zero, Inspire Global Collaboration and Performance. Whenever possible, we provide relevant environmental information for the corresponding time period for our operations.

We have expanded the scope and depth of the information reported in the Performance section, as our environmental programs have matured and expanded, and to reflect valuable stakeholder feedback. The data presented in our Performance section undergo an internal audit review to verify data collection and authentication processes. Additionally, the data representing our greenhouse gas (GHG) emissions is verified by [DNV Certification Inc.](#) with limited assurance. More information about each data set is available in the corresponding footnotes located within the Performance section.

Forward-looking Statements This report contains "forward-looking statements" within the meaning of the Private Securities Litigation Reform Act of 1995. Words such as "may," "should," "expects," "intends," "projects," "plans," "believes," "estimates," "targets," "anticipates" and similar expressions are used to identify these forward-looking statements. Examples of forward-looking statements include statements relating to our future financial condition and operating results, as well as any other statement that does not directly relate to any historical or current fact. Forward-looking statements are based on our current expectations and assumptions, which may not prove to be accurate. These statements are not guarantees and are subject to risks, uncertainties and changes in circumstances that are difficult to predict. Many factors could cause actual results to differ materially and adversely from these forward-looking statements.

Additional information concerning these and other factors can be found in our filings with the Securities and Exchange Commission, including our most recent Annual Report on Form 10-K, Quarterly Reports on Form 10-Q and Current Reports on Form 8-K. Any forward-looking statement speaks only as of the date on which it is made, and we assume no obligation to update or revise any forward-looking statement, whether as a result of new information, future events or otherwise, except as required by law.



Boeing offers the most modern and fuel-efficient family of new airplanes. (Boeing image)

Boeing builds and delivers the world's most modern and fuel-efficient fleet of airplanes. This brings enormous value for our commercial and defense customers by finding new opportunities for efficiencies that cut their fuel costs and reduce greenhouse gas emissions while improving the environmental performance of the aerospace industry. With the launch of the 777X and the 787-10 in 2013, Boeing advances the world's most efficient and flexible twin-aisle family.

OUR NEW AIRPLANES WILL
**REDUCE FUEL
CONSUMPTION
AND CO₂
EMISSIONS
BY UP TO** **20%**

787 Dreamliner The Boeing 787 Dreamliner™ is the most advanced and efficient commercial airplane in its class, setting new standards for environmental performance and passenger comfort. Composite materials, advanced engines and a new innovative wing design all help the 787 reduce fuel consumption and CO₂ emissions.

The third and longest member of the 787 family—the 787-10—will fly more than 90 percent of the world's twin-aisle routes at a whole new level of efficiency. The airplane's operating economics are unmatched: 25 percent better fuel use and emissions compared to airplanes of its size today and more than 10 percent better than anything being offered by the competition. First delivery of the 787-9 is scheduled for 2014, and the 787-10 is targeted for 2018.



 **Video: 787-9: Innovation Evolution**
[Click here to learn more.](#)



The 787-9 will use 20 percent less fuel and have 20 percent fewer emissions than similarly sized airplanes. (Boeing image)

777X In the fall of 2013, Boeing launched the 777X with agreements for 259 airplanes, representing the largest product launch in commercial jetliner history by dollar value. With [all-new composite](#) wings and all-new GE9X engines, the 777X will be the largest and most efficient twin-engine jet in the world—and 12 percent more fuel-efficient than its competitor.

The airplane's folding, raked wingtip and optimized span will contribute significantly to this greater efficiency and fuel savings.



The 777X, with all-new composite wings and GE9X engines, will be the largest and most efficient twin-engine jet in the world. (Boeing image)

747-8 The 747-8 is 16 percent more fuel-efficient than its predecessor and delivers more passengers, more cargo and more range with lower emissions and noise. In 2013, Boeing delivered the first 747-8 with performance-improved GEnx-2B engines as part of the airplane's Performance Improvement Package, or PIP. The two other components of the PIP program include flight management computer software upgrades and reactivation of the horizontal stabilizer tank fuel system on the 747-8 Intercontinental. Through the PIP program, 747-8 customers will use roughly 30 fewer trucks of fuel per airplane per year, a 1.8 percent improvement.



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737 MAX Boeing's newest family of single-aisle airplanes—737 MAX 7, 737 MAX 8 and 737 MAX 9—will build on the Next-Generation 737's popularity and reliability while delivering customers unsurpassed fuel efficiency in the single-aisle market.

The 737 MAX will deliver the significant savings in fuel that airlines require for the future. The 737 MAX improves fuel efficiency and CO₂ emissions by an additional 14 percent over today's most fuel-efficient Next-Generation 737s and 20 percent more fuel efficient than the first Next-Generation 737s to enter service. Design updates, including Boeing's Advanced Technology winglet, also will further optimize the 737 MAX performance, especially on longer-range missions.

When compared to a fleet of 100 of today's most fuel-efficient airplanes, this new model will be approximately 8 percent more fuel-efficient per seat than the competition, emit 305,040 fewer tons of CO₂ and save more than 215 million pounds of fuel per year, which translates into more than \$112 million in cost savings.

The 737 MAX will incorporate the latest quiet-engine technology to reduce the operational noise footprint of the airplane by up to 40 percent.

Development of the 737 MAX is on schedule with firm configuration of the airplane achieved in July 2013. First flight is scheduled in 2016 with deliveries to customers beginning in 2017.

The Next-Generation 737 program also continuously evaluates and incorporates value-added technologies and design innovations to improve performance

and capabilities. Recent offerings include short-field performance enhancements to increase payload capacity and to reduce takeoff and landing field length; and carbon brakes to reduce weight for improved airplane operating economics.



The 737 MAX improves fuel efficiency and CO₂ emissions by an additional 14 percent over today's most fuel-efficient single-aisle airplanes. (Boeing image)

All-electric Propulsion Satellite Boeing is building the world's first all-electric propulsion satellites. The all-electric propulsion design of the 702SP (small platform) satellites gives customers new flexibility and next-generation technology for increased performance, more affordable launch options and the ability to nearly double payload capacity.

The 702SP relies exclusively on xenon (an inert, nonhazardous gas) for its propulsion system and builds

on the success of the 702HP (high power) spacecraft hybrid propulsion technology, which uses a combination of chemical bipropellant and xenon-ion propulsion.

Production on the first 702SP satellites began in 2013, and testing, verification and assembly of the primary structures was completed in early 2014.

Chrome-free Defense Solutions Boeing, along with its customers, is committed to reducing the use of hazardous materials in the manufacture and maintenance of its products. The challenge is to find alternatives that meet strict safety, aircraft integrity and regulatory requirements.

Currently, Boeing is testing and using new solutions such as hexavalent chrome-free primers for its AH-64 Apache helicopter, the V-22 Osprey, F/A-18E/F Super Hornet and EA-18G Growler and P-8 programs. The new coatings meet strict requirements while reducing the use of hazardous chemicals in the manufacturing process.

Boeing is an industry leader in developing alternatives to paints and primers that contain hexavalent chromium, a heavy metal that resists aircraft corrosion but also can be toxic to people and the environment.

Boeing, the U.S. Navy and other customers are exploring other alternatives and are implementing lean manufacturing techniques to help optimize workflow and reduce waste.

You can hear the difference



Acoustics engineer Jackie Wu is part of the team designing quieter engines for the 737 MAX. Improvements include quieter acoustic material displayed in the foreground. (Boeing photo)

Jackie Wu brings a creative background with a fondness for music to her work in acoustics engineering, which she sees as a form of art. "Acoustics is something that you can't see or touch, but like music it can influence how it makes people feel," said Wu, an

engine acoustics engineer on the 737 MAX, the newest member of Boeing's single-aisle family of aircraft now in development.

"It's a good feeling to know people will be able to hear the difference in the advanced engine system we're developing for the 737 MAX."

The new engines, manufactured by CFM International, will include a variety of noise-reduction technologies. Wu's focus is the acoustic inlet, which is the front part of the large housing called a nacelle around the engine. The inlet conditions the airflow and includes a perforated lining on the engine's inner wall.

"Air flows into the front of the engine and passes through the fan blades and other high-speed engine parts, which produce a lot of noise," Wu explained. "We want to maximize the inlet's acoustic treatment so it acts kind of like a muffler, reducing the noise before it can leave the engine housing."

The acoustics research starts with analytical tools, acoustics theory and the experience gained from flight tests and products already in use. "My group knows this type of inlet works well and the general noise reduction we should be able to expect," Wu said. "We scale the past research to fit the new engine and reach the final design, adding new knowledge along the way."

Wu's team then develops the engineering and geometric requirements that will guide the inlet's manufacture. Noise-reduction technology is also applied to the thrust reverser and chevrons, the signature wavy section at the exit of the nacelle. "The new technology is quite different from the Next-Generation 737. The noise improvements over the current generation of engines will be substantial," Wu said.

The 40 percent smaller community noise footprint is expected to be welcome news for Boeing customers and people living near busy airports. "Airlines face stricter noise regulations at airports around the world, especially in densely populated areas," Wu said.

Wu's team will continue its work until the first major test of the new engine before the airplane's entry into service. "We will hang a single engine on a huge test fixture and

set up microphones all around it," Wu explained.

"The engine is run through its full performance range and we measure the noise. That's when we see how it compares to what we have been predicting."

Boeing and CFM engineers then continue engine development and refinement until the official certification process, which includes static and flight tests, leading up to airplane delivery in 2017.

Wu enjoys every step of the long and sometimes complicated process. "It's the combination of planning, design and seeing it all come together in a finished product that is really cool for me," Wu said. "You can actually hear the difference. I feel good that Boeing is committed to finding new ways to shrink our aircrafts' noise and environmental footprint."

Better by design



Engineer Gary May is bringing Design for Environment principles early in the development of Boeing's newest commercial aircraft. (Boeing photo)

For engineers like Gary May, the chance to help influence and shape the design of a new airplane model like Boeing's widebody 777X is an opportunity that doesn't happen very often.

"As a new airplane, the 777X has more opportunities for change, new technology and new environmental thinking, which makes it a special experience," said May, leader of the Design for Environment program.

"We consider environmental performance in the design and build process for every aircraft and new technology, and the 777X program is including environmental and workplace safety planning into the design as early as possible."

Design for Environment is a systematic design approach that minimizes a product's environmental footprint and meets quality, cost and performance requirements set by the customer and Boeing. It reduces a product's environmental impacts over its life cycle, from raw materials and manufacturing to in-service operation to the end of service.

May said environmental requirements and criteria are now included in the standard "gated" development process for the 777X. "Gated" refers to a disciplined process with steps and criteria for moving forward. It ensures that the program gains a sufficient level of maturity before it proceeds to key milestones, such as design completion, production and entry into service.

The strategy for getting environmental thinking into the aircraft's design is to provide engineers with the expertise and resources to make smart choices, May said. "We don't expect every engineer to be an environmental expert. We need them to be aware their decisions affect the environment," he said.

Design for Environment principles consider several environmental performance measures: global emissions, energy, sustainable materials, community noise, local emissions and water.

"By building more efficient aircraft and reducing fuel use, we cut greenhouse gas emissions in several ways and save significant amounts of water," said May.

May said the goal is to help educate the engineering workforce to think with a broader environmental life cycle mindset. Specific improvements from design decisions could include:

- ✈ Reducing drag from passenger windows, thus boosting efficiency and saving fuel.
- ✈ Giving customers the means to identify the optimal amount of onboard potable water needed, thus reducing unnecessary water weight and saving fuel.

Although substantial design resources are focused on the 777X and other in-development aircraft, such as the 737 MAX, May said environmental planning and strategy never end. "We want our products and operations and services to be the best they can be. We're always looking forward to the next new airplane," May said.

"It's how Boeing aircraft continue to set the standard for environmental performance."

Propelling toward a cleaner future



Engineer Holly Murphy is helping guide development of Boeing's first all-electric-propulsion satellite, being assembled in El Segundo, California. (Boeing photo)

Engineer Holly Murphy can watch Boeing's latest and most innovative satellite come together in an El Segundo, California, factory and remember when the technology was just an idea on a piece of paper.

"We started several years ago talking about and wondering what we possibly could build. Today I can walk along the manufacturing floor and see the satellite and hardware. It's a very rewarding feeling," said Murphy, engineer in the Satellite Development Center in Boeing's Space & Intelligence Systems group.

"My whole team is proud that we designed a product that will be better for the environment than previous generations of satellites."

Murphy leads the development and manufacturing of the platform hardware for Boeing's first all-electric-propulsion satellite—the 702SP (small platform.) Most satellites use a chemical propulsion engine to get to their final orbit position. The 702SP is fueled exclusively by xenon, an inert, non-hazardous gas.

The satellite uses solar panel generated electricity to power the electric thrusters which ionize the xenon gas to generate propulsion. "The all-electric propulsion enables us to reduce the amount of hazardous material present during the satellite's manufacture and operation," Murphy said.

The 702SP also is a smaller, lighter design, which means that two satellites can be stacked one on top of the other in a rocket for a double launch. Murphy said a dual manifest launch is more efficient and reduces customers' costs.

The innovations and benefits don't stop with the 702SP. "A lot of what we're learning on this satellite can be applied to other product lines," she added.

The solar panels are built by Boeing subsidiary Spectrolab. The satellite is scheduled to be delivered to the customer by mid-2015.

The varieties of challenges that come with developing a new product are what Murphy enjoys most about the job. "I like working with a diverse group of people that gets to tackle hard and different problems every day; I'm always learning," she said. "We have the freedom to challenge the way the company does business and try to do things better."

One way Murphy's team is doing things better is by designing a satellite that will help Boeing improve its environmental footprint, she said.

"We need to consider the Earth is here for all of us. I try to do my part where I can, such as in driving a plug-in hybrid electric car to work every day," Murphy said.

"From a business and environmental perspective, it's all about innovation—doing things smarter and better. The 702SP has a role to play in providing a cleaner alternative to other satellites, and it's something we all can be proud of."

Not just a paint job



Engineer Joe Finn helps lead successful efforts to develop chrome-free paints and primers for the Chinook helicopter and V-22 Osprey tiltrotor aircraft at Boeing Philadelphia. (Boeing photo)

Engineer Joe Finn has learned that reaching major environmental milestones and research breakthroughs takes commitment and a lot of patience. For example, this spring, the V-22 Osprey vertical lift aircraft became the latest Boeing military product to receive a paint primer that is free of hexavalent chromium, or chrome.

"In this research we know it's going to take time. We make continuous progress and improvements step by step; we learn as we go," said Finn, senior engineer in the chemical technology group at Boeing Philadelphia. Boeing and the aerospace industry began researching environmentally responsible replacements for chrome-based paints and primers in the 1990s.

The Philadelphia site is home to the V-22 and the CH-47 Chinook helicopter programs. Boeing began using a chrome-free primer on the Chinook helicopter in 2010. Since then, the new primer has been approved for

other military and commercial aircraft. In May, the first V-22 used the new primer for specific sections of the fuselage.

“The footprint of chrome on an aircraft is large because there is so much metal, especially on surface areas such as the fuselage. But chrome has dozens of applications,” Finn said. Hexavalent chromium has been widely used by the aerospace industry to prevent corrosion on metal aircraft structures and parts.

Each military aircraft is manufactured under its own contract with unique customer requirements and technical specifications. Alternative materials and technologies such as chrome-free primers approved for one product cannot automatically be transferred to another aircraft. It takes extensive testing and verification of performance, Finn said.

Over the past several years, paint manufacturers have made good progress in developing options for chrome-free coatings, Finn said. Government customers, such as the U.S. Navy, also added the use of chrome-free paints and primers to their product specifications.

When an industry-developed chrome-free primer gets government approval for aerospace use, Boeing then

conducts its own testing and evaluation to ensure that the material meets the company's performance requirements and criteria. A replacement option may not be suitable for all applications, Finn said.

“We currently use chrome-free paints and primers only on aircraft sections that are easy to access and inspect. The ability of Boeing and the customer to monitor its performance is critical,” Finn said. “Then over time you can understand how well it's doing and implement the replacements in other aircraft areas prone to corrosion.”

Finn said there also is close collaboration among programs and sites across Boeing, and research progress is widely shared. Additional replacements for chrome-based materials are likely to be approved by year-end.

The partnerships and collaboration are what Finn finds especially satisfying about his work. “Talking to people across the company about these kinds of technical issues is very exciting,” Finn said.

“Boeing really cares about the integrity of its products, and that includes safety and the environment. I think we're building the best aircraft in the world.”



Boeing's ecoDemonstrator Program is identifying opportunities to improve environmental sustainability across an airplane's life cycle: from design and manufacturing to in-service operations and end of service. (Boeing photo)

As a technology and innovation leader, Boeing is investing to improve the fuel efficiency and environmental performance of our products, services and operations. The company takes into account environmental performance at every step of a product's life cycle—from materials, design and manufacturing, through in-service use and end-of-service recycling and disposal. We call this strategy [Design for Environment](#).

Boeing is also accelerating the development and testing of new technologies bringing fuel efficiency and environmentally progressive advancements for our customers and our communities around the world.

ecoDemonstrator Program The Boeing ecoDemonstrator Program is focused on accelerating the testing, refinement and completion of new technologies to improve aviation's environmental performance. It also looks for opportunities to improve environmental sustainability across the airplane's life cycle: from design and manufacturing to in-service operations and end of service. Boeing has partnered with selected suppliers, airlines and government agencies on this multiyear program, including NASA and the U.S. Federal Aviation Administration Continuous Lower Emissions, Energy, and Noise (CLEEN) program on a number of ecoDemonstrator Program activities.

Later this year, Boeing will begin using one of its own 787 airplanes for the ecoDemonstrator Program to install and test environmentally progressive technologies to advance the goals of reducing emissions, improving fuel efficiency, reducing noise, using more sustainable materials, and making flight paths more logical and efficient. Some of the technology is hardware installed on the airplane; some of it is advanced software or instrumentation. Boeing plans to use a 757 platform for testing in 2015 for the ecoDemonstrator Program.



Boeing will use a 787 airplane and a 757 airplane over the next several years to test and refine new technologies to improve aviation's environmental performance. (Boeing image)

Digital Aviation Until recently, pilots often carried heavy flight cases with up to 50 pounds (22.68 kilograms) of navigation charts and flight manuals to guide planes to their destinations. Today, aviation is rapidly moving away from paper in favor of mobile devices that are lightweight and offer interactivity and customizable information.

Through its Digital Aviation unit, Boeing is developing products and services that enable more efficient flight, saving fuel and time, and reducing greenhouse gas emissions and operating costs. An example of this is a mobile application, developed by [Jeppesen](#), a Boeing subsidiary, that provides all the information traditionally included on paper charts. The application saves fuel by reducing the amount of weight carried aboard the aircraft. Other examples include Wind Updates and Direct Routes, which provide customized, real-time information about operating speeds, altitudes and routings that help pilots operate airplanes with optimal efficiency.



Applications for iPads and other mobile devices save weight and allow pilots to filter information, providing the necessary information at the right time—making navigation more efficient. (Jeppesen image)

Hydrokinetic Power Boeing and RER Hydro of Montreal have signed an agreement with the government of Quebec to provide more than 40 hydrokinetic turbines that will generate about 9 megawatts of clean, renewable power.

Once the project is completed, the St. Lawrence River near downtown Montreal will have the world's largest river-generated, hydrokinetic turbine farm.

RER, which has been testing a prototype in the river for more than three years, will build the turbines, and Boeing will provide program management, engineering, manufacturing and supplier management expertise. Boeing will also service the turbines.



Employees inspect a hydrokinetic turbine at the RER Hydro plant in Montreal. (Boeing photo)

Shining Solar Alternatives [Spectrolab](#), part of Boeing Defense, Space & Security, is the world's leading supplier of high-efficiency multijunction solar cells, panels for concentrated photovoltaic and spacecraft power systems, and airborne searchlights.

In 2013, Spectrolab set a new world record by producing a solar cell that converted 38.8 percent of solar energy into electricity, beating its previous own world record of 37 percent.

The high-efficiency multijunction solar cell was developed from new Boeing semiconductor bonding technology, which can be used to power spacecraft and unmanned aerial vehicles.

In early 2014, Boeing announced it would provide engineering, procurement and construction expertise to NRG Energy, Inc. for the island nation of Guam's first solar power plant.

Once completed, the new solar facility will generate 25 megawatts, enough clean energy to power 10,000 homes and offset consumption of almost 2 million barrels of fuel oil and diesel. The energy generated also will help Guam achieve its renewable energy goals by 2015.

Recycling Composites Boeing leads the commercial aviation industry in increasing the use and recycling of composites. Composite materials, such as those used in the Boeing 787 Dreamliner™, allow a lighter, simpler structure, which increases efficiency and reduces greenhouse gas emissions, and do not fatigue or corrode like traditional metal alloys. In yachts, composite construction also provides the ability to develop a lighter vessel that is stronger and stiffer at the same time.

Boeing is working with ORACLE TEAM USA, winner of the 34th America's Cup, to transform the science of sailing and of composite recycling. Along with

research partners, Boeing and ORACLE TEAM USA are collaborating to recycle 7,000 pounds (about 3,175 kilograms) of carbon fiber of USA-71, a yacht built for the America's Cup campaign in 2003. Boeing and ORACLE TEAM USA expect to gather data about the mechanical properties, costs and time flows to recycle sailing-grade composite materials in comparison to aerospace-grade and automobile-grade composites.



ORACLE boat USA-71 during racing in 2003 (Gilles Martin-Raget/ORACLE TEAM USA photo)



The Boeing SUGAR Freeze study shows that liquefied natural gas offers improved fuel efficiency, reduced emissions and potential fuel cost benefits compared to traditional aviation fuels. (Boeing image)

Boeing is developing innovative solutions and technologies to meet environmental requirements for its customers and the industry.

Technology [demonstration projects](#) led by Boeing, such as the Phantom Eye, Subsonic Ultra Green Aircraft Research (SUGAR), and Blended Wing Body (BWB), are showing promise of substantially cleaner, quieter and more efficient flight.

Phantom Eye Boeing's high-altitude long-endurance unmanned aircraft, [Phantom Eye](#), is designed to stay airborne longer than any other aircraft of its kind in production. Capable of maintaining altitude for several days, the propeller-driven, lightweight aircraft is fueled by liquid hydrogen, producing only water as a byproduct.

The six test flights conducted since 2012 have proved the capacities of the demonstrator aircraft, including the exceptional fuel economy of the unique liquid-hydrogen propulsion system.

In January 2014, Phantom Eye received [experimental status](#) from the U.S. Air Force 412th Operations Group, allowing for expanded testing opportunities to bring this capability to market quickly.



Video: Boeing engineers help the liquid hydrogen-fueled aircraft soar to its Experimental Aircraft Status by the U.S. Air Force. [Click here to learn more.](#)

Sweet Solutions—SUGAR Program Boeing has a vision of continuous improvements in reducing fuel consumption, emissions and operating costs. Large span, high-aspect-ratio wing technologies show promise in enabling these improvements.

SUGAR is a NASA contract awarded to Boeing for research into subsonic commercial aircraft technology to meet the agency's future environmental and efficiency goals in the 2030 to 2050 time frame.

Through a partnership with General Electric, Georgia Tech's Aerospace Systems Design Laboratory, Virginia Tech and NextGen Aeronautics, Boeing currently is studying two concepts: the SUGAR Volt, run by hybrid electric propulsion, and the SUGAR Freeze, powered by liquefied natural gas.

The study has shown that the hybrid electric engine technology on the SUGAR Volt could potentially improve fuel efficiency and noise, as well as greenhouse gas emissions. The hybrid electric engines would allow for the typical short-range flights to use mostly electric power while keeping a supply of jet fuel on board for longer-range flights.

Similarly, the SUGAR Freeze study shows that liquefied natural gas offers improved fuel efficiency, reduced emissions and potential fuel cost benefits compared to traditional aviation fuels. Another unique feature of the Freeze is the aft fuselage-mounted electric motor. Placing the fan behind the fuselage reduces drag from the motor, thereby improving fuel efficiency.

The SUGAR program has also identified potential fuel savings for the truss-based wing, which could produce a 5 percent to 10 percent improvement in fuel consumption over the conventional cantilevered wing configurations of today. After launching in 2010, Boeing's SUGAR study for NASA is expected to complete Phase 2 in mid-2014.

The potential of Blended Wing Body aircraft

Boeing and NASA have been studying new airplane concepts that incorporate BWB designs. The BWB

concept effectively merges the vehicle's wing and body, offering aerodynamic efficiencies over conventional tube-and-wing airplanes. The blended body helps to generate additional lift with less drag compared to a circular fuselage. A prototype BWB airplane—the X-48, configured first in a three-engine variant (X-48B) and then in a two-engine variant (X-48C)—was flown more than 100 times during a successful flight-test program, which [concluded](#) in 2013.

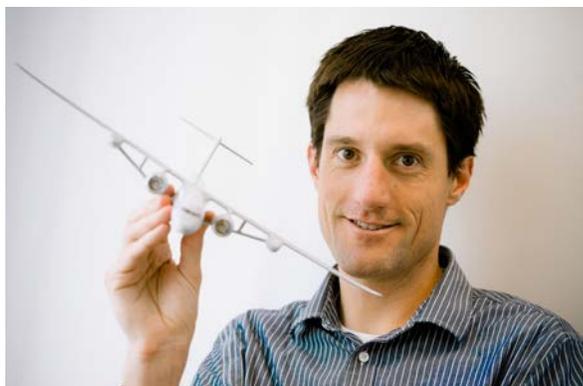
Designed by Boeing, built by Cranfield Aerospace Ltd. and flown in partnership with NASA and the U.S. Air Force Research Laboratory, the X-48 is a scale model of a heavy-lift, subsonic vehicle. Boeing believes the concept could be developed in the future for military applications such as aerial refueling and cargo missions.

The X-48C is now on display at the Air Force Flight Test Museum at Edwards Air Force Base in California, serving its new mission of educating and inspiring the next generation of aerospace engineers.



SUGAR Volt uses a hybrid electric propulsion system that can improve fuel efficiency, noise and greenhouse gas emissions. (Boeing image)

SUGAR high



Engineer Zach Hoisington helped put the SUGAR in Boeing's research and development of a hybrid electric aircraft. (Boeing photo)

As an engineer in the advanced concepts group, Zach Hoisington thinks he just may have the best job at Boeing. "I get to explore new concepts and come up with aircraft ideas and see where they go. It's the closest thing I can imagine to living the childhood dream of being able to make paper airplanes my whole life," said Hoisington, part of product development in Long Beach, California.

Hoisington was on the team that first began researching advanced aircraft concepts with dramatically improved fuel efficiency and environmental performance for the NASA-funded SUGAR—Subsonic Ultra Green Aircraft Research—project in 2008. The team studied aircraft designs and technology that could potentially reduce fuel consumption and emissions by up to 75 percent by the 2030 to 2050 time frame.

A key to the team's success in identifying concepts and candidates for new aircraft designs was the way members worked together and approached the study, Hoisington said. "The SUGAR project was wonderful because the process was so open; we could look at any idea, old or new, on a level playing field, even if the concept didn't originate with our team," he said.

"It is a great example of idea sharing. We wanted to have an unbiased look at any technology. This type of study is refreshing and brings out a better result in the end."

The team process also allows for a high level of individual creativity and input. "Like with a lot of engineers, some of my best ideas don't happen 9 to 5 at work; they come while I'm on a trip or vacation," Hoisington said. "When I get back to the office I'll analyze the potential and try to simulate how it could work.

"If an idea has merit I'll take it to the team, we'll look at it together and build on it from there," Hoisington said.

The team analyzed ideas that cover a wide spectrum of engine and airframe technology, including:

- ✈ Advanced propulsion systems, such as gas turbines combined with electric motors, fuel cells and fuel cell-gas turbine hybrids.

- ✈ Cryogenic fuels, such as hydrogen and a liquefied natural gas/methane.
- ✈ Cryogenically cooled engines and associated technologies.
- ✈ Advanced batteries.
- ✈ Open rotor/turboprop technologies.
- ✈ Conventional high-span and truss-braced wings.

Boeing and NASA are focusing continued research on several concepts, including an aircraft with hybrid electric propulsion, nicknamed SUGAR Volt, and an aircraft with a truss-braced high span wing, SUGAR High.

SUGAR program leaders say the study is providing Boeing and NASA with detailed information on high-potential technologies and a road map showing the steps needed to get the technologies ready for applications on future aircraft.

"The SUGAR project really helped develop and mature these technologies to a greater level of understanding. I think future generations of aircraft and the environment will see significant benefits from what we've accomplished," Hoisington said.

Innovating to
Zero:
Cleaner
Operations



Boeing designs all new construction and major renovation projects to meet a LEED Silver rating or higher. The new Everett Delivery Center is LEED Gold certified by the U.S. Green Building Council. (Boeing photo)

Boeing is accelerating improvements in the environmental performance of the company's operations, as business continues to grow.

ZERO
ABSOLUTE GROWTH IN:
•GHG EMISSIONS •WATER INTAKE
•SOLID WASTE SENT TO LANDFILLS
REVENUE-ADJUSTED GROWTH IN:
•HAZARDOUS WASTE

Building on the demonstrated performance over the last five years, Boeing is committed to maintaining 2012 levels for greenhouse gas emissions, water use and solid waste to landfill through 2017, even as our business continues to grow. We also are committed to our hazardous waste generation growing at a rate no more than the rate at which our business is expanding.

Increasingly, Boeing is seeking opportunities to incorporate energy conservation technologies and sustainable materials into new building designs as well as to reduce the amount of water used and waste generated by our facilities. Currently, Boeing relies on carbon-free hydroelectric and renewable energy sources for nearly half our total electricity consumption.

Carbon-free hydroelectric energy supplies more than 80 percent of the power for Boeing's Everett and Seattle facilities in Washington.

The North Charleston, South Carolina, site is powered by 100 percent renewable energy, sourced from 10 acres (4.05 hectares) of solar panels on the roof of the final assembly building, and coupled with renewable energy credits purchased from the local utility.

Twenty percent of the power that runs Boeing facilities in Southern California comes from wind energy.

This year Boeing earned the 2014 ENERGY STAR® Partner of the Year Sustained Excellence award from the EPA for leadership in energy conservation. Boeing has won the ENERGY STAR award every year since 2011.

The improvements in Boeing's operational environmental performance are the result of innovative projects—often led by employee teams—at our facilities across the globe.

LEED GOLD Delivery Center in Everett, Washington

This year, an unprecedented number of commercial airplanes will be delivered to airline customers around the world from the delivery center in Everett, Washington, located next to where the majority of Boeing's widebody airplanes are built. In April, as the 180,000-square-foot (16,700-square-meter) center celebrated its one-year anniversary, it also received the Leadership in Energy and Environmental Design (LEED) Gold certification from the U.S. Green Building Council.

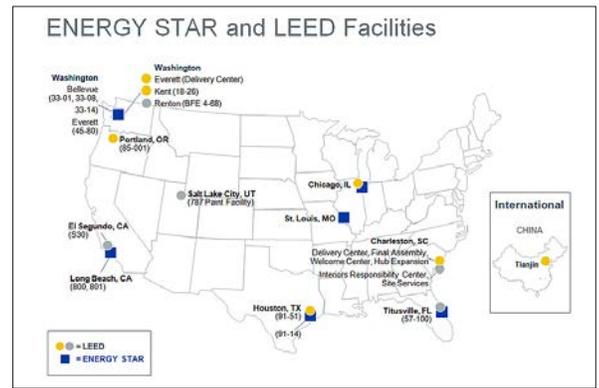
Characteristics that contributed to LEED Gold certification included lower energy and water use, natural lighting, and the use of recyclable and locally sourced materials, along with the reuse of packing materials.

The delivery and welcome center in South Carolina has also received LEED Gold certification, and work is underway to [expand](#) the delivery center in Renton, Washington, which also will meet Boeing's LEED Silver standard. The new delivery center also will more than double the space that will be available for customers and Boeing groups supporting the increasing 737 commercial airplane deliveries.

Boeing designs all new construction and major renovation projects to meet a LEED Silver rating or higher. More than 60 percent of all Boeing LEED-certified buildings have received Gold-level certification.



 **Video: Everett Delivery Center: A day in the making**
Watch a [time-lapse video](#) of a day at the Everett Delivery Center, which is LEED Gold certified by the U.S. Green Building Council. [Click here to learn more.](#) (Boeing image)



Boeing designs all new construction and major renovation projects to meet a LEED Silver rating or higher. (Boeing image)

Solar-powered Paint Facility in Salt Lake City

Located on the roof of the paint facility at Boeing's Salt Lake City site, thousands of solar tubes collect energy from the sun, making it the first Boeing paint facility to be partially heated by solar energy.

The 35,000-square-foot (3,251-square-meter) LEED Silver-certified building is used for painting the horizontal stabilizer of Boeing's 787-9 airplane. To receive the LEED Silver certification, the building was designed to include numerous large windows, which are not commonly used in paint facilities; a rainwater collection system; recycled and salvaged building materials; and enhanced heating and air controls. But it's the 3,600 rooftop solar tubes that help heat water for the paint curing process that make the building unique.

Through the use of the solar tubes, energy consumption is expected to be reduced by 7 percent for the curing process. Boeing's Salt Lake facility is also one of Boeing's six zero-solid-waste-to-landfill sites.

Boeing also uses solar energy to power its facility in North Charleston, South Carolina. The thin-film solar installation on the final assembly building roof has a peak capacity of 2.6 megawatts, and produces enough energy to power 250 residential homes. It is also one of the largest solar installations of its type in the southeastern United States.



3,600 rooftop solar tubes help power Boeing Salt Lake's state-of-the-art paint facility. (Boeing photo)



The 10-acre solar system at the Boeing North Charleston, South Carolina, facilities continues to be one of the largest thin-film solar installations in the United States. (Boeing photo)

Brighter, Energy-efficient Parking Lots in Winnipeg, Manitoba, Canada Reducing energy use is high priority for the Boeing Canada facility in Winnipeg. With the construction of a new parking lot and entrance to the site in 2013, the Winnipeg team took advantage of the rapid improvements in light-emitting diode (LED) technology to upgrade some of its lighting features. Providing 34 percent more coverage, only 45 LED light fixtures were necessary to cover the 700-stall, 272,575-square-foot (25,323-square-meter) lot, reducing the number of light fixtures required by about half. Lower maintenance costs, longer life and superior energy efficiency all translate into lower energy requirements and costs.

OUR LED LIGHT POLES SUPPLY **34%** MORE LIGHT FOR THE SAME ENERGY



The LED lights (the white lights in background) used for the new parking lot in Winnipeg, Manitoba, Canada, make a measurable difference in lighting and energy savings, compared to the existing lights (orange-yellow lights in foreground). (Boeing photo)

ISO 14001 Third-party certification to the internationally recognized ISO 14001 environmental management standard has strengthened our companywide focus on continuous improvement and enabled a common way of managing environmental processes across the company. More than 50 sites around the world, including all major manufacturing facilities, are certified to ISO 14001 standards. In 2013, four of our facilities in Australia — Brisbane, Humpty Doo, Riverina, and Townsville — all received certification for the first time. Boeing's distribution centers and many joint ventures and suppliers are also ISO 14001 certified.



More than 50 sites around the world, including all major manufacturing facilities, are certified to ISO 14001 standards. (Boeing image)

Diverse products, common goals



Engineer Linda Thomas helps find ways to reduce the use of hazardous chemicals on Boeing aircraft. (Boeing photo)

Linda Thomas helps to ensure that the full range of Boeing's defense and space products meet the environmental requirements of a diverse and complex mix of customers. It's not a simple task.

"Boeing has contracts with nearly every branch of service in the U.S. Department of Defense, NASA and many international customers — hundreds of separate projects and programs. They are like snowflakes; no two are the same," said Thomas, an engineer and Associate Technical Fellow who leads chemical risk management for Boeing's defense and space customers.

Although each contract may have unique requirements and specifications, government customers have common environmental goals and expectations for their Boeing products, Thomas said. "Our customers look to us to ensure their aircraft can be operated in an environmentally responsible way anywhere in the world."

Working with such varied and complex government contracts and criteria to continuously improve the environmental performance of Boeing products requires a different approach, Thomas said. For example, a

chrome-free paint or primer developed for one program may not meet the specifications for a different product.

"We know that a single technology won't meet the needs of every program. My goal is to provide the tools and technical expertise so each program can develop the best solutions," she said. Tools include the Product Chemical Profile System, which helps identify and catalog the chemicals in Boeing products, a key first step in reducing the use of hazardous chemicals and materials.

Boeing has made substantial progress in developing chrome-free paints and primers, which are used on a variety of military products, including the AH-64 Apache helicopter; the V-22 Osprey tiltrotor aircraft; and the F-15E Strike Eagle, Chinook helicopter, F/A-18E/F Super Hornet and EA-18G Growler tactical aircraft. Environmentally responsible replacements also have been found for brominated flame retardants on all military product specifications.

Thomas said the key to continuing the progress is ensuring that hazardous material management is included in government contracts with Boeing from the start.

In addition to providing tools and expertise, Thomas encourages Boeing programs to collaborate closely with each other and with industry groups also concerned with reducing the use of hazardous chemicals. "I take part in global working groups and other events with the International Aerospace Environmental Group and other organizations. I update them on progress at Boeing and pass along other best practices to our military product community at Boeing."

Thomas said even though her job is challenging at times, it's also very satisfying. "I feel like I'm making a difference for future generations. The decisions I make today will affect people tomorrow," she said. "When I see hazardous waste disposals and full landfills, I see the legacy of the past 50 years. I want the next 50 years to be different."

Energy for a brighter future



Chris Roe works with utilities across the country to find the best sources of electricity for Boeing's offices and factories. The power mix includes renewable energy, such as the 10 acres (4.05 hectares) of solar panels on the roof of the final assembly building at Boeing South Carolina. (Boeing photo)

Few people know as much about electricity use in Boeing's buildings as Chris Roe. Flip on a light switch in any facility in any state and he likely can tell you where that power comes from, how it was generated and how much it cost.

"I help Boeing purchase electricity to power our buildings across the country. It can be an amazing puzzle of generation sources, utility coordination and government regulations," said Roe, an engineer and energy resource leader.

Roe also helps coordinate Boeing's energy conservation program, which has produced major progress in improving the efficiency of the company's internal operations and expanded the use of renewable and low-carbon energy sources at a growing number of sites.

Boeing this year earned the 2014 ENERGY STAR Partner of the Year Sustained Excellence award from the EPA for leadership in energy conservation. Boeing has won the ENERGY STAR award every year since 2011.

On the energy supply side, Roe navigates a complex and varied energy marketplace where unique regulations govern how customers buy power and select the sources of energy they want.

The process of buying power starts at an individual Boeing site. "I work with Boeing facilities to better understand the site's business plan and forecasted energy need to support their particular operations," Roe said. "We get a good energy forecast developed and start competitive procurements with different companies."

In many locations, however, the energy market is not competitive but regulated, including utilities' rates. "For some facilities, we can buy power only from the local utility. In areas that allow direct access to a competitive market, we have more flexibility in how we source our energy supply," Roe said.

Historically, Boeing's main criteria in sourcing power have been reliability and predictable pricing, not how it's generated, Roe said.

Roe said Boeing is testing innovative strategies to better manage energy demand, too. "We're looking at creative approaches to buildings, such as leveraging 'big data,' or real-time monitoring of all systems that use energy to help reduce demand."

All new building construction or major remodeling is done to LEED Silver rating or higher, Roe said. Super-efficient LED lighting is replacing conventional lighting technology in factories and office buildings across the company.

Roe said improvements in energy efficiency can be found at almost every Boeing site. Even with robust business growth, from 2007 to 2012 the company reduced energy consumption by 3 percent, the equivalent of enough energy to power 44,000 U.S. homes for a year.

But do big energy-saving projects really help change employees' behavior? Roe thinks "absolutely." "Seeing tangible improvements in the company's environmental performance can inspire people to be more energy efficient and sustainable in their daily lives at work and at home," he said.

"We've made good progress. If we can continue building momentum with Boeing's 170,000 employees, I think we'll be amazed at what small, everyday improvements can mean for our planet."

Virtual reality has real-world environmental benefits



Engineers Emily Sprik and Brian Boutilier demonstrate equipment that creates a virtual reality painting experience designed to improve the skills and efficiency of Boeing painters. (Boeing photo)

With fluid body movements and a hand-held spray gun, engineer Brian Boutilier might look like he's pretending to paint an unseen Boeing aircraft. But with a high-tech headset, computer and 3-D technology, Boutilier has immersed himself in a virtual reality where he sees and is learning how to correctly paint a Chinook helicopter.

"This is as close as you can get to hands-on training in a classroom. It's realistic; when you pull the trigger it sounds like a spray gun," said Boutilier, a research engineer at Boeing's Philadelphia site, home to the Chinook and V-22 tiltrotor aircraft.

Boutilier and teammate engineer Emily Sprik helped develop a training program for aircraft painters that uses advanced technology to create a virtual reality painting experience with real-world benefits for the company and the environment.

"Training in a 'virtual' paint hangar allows painters to improve their skills and efficiency without wasting paint,"

Sprik said. "Reducing waste and boosting a painter's efficiency means less paint goes into the air during painting. And it helps reduce the amount of hazardous material on the aircraft and in the environment."

Sprik and Boutilier discovered the virtual reality training equipment several years ago when they were asked by the site's painting group to set up a hands-on remedial training program for painters who wanted to improve their skills.

Sprik said the technology is a one-stop shop for training. "It gives you immediate feedback on your skills. We can program the system to mimic an actual project a painter would have on an aircraft," she said.

"It helps a painter improve movement and muscle memory. And the system helps a painter avoid overspray and using too much paint, which is a real benefit for the environment."

The site's painters generally like the virtual reality experience but Sprik also noticed a generational difference in the painters' first reaction to the equipment. "The younger painters usually have more experience with new technology and video games and were comfortable with the equipment," she said.

"But once the more experienced painters tried the equipment, they could see the benefits."

The Everett, Washington, commercial airplane factory now also uses the virtual reality painting technology, and the equipment is being studied for possible use at other Boeing sites, Sprik said.

Boutilier, who has worked at Boeing for 46 years, said it's encouraging to see younger workers taking up new technology. Sprik agrees. "To me it's very important that Boeing is on the cutting edge of technology development. It's helping us improve our environmental footprint and worker safety," she said.



In 2013 Boeing completed the largest habitat restoration in the Lower Duwamish Waterway. (Boeing photo)

A key tenet of Boeing's remediation program is the invaluable input from community members and environmental groups. This, coupled with the guidance of leading environmental scientists and direction by federal and state regulatory agencies, has led to great progress in cleaning up sites to ensure the protection of human health and the environment.

Remediation activities are largely performed at sites that have been affected by past manufacturing activity and facilities where Boeing, or acquired companies, shipped chemicals or other wastes for treatment, storage or disposal. Comprehensive solutions oftentimes involve innovative cleanup methods and sustainable remediation practices.

Duwamish Waterway In 2013, Boeing completed the largest habitat restoration in the [Lower Duwamish Waterway](#), transforming nearly one mile (1.6 kilometers) of former industrial waterfront into a wetland resource that improves Puget Sound salmon runs. From tufted hairgrass and bulrush to willows and bigleaf maple, more than 170,000 native plants now occupy five acres (two hectares) along the water's edge.

Boeing is part of the Lower Duwamish Waterway Group along with the City of Seattle, Port of Seattle and King County, which are the four parties that have been leading the cleanup of a five-mile stretch of industrial waterway south of downtown Seattle. A decision on the cleanup plan for the Lower Duwamish Waterway Superfund site is expected from the EPA in late 2014.

In the meantime, Boeing has made [significant progress](#) with its "early action" cleanup work to remove contaminated sediment and restore the waterway bed with clean sand near the former Plant 2 site. The collective early action efforts of the Lower Duwamish Waterway Group will reduce contaminant risks in the sediment by half.

Boeing plans to remove 165,000 cubic yards (125,400 cubic meters) of sediment and replace it with clean sand by 2015. After the first two dredging seasons in 2013 and 2014, Boeing is halfway toward this goal with the removal of 82,000 cubic yards (63,460 cubic meters) of sediment, which is enough to fill 1,100 railcars. Boeing also installed a state-of-the-art treatment system to clean 9.3 million gallons (35 million liters) of water that was removed with the sediment during the [second season of dredging](#) in early 2014.



Boeing restored nearly one mile (1.6 kilometers) of former industrial shoreline, creating habitat to support fish and wildlife in the Lower Duwamish Waterway. (Boeing photo)

Santa Susana

A former federal government rocket engine test and energy research facility located northwest of Los Angeles, the Santa Susana Field Laboratory has a rich history of contributions to the U.S. space program. It sits within a vital habitat linkage between Southern California's inland and coastal mountain ranges and is home to rare and protected plants and wildlife. Since acquiring its portion of the site in 1996, Boeing has made significant progress toward cleanup and restoration, and is moving toward the goal of preserving Santa Susana as open space for future generations.

In September 2013, the California Stormwater Quality Association awarded top honors to Boeing's Santa Susana biofiltration system, which treats stormwater runoff while also providing habitat for pollinator species. Above ground, more than 2,000 native plants prevent water pollution and attract bees, butterflies and hummingbirds. Below ground, the biofilter is a hard-working system that uses natural processes to remove pollutants from stormwater runoff—similar to the way a swimming pool filter traps dirt and debris.

Boeing, with the help of stormwater experts, has designed and implemented advanced stormwater treatment and monitoring technology at the 2,850-acre (1,150-hectare) site. In addition to the biofilter, sitewide cleanup completed to date includes:



In 2013, Boeing hosted nine public meetings regarding its soil and groundwater investigation efforts, as well as bus and walking tours for thousands of community members.



Video: A natural winner (Boeing image)

Chemical Commodities, Inc. Boeing worked with community groups and enlisted the expertise of organizations, including the Pollinator Partnership, to transform a former chemical brokerage and recycling facility near Kansas City, Kansas, into ecological habitat. The 1.5 acre (0.6-hectare) Chemical Commodities, Inc. Superfund site is now the home of the Olathe Pollinator Prairie. Planted with native plants and trees by volunteers, it provides habitat resources for bees, birds and butterflies, as well as an educational and recreational resource for the local community. In 2013, the Pollinator Prairie was [certified](#) through the Corporate Lands for Learning program by the Wildlife Habitat Council and has been highlighted in a [video](#) by the EPA.



A walking path at the Olathe Pollinator Prairie, located near Kansas City, Kansas, guides visitors past multiple gardens designed to attract different species of bees, birds and butterflies. (Boeing photo)

From space race... to open space



Environmental project manager Arthur Lenox leads the team testing soil and groundwater as part of Boeing's remediation program at Santa Susana, California. (Boeing photo)

Growing up in California's San Fernando Valley, Art Lenox remembers frequently hearing the sounds of rocket engine tests at the nearby Santa Susana Field Laboratory. It was a time when the United States was enthralled with space exploration, and the testing supported virtually every major U.S. space program.

A portion of the 2,850-acre (1,150-hectare) site was used for government rocket engine testing and energy research. It has been nearly a decade since the last rocket engine was tested here, and the vision for Santa Susana now is focused on preserving the site as open space.

"Santa Susana has always felt like my backyard. The close proximity, combined with my love of the outdoors, is why it's so gratifying to be part of the cleanup and preservation of the site's natural environment and beauty," says Lenox, an environmental project manager

who leads the team that conducts soil and groundwater investigations as part of Boeing's remediation program.

Santa Susana is home to deer, bobcats, coyotes and cougars, and it sits within one of the last links of a vital habitat linkage that connects inland and coastal mountain ranges.

With the oversight of federal and state agencies, Boeing has made significant progress in cleaning up Santa Susana to environmental standards that are tougher than required for open space, Lenox said. For example, Boeing recently completed a four-year soil removal project to improve stormwater quality. More than 25,000 cubic yards (19,100 cubic meters) of affected soil were removed and precautions were taken to minimize the impact on streambeds and wildlife habitat.

"It is this extra level of care we take while fulfilling our cleanup and restoration commitments that represents Boeing's environmental stewardship in action," Lenox says.

Although much of the site's remediation activity has relied on technology, Lenox says the key to Boeing's progress is the involvement of and interaction with the community. "We share our open-space vision and build trust with the public by addressing concerns and answering questions," Lenox says. "As the landscape at Santa Susana changes, it's rewarding to see people enjoy the site as they attend a tour, nature walk or other event we sponsor."

Santa Susana is transitioning from a historic industrial facility to open space, with native grasses and plants reclaiming the land in the footprint of former buildings. "I think more people are discovering what I've known all along: Santa Susana is a place of wonder, beauty and vast ecological value, and it will be for generations to come."

Inspiring Global
Collaboration:
Engaging the
Industry



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

Boeing works with organizations, institutions, customers and governments around the world to drive environmental improvements throughout our industry and across the globe. In addition, Boeing employees and executives work with local, national and international environmental organizations in a number of voluntary and professional capacities.

Sustainable Aviation Biofuel As part of our core commitment to protect the environment and support the long-term sustainable growth of aviation, Boeing is the industry leader in global efforts to develop and commercialize sustainable aviation biofuel. A new sustainable jet fuel is essential to reduce commercial aviation's carbon emissions, reduce our industry's reliance on fossil fuel, and reach our industry's goal of carbon-neutral growth from 2020.

Boeing is focused on so-called "drop-in" sustainable biofuel, which can be blended directly with the traditional petroleum jet fuel supply with no changes to airplanes, engines or fueling infrastructure. Boeing's goal is that by 2016, sustainable biofuel will address 1 percent of global jet fuel demand, equivalent to 600 million gallons (2,271.25 million liters) of jet fuel. One percent often represents the tipping point to show proof of concept for a new technology, leading to increased investment and more rapid market expansion.

Sustainable aviation biofuel can be made from organic sources like plants or algae, and from bio-based inedible feedstocks such as waste cooking oil, animal fat or municipal solid waste.



Boeing is focused on alternative fuel development that meets sustainability criteria. This includes working with feedstocks that do not adversely affect local food supplies, freshwater supplies or land use policies. Many Boeing biofuel projects also encourage social and economic development, such as new opportunities for farmers to use marginal land for sustainable aviation biofuel crop production.

Biofuel efforts supported by Boeing use principles established by the international Roundtable on Sustainable Biomaterials (RSB). These sustainability principles address greenhouse gas emissions, local food security, conservation, soil, water, air, and technology, inputs and waste management. Boeing currently has active biofuel development projects on six continents, including in the United States, Europe, China, Japan, Middle East, Southeast Asia, Brazil, Southern Africa and Australia.



Boeing is collaborating on a new initiative—BIOjet Abu Dhabi: Flight Path to Sustainability—to support a sustainable aviation biofuel industry in the United Arab Emirates. (Boeing photo)

Global Approach to Aviation Emissions Because aviation is a global industry, with airplanes crossing international borders every day, Boeing believes that a global system is needed to address aviation emissions. We advocate that a global emissions framework for aviation can best be achieved through the International Civil Aviation Organization (ICAO), a United Nations organization.

Boeing fully supports the ICAO position on controlling aviation emissions and, along with the rest of the aviation industry, is working toward meeting these commitments.

Working through the ICAO, aviation was the first industry to present a clear plan to the United Nations' ongoing climate change negotiations. The ICAO calls for global

guidelines, including the development of a CO₂ standard for aircraft, improvements in air traffic control systems to cut air travel-related emissions by up to 12 percent, and continued efforts to promote the commercialization of sustainable alternative fuels. These efforts all aim to achieve carbon-neutral growth across commercial aviation by 2020 and reduce the footprint after that.

In October 2013, the ICAO General Assembly in Montreal agreed on a road map, aligned with the aviation industry's position, toward a global market-based approach to climate change. The ICAO agreement, reached by representatives from 191 nations, includes a commitment that, by 2016, the ICAO will develop a program to cut emissions using a market-based measure, most likely through carbon offsetting during which emissions from one source can be counterbalanced by environmental measures elsewhere. A global market-based measure adopted in 2016 would take effect in 2020. Boeing believes that this ICAO agreement represents great progress toward a global approach to aviation emissions, with more steps ahead.

Commercial Aviation Operational Efficiency As air traffic continues to grow around the world, air navigation and management services must keep pace. Studies have shown that a modernized air traffic management system can improve the efficiency of all airplanes flying by as much as 12 percent, reducing fuel use and greenhouse gas emissions as well as saving time for passengers and aircraft operators. Cutting flight times on a global basis by just one minute per flight would reduce carbon emissions by 4.8 million tons (4.4 million metric tons) annually, according to the International Air Transport Association (IATA).

Boeing advocates for modernization of the global air traffic management system infrastructure and is enabling greater operational efficiency through support and services that provide improved airline operations, such as the Boeing Wind Updates and Direct Routes programs.

Using industry-leading technologies and Boeing-developed algorithms, these services supply airlines with customized real-time wind and temperature information—delivered directly to the aircraft—and real-time information about optimal routings. The data generated by these programs allow for more efficient trajectory prediction during preflight operations and continuous optimization in flight by providing tailored information for flight crews and the aircraft flight management system. Wind Updates data are also individually tailored to the specific aircraft type, regardless of manufacturer, to provide optimal performance. In early 2014, Boeing and Qatar Airways announced a five-year agreement to provide Boeing Wind Updates services for the airline to maximize in-flight operational efficiency.



 **Video: Air traffic management improvements combined with advances in aircraft design can significantly reduce fuel consumption and emissions. (Boeing image) [Click here to learn more.](#)**

Chemicals and Hazardous Materials Manufacturing airplanes and defense products is a complex process, involving in some cases millions of parts from around the world; every aircraft must meet strict safety, aircraft airworthiness and regulatory requirements. Increasingly, information about the use of chemicals and hazardous materials contained in products or used in production processes is being required to meet new requirements, such as the European Union regulation of chemicals called REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals).

[The International Aerospace Environmental Group](#) (IAEG), of which Boeing was a founding member, is helping the industry meet the growing and expanding requirements. To do this, IAEG is:

- ✈ Identifying the materials/substances that are relevant for reporting.
- ✈ Developing understanding among the aerospace industry of environmental requirements faced by the world's supply chain.
- ✈ Optimizing collaboration and driving integration of different company requirements, when possible, to create industry solutions.
- ✈ Working through its member companies to conduct research to pursue the development and implementation of hazardous chemical alternatives throughout the value stream that meet aerospace performance and safety requirements.

As a result of the collaboration among the aerospace companies, a voluntary greenhouse gas reporting standard has been developed by, and for, the aerospace industry. The organization is also conducting a pilot project and survey with its member companies and numerous aerospace suppliers to develop a standard for

chemical reporting for the industry. This work will ensure that the proposed voluntary standard is effectively meeting the needs of aerospace.

These new voluntary standards help improve efficiencies by eliminating the need for each company to develop its own system. IAEG membership has doubled since the group formally was established in June 2011, now representing more than 50 percent of the world's total aerospace market.



Through collaboration with groups such as the National Center for Manufacturing Sciences Consortium and International Aerospace Environmental Group (IAEG), Boeing is supporting industry efforts to find alternatives for hazardous materials used in manufacturing and operating aircraft. (IAEG image)

Finding Alternative Solutions Through collaboration with groups such as the National Center for Manufacturing Sciences (NCMS) Consortium, Boeing is supporting industry efforts to find alternatives for hazardous materials used in manufacturing and operating aircraft. Recently, Faraday Technology Inc. in Clayton, Ohio, developed a new technology with funding from Boeing, the EPA and NCMS to reduce the amount of hazardous chemicals in the manufacture of commercial and military aircraft. The work received a [Presidential Green Chemistry Challenge Award](#) from the EPA.

The new technology is a major improvement in the process that currently requires the use of hexavalent chromium in the coating that prevents wear and extends the service life of aircraft parts, including landing gear and hydraulic system components. The improved coating process will enable manufacturers to use trivalent chromium, a less toxic material, which delivers equal or improved performance.

The EPA estimates that use of Faraday's new coating process could eliminate 13 million pounds (5.9 million kilograms) of hexavalent chromium waste each year in the United States and as much as 300 million pounds (136 million kilograms) worldwide.

Boeing is also leading the industry to accelerate the development of an industrywide non-Halon solution for propulsion systems fire protection through a new industry research consortium. We also are working to establish a time frame for developing cargo Halon replacements for the ICAO.

Global challenges, local opportunities



Michael Lakeman holds samples of algae that could be a good feedstock for sustainable aviation biofuel. Lakeman leads the Boeing biofuel program in Asia Pacific. (Boeing photo)

As Boeing's leader of biofuel strategy in the vast Asia Pacific region, Michael Lakeman tries to find consensus among an equally vast array of stakeholders, from farmers to government regulators. "It's like a multilayered jigsaw puzzle where the pieces are constantly changing shape," said Lakeman, Associate Technical Fellow and biofuel regional director for Boeing Commercial Airplanes.

"I try to fit all the pieces together to find the 'sweet spot' in our biofuel strategy—the right thing to do for Boeing, our customers, the aviation industry and the environment. It's the fun part of the job for me."

Boeing is a global leader in the research and development of sustainable aviation biofuel. The company's role is as an industry catalyst and facilitator, Lakeman said. "We're an enabler; we bring people together and make sure all the right people are at the table."

A key component of Boeing's strategy is to build consensus among stakeholders at the local and regional levels and develop a "road map" that outlines the steps needed to build a biofuel industry. "The road map is a very detailed bottom-up look at how we could build a biofuel supply chain in a specific location," Lakeman said.

The road map looks at potential feedstocks and other natural resources, economic conditions and regulations. "It's the best way we've found to align groups with

sometimes very different backgrounds around a strategy. We invite people who have concerns or ideas into a dialog so they feel included and their voices are heard."

The company's first regional road map process was in Australasia and was followed by other sustainable biofuel "firsts" in Asia Pacific, Lakeman said. The first airline to use a drop-in biofuel blend on a commercial flight was Air New Zealand.

The Australasian road map involved airline customers, major scientific research groups and Australia's defense organization. The process produced a series of recommendations, many of which were accepted by the national government and other stakeholders.

An example of a local opportunity for a sustainable biofuel supply chain is in the Australian state of Queensland. Boeing and its research partners studied an area of dry, unproductive land used mostly for cattle grazing.

"Farmers there have a challenge. They need to clear the land of native trees and shrubs, and end up burning the biomass in the field and it goes to waste," Lakeman said. "Why don't we harvest the biomass and turn it into biofuel and support the local economy?"

Lakeman said the Queensland government and the Australian defense research organization are supportive, and next steps include developing a detailed business plan and biomass production system.

The Australian road map was so successful that the strategy has been replicated around the world, including in Brazil, Mexico and the United States, with a road map process also being planned in Japan, Lakeman said.

The opportunities for a sustainable biofuel industry in Asia Pacific are part of the work's appeal for Lakeman. "It's an exciting region full of economic growth with a dynamic culture and people who are smart and optimistic," Lakeman said. "Working with great people who are as passionate about this as I am is what I find most satisfying about my job."

Biofuel from desert plants, halophytes



Boeing and research partners in the United Arab Emirates have made breakthroughs in sustainable aviation biofuel development, finding that desert plants fed by seawater will produce biofuel more efficiently than other well-known feedstocks. (SBRC photo)

The UAE continues to grow rapidly as a global center of trade, tourism and aviation. Boeing is working closely with the UAE's Etihad Airways to develop a sustainable aviation biofuel industry in Abu Dhabi that will support further sustainable growth.

Since 2009, Boeing and Etihad Airways have partnered with the UAE's Masdar Institute of Science and Technology to research and develop biofuel production using plants called halophytes, which grow in arid/desert regions and can be irrigated with seawater. In addition to the benefits for aviation, this work seeks to reduce the environmental impact of aquaculture (fish farming) while increasing food security in the Arabian Gulf and other regions with similar climates.

In January 2014, the Boeing- and Etihad-funded Sustainable Bioenergy Research Consortium (SBRC) at Masdar Institute announced research breakthroughs in its halophyte work, finding that halophytes will produce biofuel more efficiently than other well-known feedstock.

Green diesel



Boeing has identified "green diesel," a renewable fuel used in ground transportation, as a significant new source of sustainable aviation biofuel that emits at least 50 percent less carbon dioxide than fossil fuel over its life cycle. (Boeing photo)

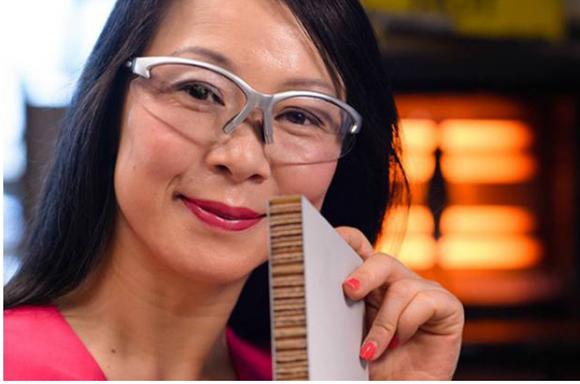
In early 2014, Boeing announced that it had identified a new source of biofuel for jets: "green diesel," a renewable diesel fuel that today is used for truck transport. The company is working with the U.S. Federal Aviation Administration and other stakeholders to gain approval for aircraft to fly on green diesel, further reducing the aviation industry's carbon emissions.

Boeing researchers performed analysis that found green diesel, which is made from oils and fats, to be chemically similar to today's aviation biofuel. If approved, the fuel could be blended directly with traditional jet fuel. This would be a major breakthrough in the availability of competitively priced, sustainable aviation fuel.

Significant green diesel production capacity already exists in the United States, Europe and Singapore that could supply as much as 1 percent—about 600 million gallons (2,271.25 million liters)—of global commercial jet fuel demand. The wholesale cost of green diesel—about \$3 a gallon with U.S. government incentives—is competitive with petroleum jet fuel. Green diesel, also called "renewable diesel," can be used in any diesel engine, which means that, if approved for use in aviation, it could be used extensively by airlines, cargo operations or government agencies with ground, sea and air operations.

Boeing, the FAA, engine manufacturers, green diesel producers and others are now compiling a detailed research report that will be submitted to key stakeholders in the fuel approvals process. (Please note that green diesel is chemically different and a different product than the fuel known as "biodiesel.")

Shanying Zeng: Researching a better way



Technical Fellow Shanying Zeng holds a sample of material treated with a new flame retardant that will be tested in Boeing's flammability laboratory. Zeng helps lead Boeing's strategy to reduce hazardous chemicals in products and services, which includes testing environmentally responsible flame retardants for aircraft interiors. (Boeing photo)

As a lead research engineer for environmental technology at Boeing, Dr. Shanying Zeng said in one sense her job is pretty simple: "I support Boeing's commitment to the environment by helping to get bad stuff out of our aircraft and good stuff into our products."

Zeng is a Technical Fellow in the Chemical Technology Group in Seattle. She leads a group of scientists and engineers who are helping Boeing and the aviation industry find environmentally progressive alternatives for hazardous chemicals and material used in commercial and military aircraft.

One example is the chemical widely used as a flame retardant on surfaces and parts throughout most aircraft. Manufacture and import of the chemical in the United States were phased out at the end of 2013 because of concern over its effects on human health and the environment.

"Finding suitable replacements for the chemical has been a challenge. It was used on more than 155 materials on our commercial and military products," Zeng said. In addition to being less toxic, replacements must meet stringent aerospace performance requirements.

The focused research at Boeing and collaboration with suppliers and industry groups around the globe have led to the development of effective alternatives for 154 of these aircraft applications, Zeng said.

"I'm confident we will have the right solutions in place as new chemical options are developed," she said. "And we won't stop there; we are always looking one step ahead."

Boeing is collaborating with Texas A&M University on a novel flame retardant technology that involves environmentally progressive coatings that could be applied to existing airplane interior materials, Zeng said.

One of the biggest environmental challenges facing the industry, Zeng said, is reducing and eliminating hexavalent chromium, or chrome, a toxic metal commonly used in aircraft paints and primers to resist corrosion. Boeing has been a global leader in researching effective chrome replacements, and now uses chrome-free paints and primers on an increasing number of its military and commercial products.

Zeng is confident that sustainable materials made from renewable resources will find applications on Boeing commercial aircraft. For example, Boeing and its research partner Commonwealth Scientific and Industrial Research Organization in Australia are developing advanced materials that could be used in an aircraft's interior panels.

Environmental challenges facing the aerospace industry are bringing together airplane manufacturers, suppliers and research organizations around the globe to find solutions. Zeng is Boeing's technical expert on the International Aerospace Environmental Group, which is developing common procedures and requirements for environmentally progressive alternatives to regulated materials, such as chrome.

Zeng's leadership in environmental R&D has brought her high-level recognitions and awards, including the 2014 Asian American Engineer of the Year, an honor given by the Chinese Institute of Engineers – USA.

Zeng said it's the feeling of being able to make a difference that makes her work at Boeing so rewarding. "I was part of the team that developed the carbon-fiber composite material used on the 787 Dreamliner™. Now when I see the 787 flying, I think 'Wow, I wasn't just doing R&D. This really is a special place to work'."



A process improvement has enabled an in-tank wing team at the Everett, Washington, Modification Center to cut its use of single-use batteries—and the related generation of hazardous waste—by 99 percent. (Boeing photo)

Boeing employees are constantly improving the way we design and build our products—by making them more efficient, cleaner, safer and higher quality. Tapping into employee ideas and enthusiasm is how Boeing makes improvements in any area of the business, and it's no different for the environment. Every day, employees come up with innovative ideas for how to improve environmental performance—of our products, supply chain and operations.

Through thousands of employee teams, as well as dozens of volunteer-based Green Teams, Boeing employees are finding ways to reduce energy and water use, and the generation of solid and hazardous waste.

For example, last year a 20-member employee team that seals the inside of wing fuel tanks on the Boeing 787 Dreamliner™ found a way to reduce its waste. In the past, the team consumed 50,000 AAA- and AA-size batteries a year to power headlamp flashlights. By switching from disposable to rechargeable batteries, the team now uses just 400 batteries a year, reducing its battery waste from 18,000 pounds (8,200 kilograms) to approximately 2,000 pounds (900 kilograms) a year.

This is just one example of the hundreds of environmental improvement projects that employee teams completed in 2013. Last year, more than 70 projects competed for Boeing's annual conservation awards.



Boeing employees also take seriously their stewardship role in the community, to make the places where we live and work cleaner and better for all. In 2013, more than 20,000 Boeing employees took part in Earth Day events at 65 Boeing sites in 14 countries.

Tapping into employee know-how and enthusiasm for environmental improvement is a critical means of achieving our 2017 environmental commitments, and Boeing aims to continue increasing employee engagement to make those improvements.

Green Team harnesses the power of one



Material handling specialists Ricky Rhine (left) and Clayton Maxwell collect a portion of the 4,000 pounds of bubble wrap recycled each month at Boeing St. Louis. Recycling has helped the site reduce by two-thirds the amount of waste it sends to landfills annually. (Boeing photo)

Cheryl Fievet remembers the early days of recycling at Boeing's St. Louis site and sometimes has a hard time believing how far the recycling program has come in the past 10 years.

"We started in 2003 with a handful of employees pushing to recycle the plastic soda pop bottles from vending machines. We thought it was a big step forward just being allowed to move recycling containers indoors from outside in the parking lots," said Fievet, an industrial engineer.

Through persistence, partnerships with the site's facilities group and support from leadership, the "handful" of employees a decade later is now the Boeing Employees for Environmental Protection, or BEEP, with 250 members. It's one of the largest teams of environmentally active employees at Boeing.

The St. Louis team is credited with helping establish innovative recycling projects that have helped Boeing reduce its environmental footprint and expand opportunities for employees to recycle and get involved with a variety of environmental activities.

Facilities manager Bryan Kury said employee engagement plays an important role in helping Boeing

continue to improve its environmental performance. "It's all about harnessing the power of the engaged and informed employee," he said.

The success of the employees' efforts can be measured in part by the amount of solid waste the site now recycles; up from 12 percent in 2007 to 67 percent in 2012. The volume of waste sent to landfills has been reduced by two-thirds. Across the company, almost 80 percent of the solid waste Boeing generated from 2007 to 2012 was diverted from landfills.

The initial push in St. Louis to recycle beverage containers expanded to include other materials, including cardboard, paper, wood, empty paint and sealant containers, Styrofoam, and several types of plastic. About 4,000 pounds (1,800 kilograms) of bubble wrap is recycled each month alone.

The strong interest in recycling enables the St. Louis team to organize on-site events during which employees can bring from home used electronics and other household items that are donated to community groups for reuse or recycling. Athletic shoes are donated to Nike for recycling into a surface material used on playgrounds and athletic fields; blankets and towels are given to a local animal shelter.

In addition to a monthly newsletter, the team has an internal website and a network of "champions" in nearly every building who monitor recycling containers and serve as employee contacts. But good communications is only one part of the picture, said Alyssa Duarte-Reinagel, a systems manager who helped launch the site's broader recycling efforts in 2003.

"You need to come with ideas, suggestions and solutions for what needs to be done; you can't just complain about something," Duarte-Reinagel said.

She and other team members say BEEP is an example of how one employee, with persistence and commitment, can make a difference.

"When I hear people say, 'We can't change things,'" Duarte-Reinagel said, "I point to the blue recycling containers all around the site and say, 'Actually, you can.'"

Inspiring Global
Collaboration:
Building Better
Communities



Boeing awards grants to Engineers Without Borders-USA professional and student chapters to enable projects such as this Georgia Tech project to build sustainable water supply systems in Oloo, Uganda (Photo: Engineers Without Borders Georgia Tech)

As a committed, responsible environmental leader focused on healthy global growth, we collaborate with research institutions, customers, universities and governments to solve problems and partner with local communities about the importance of environmental protection and preservation.

In 2013 Boeing supported almost 100 projects around the world focused on environmental education, energy efficiency and conservation efforts. Working with community and business partners in Italy, Boeing supports the nationwide educational program “Svitati per l’ambiente” (“Let’s talk about sustainability”), which fosters young people’s interest in sustainable development and raises their awareness of the importance of environmental protection. In Indonesia, Boeing has partnered with The Nature Conservancy in support of the Berau Forest Carbon Program, which aims to bring almost 2 million acres (800,000 hectares) of forest land on the island of Borneo under effective management, lowering Indonesia’s carbon emissions, while also protecting biodiversity and improving the livelihoods of local communities.



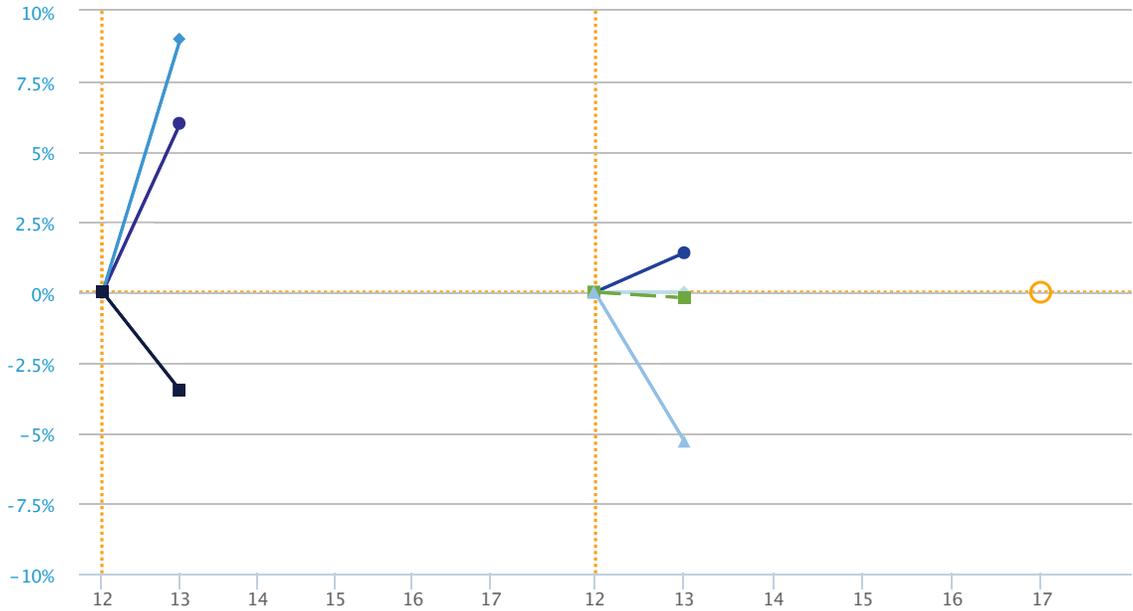
Watch the video about how Boeing is building better communities worldwide. (Boeing image)
[Click here to learn more.](#)

In the United States, Boeing supported more than 40 university student chapter projects through the nonprofit Engineers Without Borders-USA (EWB-USA), which helps to inspire the next generation of engineers to solve critical community problems by implementing deep-rooted engineering solutions that improve environmental and community performance. Through another collaboration with the Roundtable on Sustainable Biofuels (RSB), Boeing is helping Southeast Asian farmers grow plants that can be used to make sustainable aviation biofuel, which not only helps to reduce carbon emissions, but also improves the livelihoods of rural communities.

To read other stories of how Boeing is building better communities worldwide, read our [Global Corporate Citizenship report](#).

**Performance:
Operational
Footprint Goals**

Summary of Environmental and Business Performance 2013



**Business Performance
Change 2012-2013**
 ● Revenues 6%
 ▲ Deliveries 9%
 ■ Employees -3.5%

Environmental Performance to Target
 ● Hazardous Waste 1.4%*
 ▲ GHG Emissions 0%
 ■ Solid Waste -0.2%
 ▲ Water Intake -5.3%
 ✦ Environmental Target:
 0 absolute growth for water,
 greenhouse gas and solid waste;
 0 revenue-adjusted growth
 for hazardous waste by 2017
 *Revenue-adjusted

[See Appendix for Performance summary footnote](#)

While our business continues to grow, we are committed to zero growth for our environmental targets.

Operational footprint goals Boeing continues to accelerate improvements in the environmental performance of the company's operations. From 2007 to 2012, during a time of significant business growth, Boeing surpassed its first set of [absolute-reduction targets](#).

Building on the demonstrated performance of the first set of five-year targets, and as business continues to grow, Boeing is committed that, by the end of 2017, our greenhouse gas emissions, water intake and solid waste to landfills will remain the same, as they were at the end of 2012. Additionally, we are committed to limiting our hazardous waste generation to no more than the rate at which our business is growing.

About this section The graphs and charts in this section are labeled with information rounded to the nearest decimal place and reflect the environmental performance of the majority of Boeing facilities, calculated from a baseline of 2012 values. However, some slight variation in the display of the data may occur in the visual appearance of some graphs for the purpose of creating visual presentations.

Additionally, each chart is represented by its own data set that is described in the accompanying footnotes.

**Performance:
Greenhouse Gas
Emissions**

Boeing recognizes that climate change requires serious action. We have conducted an assessment of the environmental footprint across our value chain, including our greenhouse gas emissions profile. The greatest sources of greenhouse gas emissions for our industry are our products in use, followed by the supply chain and our company operations. Boeing is addressing the product-in-use emissions through a strategic three-tiered focus on airframe efficiency innovations, technology improvements to modernize the air traffic management system, and expanding the supply of sustainable aviation biofuel for the industry. We also are a leader in driving collaboration to make improvements for aerospace industry and partner with the communities where we live and work.

Within our own operations, we are taking action to reduce the company's greenhouse gas emissions. From 2007 to 2012, Boeing's carbon dioxide (CO₂) emissions decreased by 9 percent on an absolute basis.

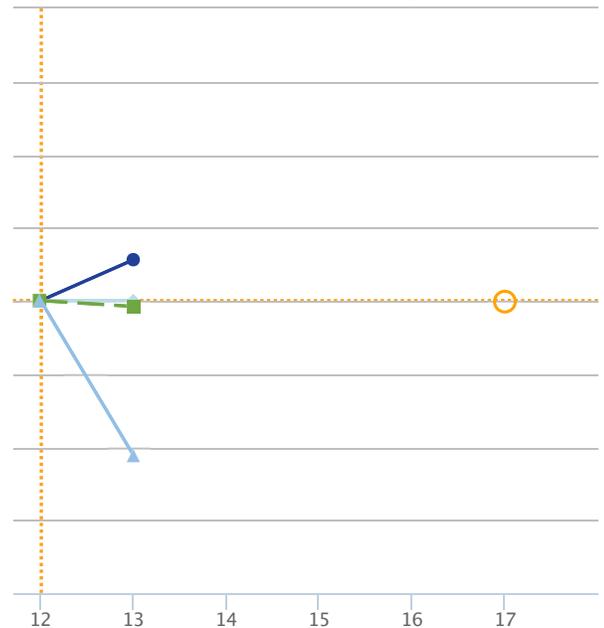
Boeing received the Excellence in Greenhouse Gas Management Award for Goal Achievement from the EPA, in recognition of successfully managing and reducing greenhouse gas emissions.

Greenhouse Gas Operation Footprint Goal As our environmental programs have grown and matured, we are now expanding our greenhouse gas target beyond CO₂ to the internationally recognized CO₂-e (carbon dioxide equivalence) standard, by including methane and nitrogen dioxide. Boeing's goal is to maintain our greenhouse gas emissions at or below 2012 levels, on an absolute basis, by 2017, thereby growing our business and limiting growth in our greenhouse gas emissions.

In 2013, Boeing's greenhouse gas emissions were 1.30 million metric tons (1.43 million tons).

To continue to meet our commitment, we are investing in energy efficiency projects, expanding our use of renewable energy and implementing ideas generated by our employees.

Environmental Performance to Target



Environmental Performance to Target

- Hazardous Waste 1.4%*
- ◆ GHG Emissions 0%
- Solid Waste -0.2%
- ▲ Water Intake -5.3%
- ★ Environmental Target:
- 0 absolute growth for water, greenhouse gas and solid waste;
- 0 revenue-adjusted growth for hazardous waste by 2017
- *Revenue-adjusted

[See Appendix for Greenhouse Gas Operational Footprint Goal footnote](#)

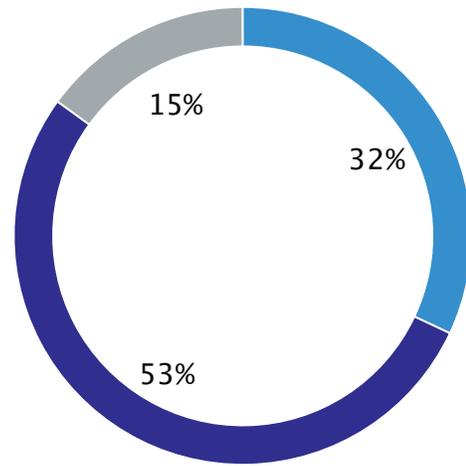
Greenhouse Gas Corporate Inventory Our corporate greenhouse gas emissions fall into three categories: Scope 1, Scope 2 and Scope 3, and go beyond our operational targets. Scope 2 emissions comprise the largest segment of our greenhouse gas emissions, followed by the direct emissions of our facilities and then our business travel.

Scope 1 emissions were 672,409 tons (610,000 metric tons) and cover our consumption of electricity, natural gas, fuel oil and the jet fuel used in our flight-test programs. Scope 2 emissions were 1,130,971 tons (1,026,000 metric tons) and focus on the sources of emissions related to our business such as transportation of parts and our purchased electricity. For Scope 3 emissions, we track the emissions associated with our business travel, which were 326,284 tons (296,000 metric tons).

In 2013, Boeing employees reduced commuting trips to and from work by more than 325 million miles, roughly equivalent to more than 679 round trips to the moon. In the average month, approximately 25 percent of Boeing employees use an alternative method to driving alone, such as carpooling, vanpooling, bus service or biking, to commute to work.

In 2013, Boeing was recognized by the CDP (Carbon Disclosure Project), for its leadership in Climate Disclosure on [CDP's Standard & Poor's 500 Climate Disclosure Leadership Index](#).

Greenhouse Gas Corporate Inventory

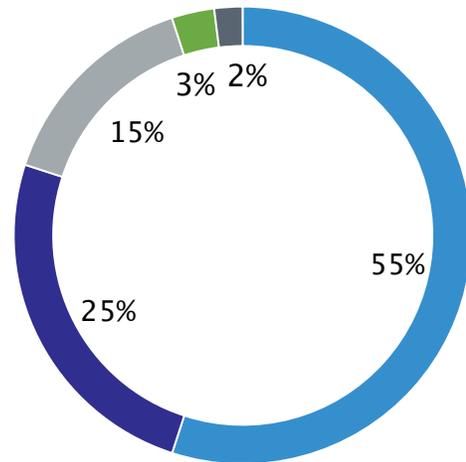


- Scope 1 Emissions
- Scope 2 Emissions
- Scope 3 Emissions

[See Appendix for Greenhouse Gas Corporate Inventory footnote](#)

[See Appendix for Greenhouse Gas Corporate Inventory site listing footnote](#)

Greenhouse Gas Scope 1 Emission Sources



- Natural Gas
- Jet Fuel
- Fugitive Emission
- #2 Diesel
- Other Fossil Fuels

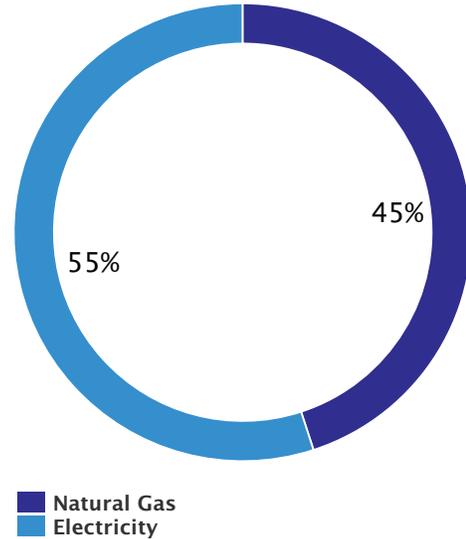
Performance:
Energy
Conservation

Improving energy efficiency across Boeing continues to be a key focus for the company. In 2013, Boeing's energy use was 13.81 million MMBtus, a 0.8 percent increase from 2012.

About half our energy is derived from electricity, the other from natural gas. View our 2007–2012 energy reduction performance in the [2013 Environment Report](#).

Boeing also sponsors an annual internal Conservation Awards program to recognize and encourage replication of best practices across the company. Now in its 11th year, more than 500 completed projects have applied for the award, which is given to a select few teams every year for driving environmental performance. Through the program, projects such as the LED lighting project in Winnipeg, Manitoba, Canada, have resulted in annual energy consumption reductions of over 2.4 million MMBtus.

Energy: Electricity vs. Natural Gas



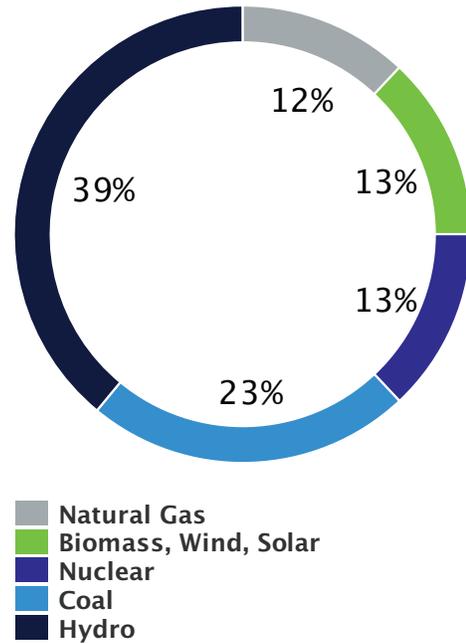
**Performance:
Alternative and
Renewable
Energy**

Boeing uses carbon-free hydroelectric and renewable energy sources for nearly half our total electricity consumption. Hydropower provides more than 80 percent of electricity to our facilities in Everett, Washington, and the Seattle area, and is also used to generate electricity at our facility in Winnipeg, Manitoba. Boeing uses the [EPA definition](#) of renewable energy, which includes resources that rely on fuel sources that restore themselves over short periods of time and do not diminish. Such fuel sources include the sun, wind, moving water, organic plant and waste material (eligible biomass), and the Earth's heat (geothermal).

The 10-acre solar system at the Boeing North Charleston, South Carolina, facilities continues to be one of the largest thin-film solar installations in the United States. The installation produces about 2.6 megawatts at peak production or enough electricity to power approximately 250 residential homes.

We are also helping our customers and communities around the world, such as in Guam and Canada, expand their use of renewable energy, and are leading the industry in developing sustainable fuel sources for aviation.

Electricity Sources



Performance:
Water

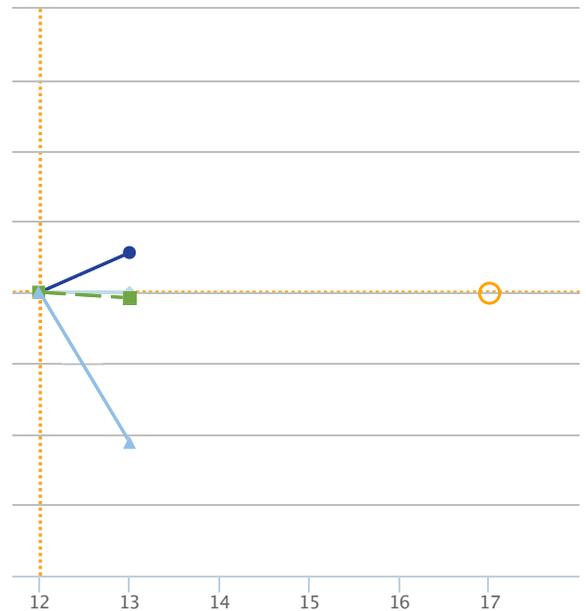


Site landscaping changes at the facility in South Carolina helped conserve water and earn Boeing a 2013 conservation award. (Boeing photo)

We continue to make progress with water-reduction efforts through alternative production methods, treatment technologies, water recycling solutions and employee awareness training on water management. In 2013, we cut our water use by 5 percent from the previous year, saving enough water to fill more than 140 Olympic-size swimming pools.

Reverse Osmosis As a part of its recent tank line system update, the Boeing Portland facility included a water reuse component. The new system uses reverse osmosis as a high-pressure filtration system to take the existing wastewater (see [Appendix for Wastewater footnote](#)) and then filter it to make it reusable. The recycled water is returned to the tank line, along with city water, and then is used again in most of the tank line's processes. Previously, the water was disposed of down the sanitary sewer. Now, as much as 80 percent is reclaimed and, after more than a year in operation, more than a million gallons of water are recycled each month.

Environmental Performance to Target



Environmental Performance to Target

- Hazardous Waste 1.4%*
- ▲ GHG Emissions 0%
- Solid Waste -0.2%
- ▲ Water Intake -5.3%
- ✚ Environmental Target:
0 absolute growth for water,
greenhouse gas and solid waste;
0 revenue-adjusted growth
for hazardous waste by 2017
*Revenue-adjusted

See [Appendix for Water Performance to Target chart footnote](#)

**Performance:
Waste**

Solid Waste Boeing measures nonhazardous solid waste (see Appendix for Solid Waste text footnote) generated by our operations. In 2013, Boeing sent 45.5 million pounds (20.6 million kilograms) of solid waste to landfills, a 0.2 percent improvement from the baseline set in 2012. Waste is diverted from landfills through a combination of reducing, reusing, recycling, composting and energy recovery programs.

Currently, Boeing has six zero-waste-to-landfill sites: El Segundo, California; Long Beach, California; Charleston, South Carolina; Huntsville, Alabama; Philadelphia; and Salt Lake City. 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.

Thousands of pounds of packaging shed as team innovates for future With the first KC-46A Tanker entering production and the first 767 Freighter for FedEx delivered, the 767 team is busy innovating for the future. Working with suppliers, the 767 team was able to remove 10,000 pounds (4,500 kilograms) of waste from every 767 produced by creating new reusable containers to store and ship parts – known as “supplier kits.”

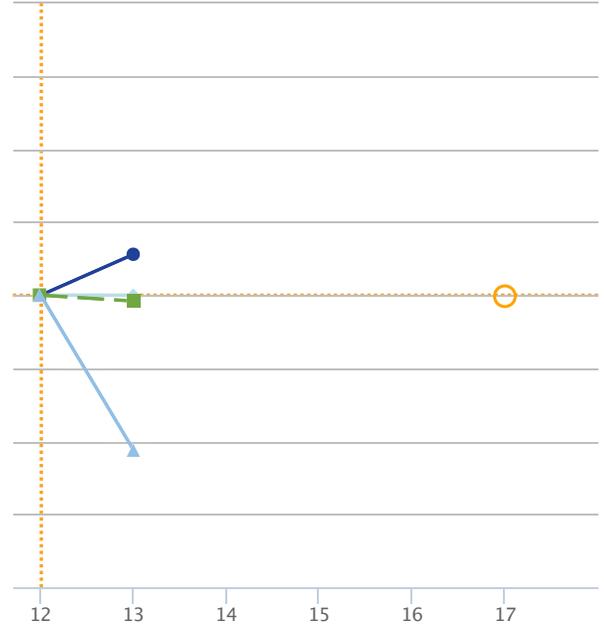
The new kits eliminate the need for the plastic wrap, cardboard and wood previously used, removing the cost and time associated with unwrapping and sorting each part. In addition to the amount of waste reduced, the new process is improving productivity by saving approximately 30 hours per airplane.



A Boeing 767 industrial engineer examines the new supplier kitting carts for the first time in Everett, Washington. (Boeing photo)

Hazardous Waste From [2007 to 2012](#), Boeing reduced the amount of hazardous waste it generated by 33 percent on a revenue-adjusted basis. Building on this demonstrated performance, we are committed that our hazardous waste generation will not grow a rate more than the rate at which our business is expanding, by the end of 2017. In 2013, we saw an increase of 1.4 percent from our 2012 baseline.

Environmental Performance to Target

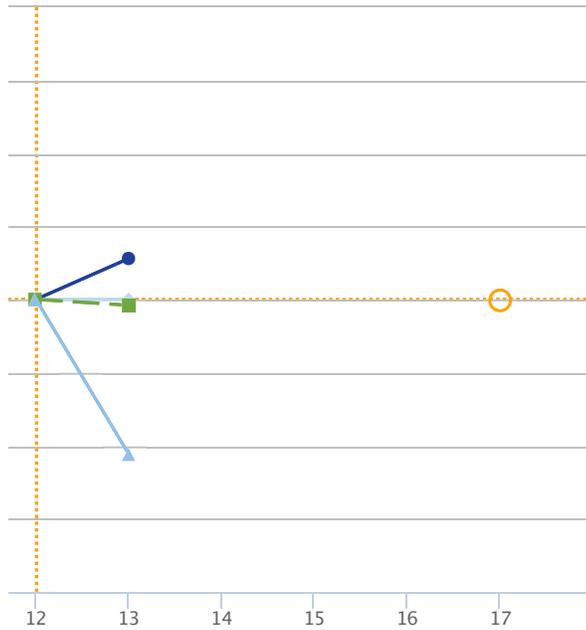


Environmental Performance to Target

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[See Appendix for Solid Waste Performance to Target chart footnote](#)

Environmental Performance to Target



Environmental Performance to Target

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for hazardous waste by 2017
*Revenue-adjusted

[See Appendix for Hazardous Waste Performance to target chart footnote](#)

To meet our commitment of zero revenue-adjusted growth by the end of 2017, we are implementing numerous projects throughout the company to reduce the amount of hazardous waste that we generate.

For example, at Boeing's Philadelphia facility, painters use a new virtual reality, 3-D environment to practice their technique before painting an aircraft. This 3-D trainer, a product called SimSpray, simulates the painting experience, and can measure paint coverage for a variety of coating systems, replicate common defects such as drips, determine quantities of wasted paint and provide immediate coaching on painting techniques. This all translates to more efficient painters, who use less paint for each aircraft and generate less hazardous waste. It is currently used for the classroom training of newly hired painters in the H-47 Chinook and V-22 Osprey programs. Applications for the Puget Sound region are also being explored.

In 2013, our South Carolina facility implemented a process to reduce its hazardous waste generation by replacing the conventional paint cleanup solvent methyl ethyl ketone (MEK) with a reusable and more environmentally sensitive alternative. The new material, EP-921® by Inland Technology, Inc., is nonhazardous, does not contain hazardous air pollutants, is low in volatile organic compounds, and met the site's

production needs. The new material can be reused multiple times thanks to the automated gun cleaning and reclamation units that were installed. Those units employ a two-stage filtration process to remove paint contaminants from the material. Liquid hazardous waste generation from the paint operations has been reduced by more than 50 percent, approximately 48,000 pounds (21,770 kilograms) annually at current production rates.



[▶ The SimSpray virtual reality paint trainer provides real-time video feeds so instructors can watch painters' progress. \(Boeing photo\) Click here to learn more.](#)



[Solving for solvents: A Boeing employee pours paint solvent into a reclamation unit which, after filtration, allows it to be reused multiple times. \(Boeing photo\)](#)

Boeing is a responsible partner, neighbor and citizen to the diverse communities and customers we serve.

With corporate offices in Chicago, Boeing employs more than 168,000 people across the United States and in more than 65 countries. This represents one of the most diverse, talented and innovative workforces anywhere. Each year we submit our environmental data to various reporting agencies according to regulatory requirements. Additionally, we report to both the U.S. Toxic Release Inventory as well as Canada's National Pollutant Release Inventory. A summary of our previous disclosures can be found in the [2013 Environment Report](#).

Australia Boeing Australia represents the company's largest operational footprint outside the United States. In 2013, Boeing Australia filed its fifth [National Greenhouse and Energy Report](#), detailing its greenhouse gas emissions, energy consumption and energy production data. Boeing Australia's CO₂-e emissions were calculated at 67,024 tons (60,804 metric tons)* and energy use at 111,865 kilowatt-hours (402,717 gigajoules). Overall, Boeing Australia has continually reduced its CO₂-e emissions since the first reporting period in 2008–2009, while simultaneously increasing production rates of high-end aerospace components.

United Kingdom Boeing participates in the Carbon Reduction Commitment Energy Efficiency Scheme (CRC Scheme), under the U.K. [Department of Energy and Climate Change](#), a mandatory emissions trading scheme aimed at reducing CO₂ emissions in the United Kingdom. For the reporting period April 1, 2012, through March 31, 2013, CRC-regulated emissions were 4,918 metric tons* (5,421 tons) of CO₂. This is an 8 percent increase from the previous year.

United States and Canada Boeing reports* to both the U.S. [Toxic Release Inventory](#) as well as Canada's [National Pollutant Release Inventory](#), an inventory of pollutant releases, off-site disposal and treatment, on an annual basis. In 2012, Boeing had a total release of 360,000 pounds (163,293 kilograms) and total transfers of 3.39 million pounds (1.53 million kilograms). Total release and transfers for 2012 equaled 3.75 million pounds (1.70 million kilograms). Data for 2013 will be submitted to the U.S. and Canadian governments after the publication of this report, and will be included in next year's report. Data for 2007 through 2011 are available in the [2013 Environment Report](#).

Appendix: Footnotes

Page 36 Footnote for Performance Summary Chart and Graph

- Data reported in this chart for the greenhouse gas emissions, hazardous waste, water intake and solid waste to landfill reflect environmental performance at the following sites from a baseline set on 2012 values. These sites (known as Core Sites) represent the vast majority of Boeing's operations and are identified by the city in which the Boeing operation resides. For each metric, additional facilities and office buildings have also been included where information is available.
 - Alabama: Huntsville
 - Arizona: Mesa
 - California: El Segundo, Torrance, Huntington Beach, Long Beach, Seal Beach, Palmdale
 - Illinois: Chicago
 - Indiana: Gary
 - Kansas: Wichita
 - Missouri: St. Charles, St. Louis
 - Ohio: Heath
 - Oregon: Gresham
 - Pennsylvania: Ridley Park
 - South Carolina: Charleston, Ladson
 - Texas: Houston, San Antonio
 - Utah: Salt Lake City
 - Washington: Auburn, Tukwila (Developmental Center, Duwamish Towers), Everett, Frederickson, Kent, Seattle (North Boeing Field, Plant 2, Thompson, South Park), Renton (737 Assembly, Longacres), SeaTac, Bellevue
 - Canada: Winnipeg
 - Australia: Fishermans Bend
 - Site changes:
 - Anaheim, California (Closed in 2012): 2012 partial year data only
 - Bankstown, Australia (Closed in 2013): 2012 and 2013 partial year data only .
- Deliveries include commercial airplanes as well as defense new-build production aircraft as reported in the Boeing Annual Report for the corresponding calendar year.
- Revenue numbers reflect the amounts reported in the Boeing Annual Report for the corresponding year.
- Employment numbers include all subsidiaries, leaves of absence less than 90 days, and full-time and part-time contingent labor, and are net of additions and reductions. They reflect the numbers as published on our Employment webpage.
- Greenhouse gas: Total greenhouse gas emissions reflect data from the Core Sites as well as the data from Portland, Oregon (PDX Paint Hangars), and the Phoenix, Arizona. One metric ton equals approximately 2,204.62 pounds. See footnote in Greenhouse Gas Emissions section for more detail.
- Water: Total water intake reflects data from the Core Sites as well as the data from Portland, Oregon (PDX Paint Hangars). One U.S. gallon equals approximately 3.79 liters.
- Solid waste: Total solid waste represents values determined from scale-weighted containers as well as calculated weights.

- Hazardous waste: Total hazardous waste generation reflects data from the Core Sites as well as data from Portland, Oregon (PDX Paint Hangars); Jacksonville, Florida ; El Paso, Texas; Macon, Georgia; and Sylmar, California.
- Environmental fines represent total environmental fines paid in the corresponding calendar year.

[Return to Performance: Operational Footprint Goals](#)

Page 37 Greenhouse gas operational footprint goal footnote

- Greenhouse gas emissions: Data reflect the 39 Core Sites as well as data from Portland, Oregon (PDX Paint Hangars), and Phoenix, Arizona. One metric ton = approximately 2,204.62 pounds. Carbon dioxide equivalent (CO₂-e) reflects the number of metric tons of CO₂ emissions with the same global warming potential as one metric ton of another greenhouse gas (according to [EPA 40 CFR 98, Mandatory Greenhouse Gas Reporting](#)).
- Greenhouse gas emissions are calculated based on consumption of electricity, natural gas and #6 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. For U.S. sites, Scope 1 emissions from natural gas, fuel oil and on-site-generated electricity are calculated using the emission factors provided in the U.S. EPA's Greenhouse Gas Mandatory Reporting Rule. Scope 2 emissions from purchased electricity are calculated using year 2010 eGRID factors (Representing 2010 energy Profile). For the Canada site, Scope 1 emissions are calculated using the emission factors provided in the U.S. EPA's Greenhouse Gas Mandatory Reporting Rule; Scope 2 emissions are calculated from the supplier data. For the Australia sites, Scope 1 and Scope 2 emissions are calculated using the emission factors provided in the National Greenhouse and Energy Reporting (NGER) Scheme.
- In 2012, Boeing South Carolina purchased Renewable Energy Credits (REC) and offset approximately 51,808 tons (approximately 47,000 metric tons) of greenhouse gas emissions. In 2013, Boeing South Carolina continued to purchase RECs and offset approximately 57,320 tons (approximately 52,000 metric tons) of greenhouse gas emissions.

[Return to Greenhouse Gas Operational Footprint Goal](#)

Greenhouse gas corporate inventory footnote:

The greenhouse gas emissions reported in this section represent 108 facilities and operational groups. These are located primarily in the United States and include two subsidiary companies in North America, the operations of Boeing Australia Holding Ltd. and its subsidiaries, and specific subsidiary facilities in the United Kingdom. Refer to the Site Listings footnote for a complete list.

Our greenhouse gas inventory process adheres to the guidelines published by the World Resources Institute (WRI) and World Business Council for Sustainable Development's (WBCSD) Greenhouse Gas Protocol Corporate Accounting Standard (the Greenhouse Gas Protocol), Revised Edition, and its associated calculation tools that are relevant to our operations, as well as the Australian National Greenhouse and Energy Reporting Act and the United Kingdom's Carbon Reduction Commitment Energy Efficiency Scheme (CRC Scheme).

The absolute value (reported in metric tons CO₂-e) of our entire greenhouse gas emission inventory can change as a result of these adjustments made in accordance with the GHG Protocol. Emissions from divested facilities are removed from the base year and subsequent years as proscribed in the GHG Protocol base year management methods. Calculation factors: Data source of global warming potentials is U.S. 40 CFR 98, subpart A, table A-1. For greenhouse gas inventory in North America, emission factors for combustion sources come from U.S. 40 CFR 98, subpart C, table c-1. U.S. Scope 2 emissions are

calculated using year 2010 eGRID factors (representing 2010 energy profile). Canada Scope 2 emissions are calculated from the supplier data. When energy data is not available, 2003 Commercial Buildings Energy Consumption Survey (CBECS) factors are used to estimate. For greenhouse gas inventory in the United Kingdom, emission factors from the CRC Energy Efficiency Scheme are used. For greenhouse gas inventory in Australia, emission factors from the National Greenhouse and Energy Reporting Act are used.

Greenhouse gas emissions are calculated based on consumption of electricity, natural gas and fuel oil from Jan. 1, 2013, to Dec. 31, 2013. These greenhouse gas emissions reported represent 108 facilities and operational groups. These are located primarily in the United States and include two subsidiary companies in North America, the operations of Boeing Australia Holding Ltd. and its subsidiaries, and Boeing and specific subsidiary facilities in the United Kingdom. These numbers do not include emissions generated at facilities that are not owned or controlled by The Boeing Company.

RECs were also applied to greenhouse gas calculation. In 2012, Boeing South Carolina purchased RECs and offset approximately 51,808 tons (approximately 47,000 metric tons) of greenhouse gas emissions. In 2013, Boeing South Carolina again purchased RECs and offset approximately 57,320 tons (approximately 52,000 metric tons) of greenhouse gas emissions.

[Return to Greenhouse Gas Corporate Inventory](#)

Site listing footnote for Corporate GHG Inventory chart:

Our greenhouse gas inventory reflects data gathered at the Boeing facilities in the following cities:

Country	State	City (site)
United States	Alabama	Huntsville
	Arizona	Phoenix
		Mesa
	California	Long Beach
Palmdale		
El Segundo		
Huntington Beach		
Pleasanton		
Seal Beach		
Santa Susana		
Sylmar		
Torrance		
Colorado		Colorado Springs
Florida	Jacksonville	
	Fort Walton Beach	
	Titusville	
Georgia	Macon	
Illinois	Chicago	
Indiana	Gary	
Kansas	Wichita	
Maryland	Annapolis Junction	
Missouri	Florissant	
	St. Louis	
	St. Charles	
Montana	Helena	
New Jersey	Millville	
New Mexico	Albuquerque	
Ohio	Heath	
Oklahoma	Oklahoma City	
Oregon	Portland (PDX Paint Hangars)	
	Gresham (Portland Fabrication)	
Pennsylvania	Ridley Park	
South Carolina	Charleston	
	Ladson	
Texas	El Paso	
	Houston	
	San Antonio	
	Richardson	
Utah	Salt Lake City	
	Ogden	
Virginia	Arlington	
	Chantilly	
	Herndon	
	Springfield	
Washington	Auburn	
	Anacortes	
	Bellevue	
	Everett	
	Frederickson	
	Kent	
	Renton (737 Assembly)	
	Renton (Longacres)	
	SeaTac	
	Tukwila (Development Center)	
	Wyoming	Cheyenne
Canada	Manitoba	Winnipeg
Australia	Queensland	Amberley
		Banyo
Brisbane (Adelaide St)		
Brisbane (Archerfield)		
Brisbane (BT&FS)		
Brisbane (Insitu Pac)		
Brisbane (Level 6 Boeing House)		
Brisbane (Toowong)		
Cairns		
Eagle Farm		
Oakey		
	Western Australia	Townsville (Bohle River Tx)
Townsville (Speed Creek Rx)		
	Victoria	Armadale
		Exmouth
		Geraldton
		Jandakot
		North West Cape (HFMOD Exmouth Tx)
		North West Cape (HFMOD Rough Range Rx)
		Fishermans Bend
		Melbourne
		Moorabbin
		Tullamarine (BACR)
	Tullamarine (Lindaway Place Aviall)	
	New South Wales	Holsworthy
		Mayfield
	Sydney	Shoal Bay
		Sydney (BAH Bridge St)
		Sydney (Aviall Bankstown)
		Sydney (BAA Bankstown)
	Sydney	(JeppensGladesville)
		Wagga Wagga
		Williamstown
	Australian Capital Territory	Canberra (55 Blackall St)
		Barton
	Canberra	Canberra (Russel offices)
		Canberra (Jeppesen)
		Fyshwick (65 Tennant St)
	Northern Territory	Humpty Doo (Darwin Naval Comms Station)
		Lyndoch (Riverina)
United Kingdom	England	Bristol (Dakota House)
		Bristol (Building 630)
		Bristol (Integration House)
		Colnbrook
		London (Gatwick airport)
		London (Charlton House)
		Manchester
		Newbury

[Return to Greenhouse Gas Corporate Inventory](#)

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Water Performance to target chart footnote:

- In addition to data from Boeing's 39 Core Sites, water performance also includes data from Portland, Oregon (PDX Paint Hangars).
- 1 U.S. gallon = approximately 3.79 liters.

[Return to Water Performance to Target](#)

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Wastewater footnote:

Wastewater is the amount of water sent for treatment before discharge. Wastewater intensity is the ratio of pounds of wastewater per pound of production. Although wastewater intensity is not compiled for the total company, Boeing is dedicated to water conservation and reducing its overall water use.

[Return to Reverse Osmosis](#)

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Solid Waste Performance to target chart footnote:

- Data reflects performance at Boeing's 39 Core Sites.
- Total solid waste represents values determined from scale-weighted containers as well as calculated weights

[Return to Solid Waste Performance to Target](#)

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Solid Waste footnote:

Nonhazardous solid waste 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.

[Return to Solid Waste](#)

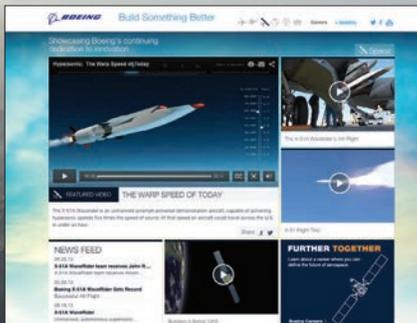
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Hazardous Waste Performance to target chart footnote:

- Environmental target: Zero revenue-adjusted growth for hazardous waste generation by 2017.
- In addition to data from Boeing's 39 Core Sites, hazardous waste generation performance also includes data from Boeing's operations in Jacksonville, Florida; El Paso, Texas; Macon, Georgia; Sylmar, California; and Portland, Oregon.

[Return to Hazardous Waste Performance to Target](#)

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.

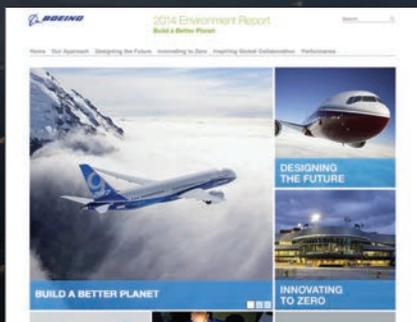


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Photo above: With all-new engines and composite wings, the 777X will be the largest, most efficient twin-engine jet in the world.



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