



Build Something Cleaner

The Boeing Company
2016 Environment Report



About The Boeing Company

Total revenue in 2015: **\$96.1 billion**

Employs **160,000 people** across the United States and in more than **65 other countries**

21,500 suppliers and partners around the world

For **five straight years**, has been named a top global innovator among aerospace and defense companies

Established **11** research and development centers, **17** consortia and **72** joint global research centers

Currently holds **15,600 active patents** around the world

Has customers in **150 countries**

For more than a decade, has been the **No. 1 exporter** in the United States



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

CONTENTS

Our Approach	2
Design and Development	18
Manufacturing and Operations	28
In Service	38
End of Service	46

Jonathon Jorgenson, left, and Cesar Viray adjust drilling equipment on the 737 MAX robotic cell pulse line at Boeing's fabrication plant in Auburn, Washington. Automated production is helping improve the efficiency of aircraft manufacturing. (Boeing photo)

Our Approach



The Boeing ecoDemonstrator Program plays a key role in the company's environmental strategy by using flight testing to accelerate new technologies that can reduce emissions and noise, improve airlines' gate-to-gate efficiency and help meet other environmental goals. (Boeing photo)

As Boeing celebrates its first century, we are looking forward to the innovations of the next 100 years.

We are working to be the most environmentally progressive aerospace company and an enduring global industrial champion. We can get there, despite the very real challenges we face.

Increases in carbon dioxide concentration are expected to lead to rising global temperatures and climate changes.

Climate change is a global challenge. Aviation is a global industry, accounting for about 2 percent of total manmade carbon dioxide emissions, and therefore global action is required to meet the challenge. We work with stakeholders around the world to inspire global collaboration and create industrywide solutions throughout the aviation life cycle.

These solutions start in the heart of our operations, where we work to find solutions every day.

Join us as we build something better, cleaner and more efficient.



Dennis Muilenburg
Chairman, President and
Chief Executive Officer

Ursula English
Vice President,
Environment, Health & Safety

Leadership Message

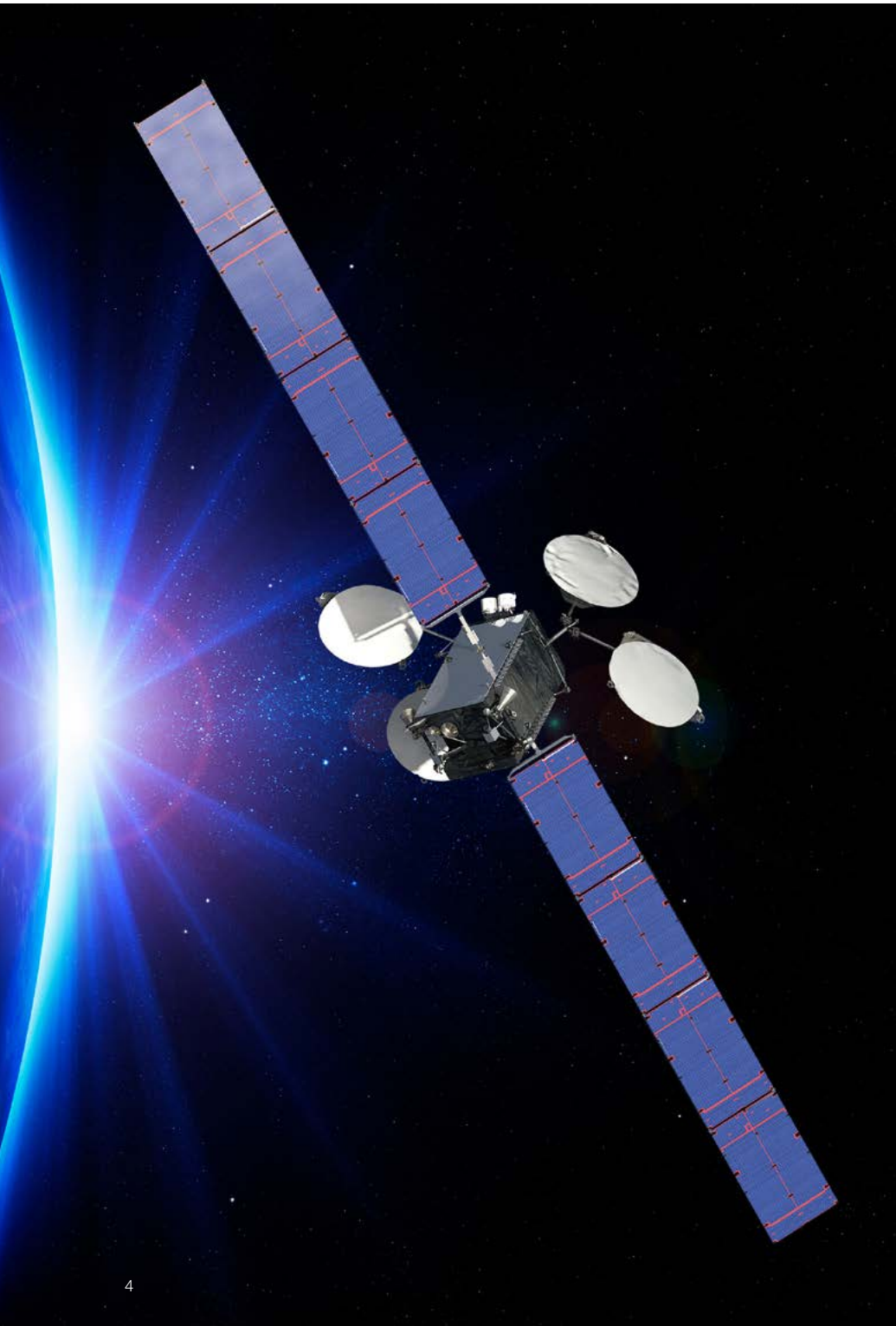
In 2016 — a year when Boeing marks its centennial — we proudly reflect on and celebrate our company's role in connecting people around the world, protecting nations and promoting global stability, exploring the universe and inspiring the next generation of innovators.

We look forward with great excitement to our next century and the innovations yet to come — including important work to improve our environmental performance as described in this year's report.

Strong environmental performance is necessary to ensuring a healthy planet and our long-term business success. That's why we aim for nothing less than to be the most environmentally progressive aerospace company and a leader among a broader group of our industrial peers. In the past year we continued to improve the efficiency of our products and services, reduce waste within our operations and manufacturing facilities, collaborate

with global partners and support international efforts to reduce aviation emissions, all of which contribute to creating healthier communities where we live and work.

True environmental leadership requires constant improvement. Accordingly, we continue to improve efficiency and reduce environmental impact as we design, build, deliver and support commercial aircraft and defense and space products. The Boeing 787 Dreamliner, for example, is the most fuel-efficient airplane in its class, reducing fuel use and carbon dioxide emissions by 20 to 25 percent compared to airplanes it replaces. Since entry into service in 2011, those efficiencies have resulted in



more than 7.7 billion pounds (3.5 billion kilograms) of fuel saved. And last year, the Boeing-built 702SP became the world's first operational all-electric propulsion satellite, using non-hazardous elements to extend overall service life for our customers.

In our factories and offices, we are focused on continuing to reduce greenhouse gas emissions, hazardous waste generation, solid waste to landfill and water intake. We reduced each measure between 6 and 11 percent between 2012 and 2015, while increasing our airplane production rates and growing our operations. For these and other efforts, this year we received the ENERGY STAR Partner of the Year—Sustained Excellence Award from the U.S. Environmental Protection Agency.

Additionally, since this opportunity is bigger than any one company, we seek to inspire the global collaboration needed to solve complex environmental challenges. For instance, we are working with our customers, industry partners, governments, research institutions, engine manufacturers and others to develop and one day commercialize sustainable aviation fuel. This effort

is critical to meeting the aviation industry's aggressive environmental goals for carbon dioxide emissions and other standards, which our newest commercial airplanes are designed to meet and even exceed.

With a passion for progress and achievement inspired by our founders 100 years ago, Boeing and its 160,000 employees around the world are committed to investing in technologies, partnerships and ideas that advance human development, improve environmental performance and inspire the world in our second century.

Dennis Muilenburg
Chairman, President and
Chief Executive Officer

Ursula English
Vice President,
Environment, Health & Safety

**An artist's rendering of an ABS-3A all-electric propulsion satellite on-orbit and operating in space.
(Boeing image)**



Major assembly of the first 787-10 Dreamliner is underway; it's the latest major milestone in the development of the newest member of the super-efficient 787 family. (Boeing photo)

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 employees and their families participated in 178 events across 15 countries as part of Earth Day and World Environment Day in 2015. (Boeing photo)





Our Governance

Our company's environmental strategy and policies are guided by the Environment, Health & Safety (EHS) Policy Council, composed of Boeing's [Executive Council](#) and led by the chairman, president and chief executive officer.

The Policy Council ensures that strategy and performance targets are set and monitored. A team of 20 cross-functional executives meets twice a month to advance our strategy and plan.

Reviews by the EHS Policy Council and a functional review with the chairman, president and chief executive officer are conducted twice a year. Progress and status are reported through each of these venues in addition to other internal executive reviews across the company. One Policy Council meeting each year is focused on setting targets that are aligned with corporate long-range business planning; the other is focused on detailed planning and reviewing our performance.

Environmental initiatives are embedded into every organization and function within Boeing. The EHS

organization comprises functions focused on workplace safety and health, environmental performance and regulatory compliance. The team also works with our business unit and operational leaders to drive an integrated, enterprisewide strategy that includes our products, services, processes and operations.

This highly integrated and coordinated approach has driven continuous improvement in the environmental performance of our products and operations around the world.

Engineers Nalaka Kahawatte, left, and Ngoc Huynh use innovative design strategies and tools to help improve the efficiency and environmental performance of Boeing aircraft. (Boeing photo)



A community garden with a pollinator habitat replaced a former chemical processing facility in Olathe, Kansas, as part of a remediation strategy that is setting new standards for environmental stewardship. (Boeing photo)

Boeing's Operating Environment

Boeing cannot succeed without a sustainable global economy, which depends on a healthy natural environment. Around the world, ecosystems are in a period of change — including reductions in biodiversity and natural resources and a changing climate. The following are several key external drivers affecting the global economy and ecosystems.

Population and consumption growth:

The United Nations Population Division estimates the global population surpassed the 7 billion mark in 2011. It is projected to grow to approximately 9.3 billion by 2050, with the majority of growth occurring in developing countries. Consumption

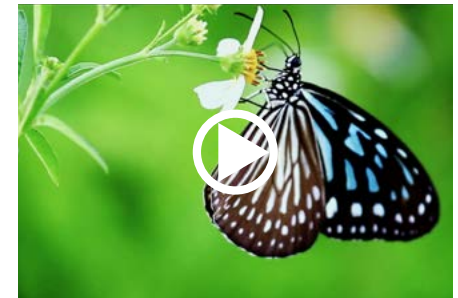
rates are predicted to increase even faster, with the United Nations estimating that by 2050, world consumption rates will triple to 140 billion tons (127 billion metric tons) of material consumed per year.

Resource constraints and vulnerable ecosystems:

With growing economic activity and population levels, the demand and competition for raw materials and other natural resources, such as food, land, fresh water and energy, have increased. In many areas, natural resource scarcity and ecosystem vulnerability have put extreme pressure on ecosystems and intensified regional political instability. Current levels of growth in consumption and population cannot be sustained given the realities of finite resources and vulnerable habitats.

Increasing global stakeholder expectations:

A new generation of workers expect a new level of environmental responsibility from employers. National and local governments are responding with regulatory and legislative efforts on many fronts, including carbon emission reduction frameworks; pollution controls; product chemical composition inventory and chemical bans; water, waste and land use policies; and producer responsibility requirements. Increased demand from governments, nongovernmental organizations and individuals is encouraging businesses to provide new levels of responsibility, transparency and reporting of environmental performance and product composition.



Watch: Flying toward a cleaner future



The Boeing 737 MAX 8 took to the skies for the first time in January 2016. Seen here is an air-to-air picture. (Boeing photo)

Aerospace Industry Analysis

Environmental challenges resulting from population growth, consumption, resource constraints, vulnerable ecosystems and increasing global stakeholder expectations will have a significant effect on the aviation industry.

According to the [Air Transport Action Group](#), the aviation industry supports an estimated 58 million jobs and will contribute \$1 trillion to the global gross domestic product (GDP) by 2026. Boeing recognizes pollution and climate change are serious issues requiring credible actions and global solutions.

Population growth and urbanization: Growing population and urbanization will further boost demand for transportation globally. While this benefits the aviation industry, it also presents challenges such as increased emissions and community noise as flights increase.

Global security: In 2014, the Quadrennial Defense Review released by the U.S. Department of Defense noted, “The pressures caused by climate change will influence resource competition while placing additional burdens on economies, societies and governance institutions around the world. These effects are threat multipliers that will aggravate stressors such as poverty, environmental

degradation, political instability and social tensions — conditions that can enable terrorist activity and other forms of violence.”

Climate change and carbon dioxide emissions: According to the [Intergovernmental Panel on Climate Change](#), the air transport industry accounts for about 2 percent of total manmade carbon dioxide. That is why in 2008, the airlines and manufacturers came to an agreement on three ambitious goals: realizing 1.5 percent average annual fuel efficiency improvements from 2009 to 2020, stabilizing net aviation carbon dioxide emissions at 2020 levels through carbon-neutral growth and reducing aviation’s net carbon dioxide

emissions to 50 percent of what they were in 2005 by 2050. For more on the goals and how the aviation industry will meet them, visit www.atag.org.

Customer requirements: Commercial and government aviation customers increasingly require that Boeing’s products and services include environmentally progressive technologies to help them address environmental concerns and resource constraints, without sacrificing performance or increasing life cycle costs.



Boeing's Environment Strategy

Our products are at home in the skies, but they are built on the ground. Naturally, we have a deep commitment to using the technology and innovation we are known for to benefit the environment.

In addition to providing the most advanced and efficient products and services for our customers, we also aspire to be the most environmentally progressive aerospace company. The following tenets comprise our environmental leadership strategy.

Inspire global collaboration:

Aerospace is a complex global industry with equally complex environmental challenges. Continued collaboration with key stakeholders, including customers, suppliers and competitors, is required to effectively address the environmental impact of the aerospace industry.

Design in environmental performance:

The vast majority of greenhouse gas emissions in the product life cycle occur during product use, and so the greatest opportunity for reducing our

environmental footprint is in our customers' use of Boeing products. That's why we pay special attention to ensure the products Boeing designs and builds incorporate leading-edge, environmentally progressive technology and practices to reduce the environmental footprint and create market value for our customers.

Innovate for sustainable operations:

Achieving world-class environmental performance year after year is a journey. Our focus is on innovating for sustainable operations — to continuously look at technologies and processes that enable reduction of water use, waste, emissions and hazardous materials and increased use of environmentally progressive materials. Boeing's remediation program is focused on using innovative approaches in cleanup efforts and relies on input from community members and environmental groups.

Boeing, Etihad Airways, Masdar Institute of Science and Technology and the Abu Dhabi Oil Refining Company (TAKREER) are working in the United Arab Emirates using seawater on salt-tolerant plants that will be used to make sustainable aviation fuel. (Boeing photo)

2015 Goals and Progress

At Boeing, we are committed to:

- ✦ Partnering with community, customers and employees to make greater progress on environmental goals.
- ✦ Improving the environmental performance of Boeing products to benefit our customers, our company, our employees and our planet.
- ✦ Reducing the environmental impact of Boeing operations and facilities to benefit local communities.

To meet these commitments, we have set a number of goals for our company. Here's a look at what they are and how we're meeting them.

Inspire Global Collaboration


Goal: Invest in organizations and projects that will positively affect the environment globally and in the communities in which we operate.

Progress: In 2015, Boeing committed further resources to help The Nature Conservancy (TNC) scale the land management community work they are doing in Indonesia to Brazil and Mexico. In addition, Boeing is partnered with TNC on domestic projects in Washington, Montana and South Carolina to help communities develop plans and models to improve the health of their water resources. The support from Boeing and other

organizations is helping communities across the globe manage more than 6.5 million acres (2.6 million hectares) of land. Also in 2015, Boeing supported environmental education programs that reached more than 250,000 students, and Boeing employees supported more than 200 community volunteer activities in 15 countries.

Goal: Support the development and implementation of a global industrywide approach under ICAO for aviation carbon dioxide emissions.

Progress: In February 2016, the aviation industry reached a major milestone with agreement by the [ICAO Committee on Aviation Environmental Protection \(CAEP\)](#) on a challenging new standard for



Craig Youngchild looks for small cracks or flaws in airplane parts that are being prepared for corrosion-resistant primers and paints. Boeing is researching environmentally responsible alternatives to chemicals that face possible restrictions around the globe. (Boeing photo)

airplane carbon dioxide emissions performance. Separately, progress continues toward agreement on a global carbon offset mechanism for international aviation that will ensure that our industry meets its commitment for carbon-neutral growth from 2020. Boeing continues to actively participate in both of these efforts.

Goal: Catalyze the industry toward sustainable aviation fuel commercialization.

Progress: Boeing continues to be a leader in the aviation industry for developing and commercializing sustainable aviation fuels. Substantial progress has been made on a number of collaborative projects around the world with near- and long-term potential to deliver sustainable aviation fuel to airline customers. A notable highlight is in the United Arab Emirates, where the Sustainable Bioenergy Research Consortium completed the construction of a pilot facility that will use desert land irrigated by seawater to grow plants for sustainable fuel.

Design in Environmental Performance

Goal: Work with aviation stakeholders to ensure that all Boeing products comply with chemical restrictions and bans.

Progress: We are continuing to monitor and assess global chemical regulations for potential impact

to Boeing products. An example includes the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulations in the European Union (EU). We are coordinating with our research and technology organization and across our supply chain for alternatives to substances targeted for restrictions or bans. Where alternatives do not exist, we are communicating with regulatory agencies or applying for authorization for continued use until alternatives can be identified and implemented. Additionally, more than 90 percent of first-tier EU suppliers have provided details on their uses of chromates in manufacturing and in their supply chains. Where known, suppliers have declared whether they plan to obtain authorization to continue using chromates, implement substitutes for chromates, or discontinue or move operations.

Goal: Reduce the environmental footprint of Boeing products throughout the product life cycle.

Progress: Development of new, more environmentally efficient Boeing airplanes continues on schedule. The 737 MAX completed its first flight in January 2016; the 787-10 is on track for first delivery in 2018; and the 777X is on track to begin production in 2017, with first delivery in 2020. Each of these airplanes is expected to be at least 15 percent more fuel efficient than the airplanes it replaces. In addition, the ecoDemonstrator Program completed testing on its

third major airplane platform in 2015, advancing a portfolio of environmental and innovation technologies for implementation on airplanes in the future. Technologies such as the MAX winglet validated on the ecoDemonstrator will result in an additional 1.8 percent fuel efficiency.

Goal: Deliver operational efficiency improvements across Boeing products and services.

Progress: We continue to make progress in lowering both emissions and noise through better flight operations. Boeing is involved in several countries in Europe and Asia with implementing new airport arrival and departure procedures that reduce miles flown and emissions. Boeing worked with an industry team of air navigation service providers and airport operators to publish a guideline for methods to reduce airport noise. Teams are working with the 777, 777X and 737 MAX programs to design and implement product improvements specific to minimizing engine use during taxi, avoiding turbulence and implementing technology to enable GPS landing approaches that further improve efficiency. These technologies and procedures can enable fuel savings of 1 to 2 percent.

Innovate for Sustainable Operations

Goal: Reduce our remediation footprint in a manner protective of both human health and the environment.

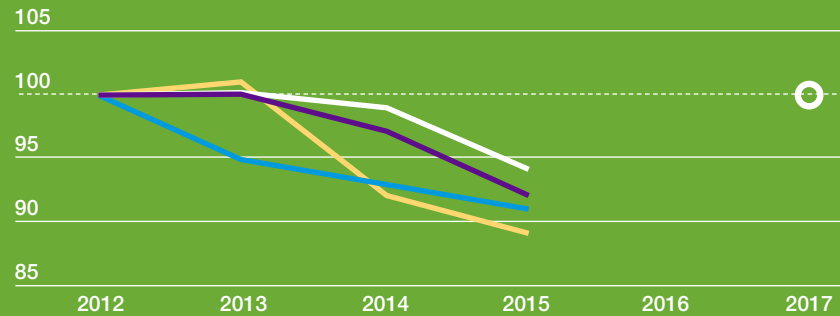
Progress: Over the past five years, we have continued to reduce the number of remediation sites we are actively working, including closing four sites in 2015. We expect to close three sites in 2016. In 2015, we completed the sediment and shoreline cleanup and restoration project along the Lower Duwamish Waterway near Seattle, at the site of Boeing's former Plant 2. This included cleanup of a one-mile (1.6 kilometer) long stretch of the sediments and shoreline along the river, restoration of the shoreline, and construction of a five-acre (2 hectare) salmon habitat. In Dallas, we used an innovative in situ oxidation groundwater treatment at the former site training facility at the Dallas Fort Worth International Airport (DFW). This technology allowed us to remediate the training facility without extensive building demolition.

Goal: Maintain 2012 levels for greenhouse gas emissions, water intake, solid waste to landfill and hazardous waste.

Progress: We continue to perform better than plan against our goal of zero growth to the 2012 baseline for all of the metrics we track, even as we increase commercial airplane production. (Note: Hazardous waste generation targets are on a revenue-adjusted basis.)

2015 Environmental Performance

Data Representative of the Majority of Boeing Facilities
(Percent Performance to 2012 Baseline)



Since 2012, Boeing has reduced:

- Hazardous Waste Generation* 10.7%
- GHG Emissions 7.8%
- Solid Waste to Landfill 6.5%
- Water Intake 9.5%

○ 2017 Target: 0% absolute growth — water, greenhouse gas emissions and solid waste; 0% revenue-adjusted growth — hazardous waste

*Normalized to revenue

Summary of Environmental and Business Performance in 2015

	2012	2013	2014	2015	% change*
Revenue (U.S. dollars in millions)	81,698	86,623	90,762	96,114	17.6%
Deliveries	745	812	902	948	27.2%
Employment (year-end)	174,429	168,421	165,529	161,368	-7.5%
Greenhouse Gas Emissions (in millions of metric tons)	1.18	1.18	1.14	1.09	-7.8%
Hazardous Waste (in hundreds of U.S. pounds/\$U.S. millions)	2.09	2.12	1.93	1.87	-10.7%
Water Intake (in billions of U.S. gallons)	1.88	1.79	1.75	1.70	-9.5%
Solid Waste to Landfill (in millions of U.S. pounds)	45.60	45.48	45.35	42.64	-6.5%
Environmental Fines (U.S. dollars in thousands)	78.50	6.55	40.65	51.13	

*Percent change since 2012 values is reported as absolute with the exception of Hazardous Waste, which is reported as revenue adjusted.

See Appendix for footnotes regarding: Performance Summary, GHG Emissions, Water Intake, Solid Waste to Landfill, Hazardous Waste Generation, Global Reporting, Greenhouse Gas Corporate Inventory and Global Reporting site listings.

2015 Operational Performance

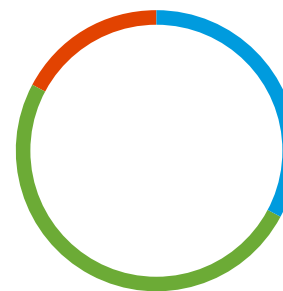
In 2015, Boeing continued progress toward its commitment to reduce the environmental impact of Boeing operations and facilities from a 2012 baseline.

The year saw reductions of between 6 and 11 percent in all areas: greenhouse gas emissions, solid waste to landfill, water intake and hazardous waste generation.

The graphs and charts on this page 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. (Note: Hazardous waste generation targets are on a revenue-adjusted basis.)

Additionally, Boeing submits environmental data to various regulatory agencies and voluntary disclosure organizations, including Australia’s National Greenhouse and Energy Reporting Scheme, the United Kingdom’s Carbon Reduction Commitment Energy Efficiency Scheme, the U.S. EPA Toxics Release Inventory and Canada’s National Pollutant Release Inventory.

Greenhouse Gas Corporate Inventory



- Scope 1 Emissions 33%
- Scope 2 Emissions 50%
- Scope 3 Emissions 17%

Greenhouse Gas Scope 1 Emission Sources



- Natural Gas 53%
- Jet Fuel 25%
- Fugitive Emissions 18%
- #2 Diesel 3%
- Other Fossil Fuels 1%

Boeing reports our corporate greenhouse gas emissions to the CDP (formerly Carbon Disclosure Project) annually. These emission calculations fall into three categories — Scope 1, Scope 2 (purchased electricity only) and Scope 3 (business travel only) — and go beyond our operational targets. Scope 2 emissions are the largest segment of our emissions.



Ursula English, vice president of the Boeing Environment, Health & Safety group, accepts the 2015 Excellence in Restoration award from Will Stelle, regional administrator, National Oceanic and Atmospheric Administration. (Boeing photo)

Awards

Boeing's environmental leadership has earned awards and recognition from nonprofit and government organizations at every level.

Awards for 2016 and 2015 include:

2016 ENERGY STAR Partner of the Year – Sustained Excellence Award

from the U.S. EPA for the company's continued leadership in protecting the environment through superior energy efficiency. This is the sixth consecutive year the company has received an ENERGY STAR award. "Boeing demonstrates a strong commitment to energy efficiency and to preserving a healthy planet for future generations," said EPA administrator Gina McCarthy.

The EPA also singled out Boeing's Chicago headquarters building for a 2015 ENERGY STAR award for using 35 percent less energy than typical office buildings. The 37-story structure is certified to the Leadership in Energy and Environmental Design (LEED) Gold standard.

2016 Rain Catcher Award from the U.S. EPA's Region Four, recognizing Boeing South Carolina (BSC) for excellence in the implementation of stormwater green infrastructure practices. BSC reuses stormwater from site retention ponds to irrigate site landscaping.

2015 Utah Recycler of the Year

from the Recycling Coalition of Utah. The group recognized Boeing's Salt Lake City site for its outstanding recycling efforts.

2015 Excellence in Restoration

award from the National Oceanic and Atmospheric Administration (NOAA) for Boeing's habitat restoration at the site of its former Plant 2 along the Lower Duwamish Waterway near Seattle. The award honors leaders in coastal restoration who are focused on ecological value and the importance of effective collaboration with project partners.

NOAA and the Natural Resource Trustees, made up of government agencies and local tribes, oversaw the habitat project's design.

2015 Best Workplaces for Waste Prevention and Recycling award

from King County, in Washington state. The award recognizes "exceptional commitment" to recycling and reducing the amount of waste sent to a landfill, showing action that helps reduce the effects of climate change and feeding recycled materials back into the economy.

LEADERSHIP PROFILE

Elizabeth Lund

“The aerospace industry is about bringing the world together, and we only have one world we all share. We want to leave a cleaner, more sustainable world for future generations.”

From her office above the 777 production line in the Everett, Washington, factory, it’s easy for Elizabeth Lund to see the progress — and challenges — in improving the environmental performance of Boeing’s largest manufacturing site.

“I can look at the factory and remember the bins full of unsorted trash headed for a landfill. But we worked hard to improve our recycling and waste reduction,” said Lund, vice president and general manager of the 747, 767 and 777 programs and leader of the Everett site. “We’ve made remarkable progress, but there is still a lot of work ahead of us.”

The company’s environmental leaders credit Lund and her team for the vision and leadership that are making a difference in reducing waste, conserving resources and engaging employees across the huge facility.

The Everett site is home to approximately 40,000 employees and production of Boeing’s widebody commercial airplanes and the military’s KC-46 aerial refueling tanker. The factory is the world’s largest building by volume.

The site’s operations are guided by tenets that list areas for improvement, including:

- ✦ Reducing solid waste and hazardous waste.
- ✦ Conserving energy and water.
- ✦ Increasing recycling and composting.
- ✦ Improving alternative commuting options.
- ✦ Expanding employee involvement in environmental activity.
- ✦ Increasing communication and awareness.



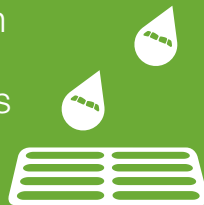
The **biofiltration system** at Boeing's Plant 2 in Seattle, Washington, treats an average of **84 million gallons of stormwater annually**.



The fastest-selling airplane in Boeing's history, the **737 MAX has a 40% smaller noise footprint** than today's single-aisle airplanes.



Boeing provided more than **\$2.5 million in grants** to support 20 organizations based in Puget Sound, most of them focusing on **stormwater management**.



Since 2012, Boeing's **reduction in greenhouse gas emissions** at the majority of facilities is equal to **taking 28,000 cars off the road for one year**.



Nearly **30,000 Boeing employees**, about 20% of our workforce, save money while **cutting emissions by choosing alternative commuting** methods daily.



With Boeing's support, **Friends of the National Parks Foundation** has **reforested 1,026 acres** of national park and wildlife **conservation** in Central Kalimantan on the island of **Borneo**.



The **747-8 Intercontinental** provides **18% fuel efficiency improvements** over the airplane it replaces.



To date, the Boeing **ecoDemonstrator** Program has tested **more than 50 technologies**, using a 737-800, 787 and 757 as flying testbeds.



Electric power from Boeing subsidiary Spectrolab's **high-efficiency solar panels** ionizes xenon using magnetic fields, firing tiny particles out of the 702SP satellite's thrusters at about **60,000 mph**.



Boeing's remediation team **removed 265,000 cubic yards of sediment** — enough to fill **4,000 rail cars** — from the Lower Duwamish Waterway in Seattle and brought in **170,000 native plants** to provide food and refuge for fish and wildlife.



Boeing has developed a **reversible fuel cell** that can produce up to 50 kilowatts, **enough to light 500 100-watt bulbs**.



With **12% lower fuel consumption** than competitor airplanes, the **777X will have the world's largest composite wing**.



Sustainable aviation fuel **reduces carbon dioxide emissions by 50 to 80%** on a life cycle basis compared to fossil fuel.



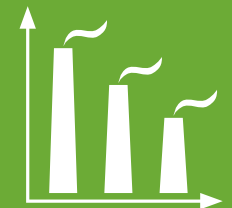
New floor insulation under ovens that help create 787 components **reduced carbon dioxide emissions by 148.3 tons**, the emissions equivalent of an average **passenger vehicle driving 320,000 miles**.



In 2015, Boeing supported the environment and other causes with **\$76 million in charitable donations**.



The 787 Dreamliner family **improves fuel efficiency and reduces carbon dioxide emissions by 20 to 25%** compared to airplanes it replaces.



Design and Development

The first step in the production process is design and development. This is when our team of talented employees explores fresh ideas to build environmental improvements into the process.

We also consistently engage with organizations around the world to understand and support industry standards, restrictions, bans and opportunities. We believe in an industrywide, global approach to aviation regulations, and design our products accordingly.

The ecoDemonstrator Program is a flying testbed that allows our engineers to take innovative ideas and apply them to accelerate testing and development.

We actively pursue innovative technology and developments that provide environmentally progressive solutions.

Boeing engineer Meagan Haugo explores the detailed parts of the 777X folding wingtip in a 3D design lab, looking for opportunities to create a simpler and more efficient design. (Boeing photo)



Designing for the Environment

Reducing the environmental footprint of our airplane products means designing them with environmental impact in mind and using sustainable production methods. In 2015, Boeing tested production of parts reinforced with recycled carbon fiber from factory operations using additive manufacturing to produce components for the flight deck.

Additive manufacturing — using selective laser sintering technology — enabled creation of complex ducts that demonstrated significant noise improvement over current designs, resulting in a quieter flight deck and more comfort for the crew. Similar 777X ducts were then made in the same fashion, with the added benefits

of reduced part count and easier assembly.

The aisle stand, located between the pilot's and first officer's seats, showcased two innovations in part design. In addition to using selective laser sintering to manufacture the stand itself, detailed parts within the assembly were created using recycled carbon fiber material, eliminating waste and the need to use energy and other chemicals to create new materials. This demonstrated another step in Boeing's strategy for more environmentally progressive manufacturing processes and other aerospace applications.

Both of these parts were tested aboard the 2015 ecoDemonstrator 757, proving that these methods could be used for future Boeing airplanes.

In 2015, Boeing tested the addition of recycled carbon fiber in the additive manufacturing production of components for the flight deck. (Boeing photo)



EMPLOYEE PROFILE

Michelle Woods

As a chemist in Boeing's research and technology group, Michelle Woods often finds herself on the front lines of ensuring the products and material used in manufacturing Boeing aircraft meet the highest standards of quality, safety and environmental performance.



The ecoDemonstrator 757 tested more than 15 technologies in 2015. (Boeing photo)

Boeing's ecoDemonstrator Program

In March 2015, the Boeing ecoDemonstrator 757 took to the skies to evaluate more than 15 new technologies to improve commercial aviation's efficiency and reduce noise and carbon emissions. Boeing collaborated with European customer TUI Group and NASA on flight tests for the 757, the third ecoDemonstrator airplane.

On the 757's left wing, Boeing tested technologies to increase aerodynamic efficiency by reducing environmental effects on natural laminar flow, including a Krueger shield to protect the leading edge from insects.

Two technologies tested were under contract with NASA's Environmentally Responsible Aviation (ERA) project. On the vertical tail, NASA and Boeing tested active flow control to improve airflow over the rudder and maximize aerodynamic efficiency. Based on NASA wind-tunnel testing, active flow control could improve the rudder's efficiency by about 17 percent and may allow for a smaller vertical tail design in the future.

On the 757's right wing, NASA and Boeing tested "bug phobic" coatings that can reduce aerodynamic drag from insect residue, enabling more laminar flow by smoothing the airflow on the surface of the wing. Except for Boeing proprietary technology, NASA knowledge gained in collaboration with Boeing from ecoDemonstrator

research will be publicly available to benefit the industry.

The ecoDemonstrator Program plays a key role in the company's environmental strategy by using testing to accelerate technologies that can reduce fuel use, carbon dioxide emissions and noise. Proven technologies and processes may be applied to models in development, in production or in service.

To date, the program has tested more than 50 technologies, using a 737-800 (2012), 787 (2014) and 757 (2015) as flying testbeds. This year, Boeing and Brazilian airplane manufacturer Embraer will test ecoDemonstrator technologies on an Embraer airplane.



Watch: Engineering comes to life



Industry Collaboration Through IAEG

Promoting environmental citizenship in the aerospace supply chain is a central goal of Boeing's close work with the International Aerospace Environmental Group (IAEG).

Boeing is a founding member of IAEG, a trade association that represents the industry's largest aerospace manufacturers and suppliers. The group helps develop voluntary consensus standards that promote environmentally responsible design, operations and practices.

For example, in 2015, the IAEG released the industry's first "declarable substance" list, which identifies chemicals commonly

used by manufacturers and parts suppliers throughout aviation. The list is a critical step in identifying and finding environmentally responsible replacements for chemicals and substances of concern used throughout the industry.

Also last year, IAEG created a platform for collaborative research and development, provided an industry-wide glossary of terms to ensure organizations around the world use the same language and piloted an environmental sustainability questionnaire as a research tool.

Boeing believes its close collaboration with groups such as ICAO and the IAEG is a key to building a more sustainable future for the aerospace industry.

Installer Dany Rath lays down a strip of gel gasket on the cargo compartment floor of a Next-Generation 737 at the Renton, Washington, factory. The gasket was selected for its natural water-repellent properties, and it does not contain hazardous chemicals typically found in other forms of corrosion-prevention materials. (Boeing photo)

Boeing Supports ICAO Standards

Boeing's support for the global commercial airplane carbon dioxide emissions standards announced this year by the United Nations is part of its collaboration across the aerospace industry to find global solutions for complex environmental challenges.

The new global standards were developed by the [United Nation's International Civil Aviation Organization \(ICAO\)](#). They stem from more than six years of work by international experts from ICAO member states, industry and nongovernmental organizations.

Boeing is committed to meeting the new global standard, which represents real progress beyond the substantial industry achievements already made to reduce aviation emissions, with more steps ahead.

This is an important part of the basket of measures that the aviation industry is pursuing to meet ambitious, self-imposed environmental targets.



Chemicals in Aviation

The use of chemicals in Boeing products — commercial and military aircraft, satellites and even unmanned underwater vehicles — faces growing restrictions around the globe over concern about environmental and human-health effects of target substances. Boeing and the aerospace industry have developed strategies to ensure compliance with a changing regulatory landscape and ongoing research into innovative chemical solutions.

A variety of chemicals have a critical role in keeping airplane passengers safe and ensuring efficient aircraft operations. For example, fire-retardant chemicals are used to provide effective fire resistance to materials throughout the passenger cabin, and substances such as halon are key components in fire-suppression systems. Chromium and other chemicals also protect aircraft parts and structure from corrosion.

Parts inspector Michael S. Grady checks for cracks and other flaws by immersing the parts in a solution that clings to and helps highlight small cracks or flaws in the metal (top). The parts are washed (center), defective pieces discarded, and the non-defective pieces sent to painting (bottom) where Deryl Roberts applies a corrosion-resistant primer. (Boeing photos)

A key focus of Boeing's environmental work is to accelerate the implementation of viable, environmentally responsible alternatives for chemicals subject to restrictions or bans around the world.

Boeing works across the industry — with groups such as the IAEG — to meet requirements for greater disclosure of the chemical makeup of delivered aircraft. The collaboration will help ensure an industrywide approach to developing new standards for effective and efficient chemical reporting.

The rapid change in chemicals management is being driven in large part by compliance with new regulations being implemented around the globe, such as the European Union's (EU) Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation.

While we work to develop and implement more environmentally responsible replacements, we are collaborating with Boeing suppliers, customers, industry associations and regulatory agencies to ensure that safety is not compromised and we retain uninterrupted access to chemicals necessary in production and maintenance and throughout the product's life cycle.



Since 1993, Japan Airlines has been sampling air in the upper atmosphere during long-haul flights to help researchers better understand the mechanism by which greenhouse gases, in particular carbon dioxide, circulate around the globe. The idea is to use the data to accurately predict future weather patterns and help formulate an effective strategy against the consequences of global warming.

Special measuring equipment was first introduced on its fleet of Boeing 747 airplanes and subsequently expanded to its 777s. This initiative, known as the Comprehensive Observation Network for Trace Gases by Airliners (CONTRAIL) project, was also included in the 2014 787 ecoDemonstrator program.

Having retired its last 747 in 2011, Japan Airlines is now carrying out studies with Boeing regarding the feasibility of having the new backbone of its international fleet – the 787 – carry on the work.
(JAL photo)



LEADERSHIP PROFILE

Perry Moore

“We have to think differently about everything we do to be successful in the future; that includes how we manage our effect on the environment.”

As Perry Moore walks through the Composite Wing Center at Boeing’s Everett, Washington, site, he is confident the same creative thinking that designed the 777X will also generate new ideas that will drive environmental progress throughout the program.

“I challenge my team to go beyond traditional approaches to solving problems, just like using carbon fiber composite wings is an innovative way to improve airplane performance,” said Moore, leader of the 777X Wing program.

The 777X composite wings will be fabricated inside the new Composite Wing Center, built to meet or exceed a LEED Silver standard with improved energy and water efficiency, reduced emissions and better overall environmental quality than found in standard construction.

Moore said that reducing and eliminating the amount of composite materials sent to a landfill when the 777X is in production will be a challenge. Recycling options for composites are currently limited mostly to small markets for consumer products. Testing on using recycled

composite materials for high-performance aircraft parts and other nontraditional uses is underway.

Moore said product development teams at Boeing are putting a lot of effort into finding new ways to recycle or reuse composite materials. “We have to think differently about everything we do to be successful in the future; that includes how we manage our effect on the environment.”

Moore’s team also is looking at ways to bring down the cost and expand the use of rotatable, or reusable, shipping containers, which could help reduce waste.

Before leading the 777X Wing team in Everett, Moore led Boeing’s site in Portland, Oregon, which included an innovative, environmentally responsible chemical processing center. Moore’s team developed a 30-year environmental vision to guide the site’s operation.

“The Boeing brand is recognized around the world. Our employees, customers and global communities expect us to demonstrate environmental leadership,” Moore said.

Employee Engagement

The commitment, fresh ideas and active engagement of employees are a key part of Boeing's work to improve environmental performance.

The company's environmental engagement program focuses on supplying employees with tools and resources to save energy and water, reduce waste and implement sustainable solutions in the product life cycle. Resources are centrally available through a website that includes tools such as:

- ✈ A social networking site that allows employees to ask questions, submit suggestions and connect with other employees around environmental topics.
- ✈ Waste hunts that help employees understand and reduce the environmental impacts of their daily work.
- ✈ An environmental learning program that helps employees understand company environmental goals and how to identify environmental project opportunities.
- ✈ Environmental tips and best practices that share good ideas across the company.
- ✈ A calendar that spotlights learning events and volunteering opportunities.

Company leaders recognize the challenge of growing and inspiring sustainable behaviors in an expansive, complex and geographically diverse business and workforce.



Doing so requires unique approaches at different sites and with different groups of employees.

Employee Engagement in Korea

Corporate citizenship is a key component of Boeing's business strategy.

Every year, about 30 Boeing Korea employees in Seoul head to Noeul Park to plant trees and maintain the outdoor space. This event has been held to coincide with Earth Day since 2013.

The environment is a key focus area for Boeing in Korea. Employees care deeply about working together and creating beneficial living situations globally and locally.



Top: George Maffeo, former president of Boeing Japan, celebrates with employees from All Nippon Airways during a Global Month of Service event in 2015. (Boeing photo)

Bottom: Boeing Korea employees plant trees in Seoul's Noeul Park. (Boeing photo)



EMPLOYEE PROFILE Natalie Smith

Natalie Smith doesn't hesitate to ask a lot of questions and push back when the answer she gets is a variation of "That's how we always have done it." Her willingness to look for new ideas and solutions is one of the reasons behind a substantial reduction in hazardous waste generated at Boeing's fabrication facilities in Auburn, Washington.



Professional Learning Opportunities

Boeing provides an array of opportunities for employees to enhance their professional development as they strive to reach their individual career goals.

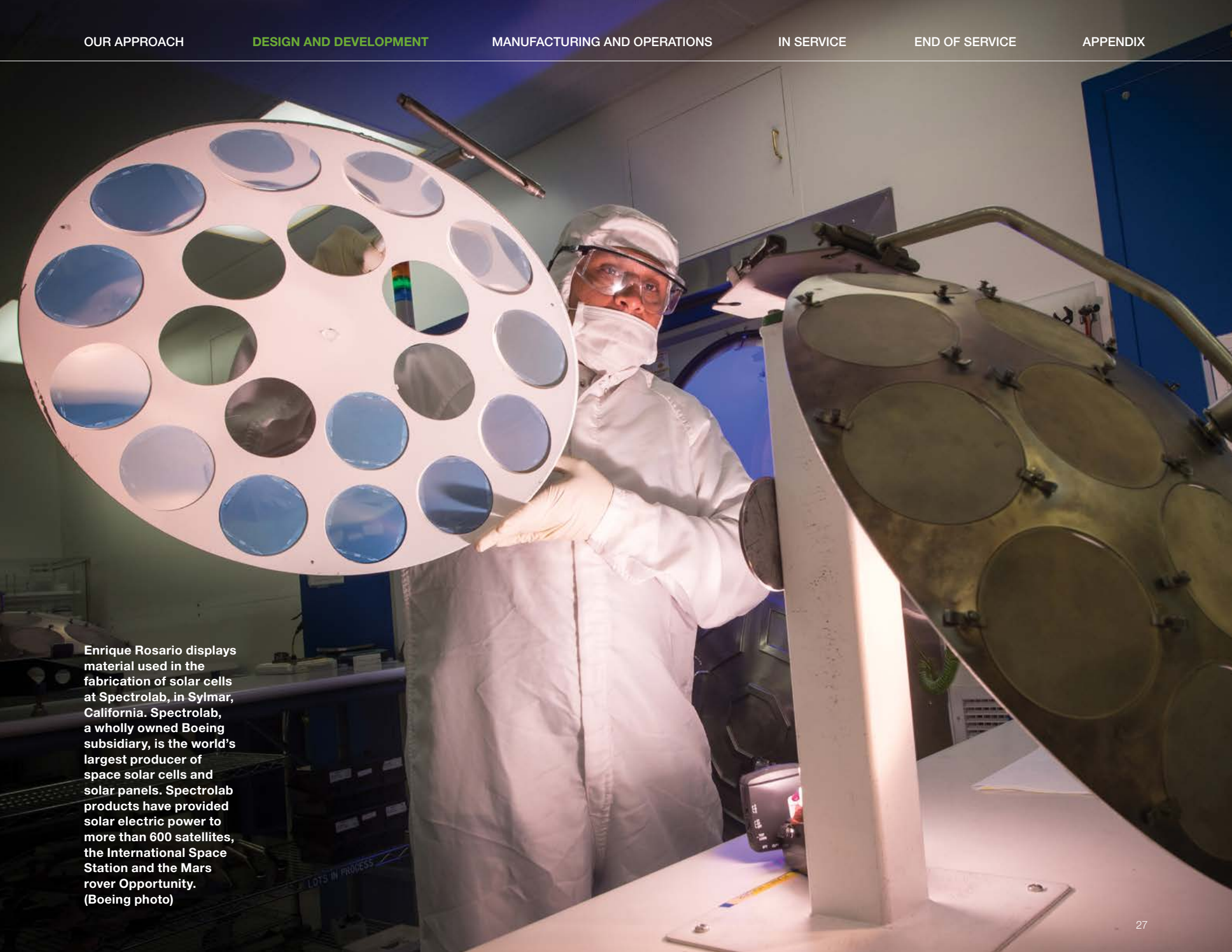
The Learning Together Program is one of many career development tools and resources available to Boeing employees. Since the program launched in 1998, Boeing has invested more than \$1 billion in tuition, books and fees for degree and professional certificate programs and individual courses.

Boeing pays for select professional and technical certifications to enable employees to broaden and deepen their capabilities, which can improve individual and team performance, drive functional excellence and

advance careers. Company leaders have identified these certifications as strategic to the Boeing business.

Options include tuition assistance toward degrees and professional certifications that specifically advance Boeing's goal to be the most environmentally progressive aerospace company. Employees can pursue degree programs in environmental engineering and environmental studies at more than 100 colleges and universities in the United States and around the globe. Employees are also encouraged to achieve professional certifications such as certified environmental auditor, certified water efficiency professional, certified energy manager and LEED-accredited professional.

Boeing provides tuition assistance toward environment-related degree programs and professional certifications. (Stock image)



Enrique Rosario displays material used in the fabrication of solar cells at Spectrolab, in Sylmar, California. Spectrolab, a wholly owned Boeing subsidiary, is the world's largest producer of space solar cells and solar panels. Spectrolab products have provided solar electric power to more than 600 satellites, the International Space Station and the Mars rover Opportunity. (Boeing photo)

Manufacturing and Operations

Manufacturing and operations refer to products that we build — and how we build them.

In 2007, when we set our first goals for our operational environmental footprint, we found that we could maintain or reduce our environmental footprint while growing our business.

We exceeded those first goals and are on our way to meeting our second set. We continue to advance recycling, work with our supply chain, find new ways to use materials and strive to benefit the communities where we live and work.

Advanced engines for the Next-Generation 737 are being prepared for installation in the Renton, Washington, factory. The Renton plant uses 100 percent renewable electricity from a combination of hydroelectricity and renewable energy credits from wind energy. (Boeing photo)



LEADERSHIP PROFILE

Larry Coughlin

“All of our efficiency improvements and new technology will conserve resources and cut costs; they’re good for the environment and our balance sheet. We can do both.”

Larry Coughlin can look at the mountain ranges in the distance from Boeing Salt Lake in Utah and see a direct connection between the site’s environmental performance and the surrounding community.

“The Salt Lake Valley can have serious air pollution caused by cold weather inversions that trap pollutants. Everyone who lives and works here has a role to play in our local environment. Our efforts to reduce emissions from this site can help make a difference in air quality in a way that everyone can see,” said Coughlin, Boeing Salt Lake site leader.

Boeing Salt Lake’s approximately 750 employees fabricate composite and metal parts for all commercial airplane models.

Coughlin said helping employees see a link between their personal actions and the local community helps motivate involvement in site programs to reduce waste and conserve resources. The site is continually improving recycling programs.

“Recycling more material means we send less waste to an incinerator, which will help improve local air quality,” Coughlin said.

The waste reduction efforts earned the site the 2015 Utah Recycler of the Year award from the Recycling Coalition of Utah.

The site’s state-of-the-art paint hangar was designed to meet ambitious energy and resource efficiency standards and includes a rooftop solar thermal system that uses sunlight to help heat the facility’s water. Other new buildings use energy-saving LED lighting technology.

Enhanced Recycling

Enhanced Recycling, Boeing's expanded employee recycling program, is rolling out across the company. Employees now have more opportunities to separate their discarded waste into new color-coded bins at Mixed Recyclables, Compostables, and Waste to Landfill stations available in their workplace. (Note: Some Boeing sites send waste that isn't compostable or recyclable to incinerators for [energy recovery](#).)

Instead of a desk-side waste can, employees receive small desktop containers to temporarily hold waste items until they can be emptied into the larger bins. Wherever local composters allow, compostable serviceware items such as plates, bowls and utensils are available in Boeing cafeterias.

Sites in Auburn, Washington; Huntington Beach, California; St. Charles, Missouri; Charleston, South Carolina; and Winnipeg, Canada, are using the new waste-disposal method, and implementation is under way in St. Louis, Missouri, and Everett and Renton in Washington. The overall project plan is to implement this change at several more sites across the enterprise.



"The Enhanced Recycling program is a great step for environmental stewardship," said Dean Gallinger, senior manager of Shared Services Group's Environment and Utilities Services organization. "While we build great aerospace products, reducing waste to landfill is one of the many ways we try to make our world a better place to live."

New recycling bins are available at select Boeing sites. (Boeing photo)



EMPLOYEE PROFILE

Mike Ramos

Longtime employee Mike Ramos has the sharp eye of a design engineer and can spot waste in everything from a complex work process to trash recycling.

"My goal is to bring together my focus on designing more efficient factory processes and my desire to create the most efficient possible reuse and recycling of our trash and solid waste," Ramos said.



Russian Employees Identify Conservation Opportunities

Ural Boeing Manufacturing (UBM), a joint venture of Boeing and VSMPO-AVISMA Corporation, the world's largest titanium manufacturer in Russia's Sverdlovsk region, is actively striving for culture improvement and employee involvement in environmental and safety improvement processes.

UBM currently performs rough machining of titanium forgings for Boeing 737, 777 and 787 programs. Based on employee feedback, UBM replaced standard factory lighting with LED lights. As a result, the lighting intensity increased 60 percent, creating a safer work area while reducing energy consumption.

Additionally, UBM installed coolant mist collectors on numerical control machines to reduce the coolant that becomes airborne during the milling operations, reducing the amount of airborne coolant mist by 40 percent.

By changing the lighting in its factory, Ural Boeing Manufacturing (UBM), a joint venture of Boeing and VSMPO-AVISMA Corporation, created a safer work environment while reducing energy consumption. (Boeing photo)



Tracking Boeing's Operational Footprint

One of Boeing's environmental commitments is to reduce the environmental impact of Boeing operations and facilities. We do this by "innovating to zero": ensuring that several operational metrics remain at 2012 baseline levels — or below — on an absolute basis. (Note: Hazardous waste generation targets are on a revenue-adjusted basis.)

Greenhouse gas emissions: We measure greenhouse gas emissions based on electricity, natural gas and fuel oil used at our sites. All of the electricity at our Washington 737 and South Carolina 787 factories comes from renewable sources.

Water intake: 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.

The EPA singled out Boeing's Chicago headquarters building, pictured here, for a 2015 ENERGY STAR award for using 35 percent less energy than typical office buildings. The 37-story structure is certified to the Leadership in Energy and Environmental Design (LEED) Gold standard. (Boeing photo)

Solid waste to landfill: In 2015, Boeing had four zero-waste-to-landfill sites: El Segundo, California; Charleston, South Carolina; Huntsville, Alabama; and Philadelphia, Pennsylvania.

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

Measuring these metrics allows Boeing to evaluate how a site is performing to plan in these areas and provides a conduit for Lean Energy Assessments.



ISO Certification in Australia

Boeing Australia Component Repairs (BACR) in Melbourne, Australia, became the first global Boeing operation certified in the revised Environmental and Quality Management standard ISO 14001:2015 and ISO 9001:2015. Both updated standards were released in September 2015.

While organizations have a three-year period to transition to the new standards, BACR achieved its certifications within just two months of the release of the standards.

Industries across the world value ISO certifications because they provide a common approach to help companies such as Boeing

continually improve environmental performance, going above and beyond other compliance measures. The revised 2015 standards require even more stringent management controls and improved communications.

Through the ISO 9001:2015 and ISO 14001:2015 certification, BACR assures all of its stakeholders that BACR maintains a Quality and Environmental Management System that conforms to the new standards.

BACR has operated in Melbourne since 1990 and maintains, repairs, overhauls, modifies and manages a range of composite, bonded and conventional metal aircraft structures for both commercial and military operations.

With significant effort and collaboration with customers in Australia, Boeing continues to build an environmentally responsible workplace, thanks to ongoing internal and external stakeholder engagement, continual improvement, innovation and employee commitment to the environmental strategy. (Boeing photo)



EMPLOYEE PROFILE

Luke Peterson

Luke Peterson doesn't let the small size of Boeing's Helena, Montana, site — 150 employees — limit his vision and planning for ways to improve the facility's environmental performance.

"We may not have the same infrastructure for recycling and reusing material as larger Boeing sites, but I see a lot of opportunity for the kind of projects and activity that will support our facility and employees," he said.



Small Changes Make a Big Impact

To support future 787 production rate increases, Boeing employees in Australia developed an innovative insulation technology.

Employees from Boeing Aerostructures Australia (BAA) and Boeing Research & Technology–Australia teamed up to improve the performance of four new ovens that support the resin-infusion process used to fabricate 787 movable trailing-edge components.

The savings were achieved by installing new floor insulation under the ovens that led to a faster oven cooldown, thousands of dollars of

savings each year on electricity and a significant reduction in carbon dioxide emissions: 148.3 tons (134.5 metric tons), the equivalent of the emissions of an average passenger vehicle driving 320,000 miles (515,000 kilometers).

“Through teamwork and innovative thinking of the lab and factory, we will save nearly \$30,000 per year on our new ovens,” said Jo Staines, general manager of BAA Business Operations. “The work has also realized safety and flow benefits, as the insulation allows the concrete slab temperature to cool down quicker, enabling employees to access the tools and parts in the ovens sooner.”

Boeing employees Christoph Bitterlin (left) and Lauren Burns showcase a panel of the new insulation for the curing ovens used by Boeing Aerostructures Australia as part of an energy- and cost-saving initiative. (Boeing photo)

LEADERSHIP PROFILE

Tom Hubble

“It’s not just the right thing to do for the environment; we’re investing in a better future for the company, our customers and the community, too.”

It may be one of the company’s smaller sites, but the Boeing Guidance Repair Center in Heath, Ohio, has a unique mission that presents Tom Hubble and his team a special challenge in trying to save energy and conserve resources.

“Our work requires more energy use per square foot — a greater energy intensity — than almost any other Boeing facility, all carried out in a building that dates back to the 1950s,” said Hubble, leader of the Heath Facilities team.

The Heath site is the country’s exclusive repair shop for guidance systems on board the U.S. Air Force’s Minuteman III intercontinental ballistic missiles. It’s a mission vital to the nation’s defense and requires unique support, such as environmentally controlled cleanrooms where some temperature spans are controlled within one half of a degree of a set point.

Site infrastructure includes 85 heating, ventilation and air-conditioning (HVAC) air-handling units, with many mechanical systems running 24/7 to meet the customers’ production requirements.

While keeping in step with customer schedules, Hubble and his team have upgraded equipment, improved system and process efficiencies throughout the facility and built partnerships with local utilities. Over the past three years, the strategy and energy-reduction plan have saved almost 5 million kilowatt-hours (18,000 gigajoules) of electricity — enough energy to power 450 homes for a year.

The upgrades will continue through 2016, with additional investments in digital controls associated with HVAC systems and energy-efficient lighting.

Hubble is proud of what his team and the site have accomplished. “It’s not just the right thing to do for the environment; we’re investing in a better future for the company and our customers, which means a better future for the community, too,” he said.



Supply Chain

Boeing actively promotes sustainable business practices, environmental awareness and close collaboration throughout its global network of suppliers.

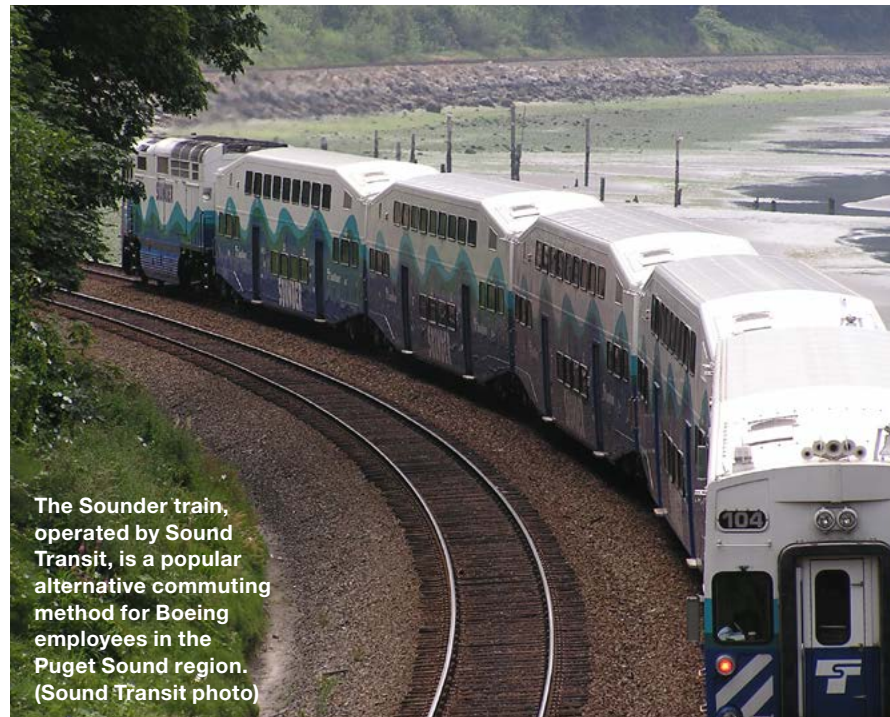
As part of its procurement process, Boeing requires its suppliers to have an environmental management system appropriate for their business that considers the impacts of materials, water and energy use, emissions, and solid and hazardous waste.

As cofounder of the International Aerospace Environmental Group, Boeing promotes sustainable business practices at the industry level. This group includes aerospace manufacturers and suppliers working together to develop common approaches to complex environmental issues.

Boeing also integrates its procurement processes into the company's environmental strategy and product development to promote sustainable business practices throughout the life cycle of commercial and military aircraft. The same attention to environmental stewardship extends to Boeing services and Boeing production and business facilities.



Jeff Power sorts through incoming packages containing supplier parts at the Renton, Washington, factory. Boeing requires its suppliers to have an environmental management system that considers the impacts of materials, water and energy use, emissions, and solid and hazardous waste. (Boeing photo)



The Sounder train, operated by Sound Transit, is a popular alternative commuting method for Boeing employees in the Puget Sound region. (Sound Transit photo)

Alternative Commuting

Boeing's Commuter Services organization connects employees with alternative commuting methods including carpool, vanpool, public transit, cycling and walking to reduce traffic congestion and carbon emissions.

Employees who choose alternative commuting methods instead of driving to work alone may receive benefits such as pretax payroll deductions and ride-matching tools. Nearly 30,000 Boeing employees, about 20 percent of our workforce, save money while cutting emissions by choosing alternative commuting methods daily.

By collaborating with transit agencies in communities where Boeing employees live and work, Commuter Services offers best-in-class commuter programs and services. In 2015, Commuter Services partnered with Community Transit in Snohomish County, Washington, to launch "Going to Boeing" — a valuable resource outlining bicycle routes and transit service information specifically for employees commuting to the Everett site. In January 2016, Pierce County Transit in Washington recognized Commuter Services for its work establishing a guaranteed ride home program for alternative commuters.

Commuter Services is expanding outreach to establish commuter programs for Boeing employees in Oklahoma City, Oklahoma; Philadelphia, Pennsylvania; St. Louis, Missouri; and Chantilly, Virginia.

Managing Stormwater

Rainwater that cannot soak into the soil but flows over rooftops, roads, parking lots and other paved surfaces picks up pollutants that can affect water quality for humans and wildlife alike. That's why Boeing is committed to managing and improving the quality of stormwater runoff from its facilities for the benefit of employees, our communities and the environment.

Boeing's leadership in stormwater management includes collaborating with numerous research and nonprofit groups such as the Washington Stormwater Center (WSC), Los Angeles Conservation Corps, Washington State University (WSU), the University of Alabama and the University of California, Los Angeles, on technology and green infrastructure solutions that can mitigate stormwater pollution. Our latest collaboration with WSU and WSC shows great potential in the development of stronger permeable pavement. This porous paving material allows stormwater to percolate through the surface into the soil below where the water is naturally filtered and pollutants removed.

Scientists are testing if carbon fiber recycled from Boeing's aircraft production can strengthen permeable pavement and expand its potential applications. Early results are positive. Researchers report that in addition to strengthening the material, carbon



Plants, shrubs and other natural vegetation are part of a bioswale that helps filter and clean stormwater runoff at Boeing's former Plant 2 site near Seattle, Washington. (Boeing photo)

fiber in the porous asphalt is likely able to capture toxic chemicals in stormwater.

Boeing also provides funding to The Nature Conservancy and Trust for Public Lands on a series of green infrastructure summits in California and Washington that bring academics, non-profits, municipalities and businesses together to help advance environmentally progressive stormwater technology, infrastructure and policy.

Locally, Boeing supports water quality and conservation efforts in Washington, Missouri, California and South Carolina through organizations like Stewardship Partners, TNC, Low Country Land Trust and others who seek to protect natural landscapes and marine habitat.



Watch: Concrete solutions



EMPLOYEE PROFILE

Lori Blair

Along with becoming an expert on the science and technology of remediation and stormwater management, Lori Blair also has honed other critical skills: patience, and the art of being a good listener.

"I have sometimes found myself in contentious discussions over stormwater permits that might involve several government agencies and a panel of experts," said Blair, engineer and Boeing's stormwater program leader. "The challenge is getting people with very different viewpoints to work together and succeed as a team."

In Service



Aerospace is an essential part of modern life. It helps drive economic growth and prosperity, and it brings the people of the world closer together.

Our products connect people, protect nations, explore space and sea, and inspire the world. We work hard to ensure that our new-generation products are efficient and have environmental measures in their designs.

We're looking at the routes our products take through the skies and how to increase efficiency there, as well. Additionally, our leadership in global efforts to develop sustainable aviation fuel is about finding new ways to power our airplanes and reduce emissions.

Our talented employees are also innovating in the realm of fuel-cell technologies to create entirely new ways to capture renewable energy and store it for later use.

Boeing is on track to deliver the 777X – the largest and most efficient twin-engine jet in the world – in 2020.
(Boeing photo)



737 MAX First Flight

Thousands of employees were on hand in January 2016 to watch the first flight of the 737 MAX in Renton, Washington, near the factory where the airplane is assembled. A few hours later, the first 737 MAX set down at Boeing Field in Seattle to begin additional flight tests.

The 737 MAX will deliver unprecedented fuel efficiency in the single-aisle market, reducing fuel use and carbon dioxide emissions by 20 percent compared to the original Next-Generation 737. The 737 MAX also is the fastest-selling airplane in Boeing's history, winning more than 3,000 orders from more than 60 customers (as of May 2016). With first delivery planned in mid-2017, the 737 MAX also has a 40 percent smaller noise footprint than today's single-aisle airplanes.



The Boeing 737 MAX 8 took to the skies for the first time in 2016. The airplane is seen here taking off from Renton, Washington. (Boeing photo)

Boeing employees line up to watch the first flight of the Boeing 737 MAX 8. (Boeing photo)

Boeing Commercial Airplanes Product Footprint

Boeing is investing billions of dollars to design and build a new generation of more fuel-efficient and quieter airplanes and increase efficiency for in-production airplanes. These environmental gains are aligned with the business needs of Boeing and our customers, as cutting fuel use supports airline profitability and reduces carbon dioxide emissions.

The 747-8 offers airlines the lowest operating costs and best economics of any large passenger or freighter airplane in its class, while providing enhanced environmental performance. Today's 747-8 provides 18 percent fuel efficiency improvements over the airplane it replaces. This includes a 2 percent efficiency gain in recent years from better engine performance, weight reduction and other improvements.

The 777 makes extensive use of lightweight, cost-effective structural materials that lessen airplane weight and contribute to fuel efficiency and environmental performance. In recent years, Boeing further improved 777 fuel efficiency by an additional 2 percent, including greater efficiency from the 777's GE90 engine and aerodynamic gains that further shave fuel use and emissions.

Boeing is on track to deliver the 777X—the largest and most efficient twin-engine jet in the world—in 2020. With 12 percent lower fuel consumption than competitor airplanes, the 777X will have the world's largest composite wing, aerodynamic improvements and an efficient GE9X engine contributing to the airplane's environmental performance.

In 2015, the 777-9, the first member of the family to be developed, reached firm configuration. In 2016, Boeing completed construction of the 777X Composite Wing Center in Everett, Washington.

The revolutionary 787 Dreamliner family improves fuel efficiency and reduces carbon dioxide emissions by 20 to 25 percent compared to airplanes it replaces. As of April 2016, Boeing had delivered 403 787s from



factories in Washington state and South Carolina, saving millions of gallons of fuel and tons of carbon dioxide.

Boeing began final assembly of the 787-10, the largest model, in March 2016. Delivering 25 percent greater fuel efficiency and lower carbon dioxide emissions than airplanes it replaces, the 787-10 environmental performance will be at least 10 percent better than anything offered by the competition.

The 747-8 creates a unique opportunity to maximize the bottom-line potential of any high-volume route, thanks to more than 400 seats available and 18 percent fuel efficiency improvements over the airplane it replaces. (Boeing photo)



Watch: Super plants



Watch: Preparing for takeoff

Collaboration on Sustainable Aviation Fuel

Boeing continues to lead global efforts to develop and commercialize sustainable aviation fuel, helping to reduce aviation's reliance on petroleum fuel and supporting our industry and customers to reduce carbon dioxide emissions. Boeing is participating in fuel projects on six continents, which include locations in the United States, Canada, China, Europe, Japan, Mexico, Middle East, South Africa and Southeast Asia — working closely with airlines, research institutions, governments and others.

All biofuel efforts supported by Boeing use principles established by the Roundtable on Sustainable Biofuels, addressing the three pillars of sustainability: social, environmental and economic.

Sustainable aviation fuel reduces carbon dioxide emissions by 50 to 80 percent on a life cycle basis compared to fossil fuel. This is because a biofuel feedstock, or source material, absorbs carbon dioxide during its growth cycle (e.g., photosynthesis). Approved fuel performs as well as or better than petroleum jet fuel while also cutting sulfur emissions, soot and particulates.

The Port of Seattle, Alaska Airlines and Boeing are partnering to move toward a significant environmental goal: powering all flights by all airlines at Seattle-Tacoma International Airport with sustainable aviation fuel. (Alaska Airlines photo)

Global Sustainable Aviation Fuel Initiatives

Boeing works aggressively with customers, governments, research institutions and other stakeholders to research and develop sustainable feedstocks, approve fuel pathways to expand supply globally and regionally, and advocate for

policies that encourage sustainable aviation fuel development. Boeing's intent is not to predict winners in feedstocks or fuel types, but to identify biomass sources that can be grown, harvested and processed sustainably and at a price point that's competitive with fossil-based fuels.



Click on the blue icons to read more about our biofuel initiatives in each country.



A 787 comes in for a landing. The Operational Efficiency team within the Commercial Airplanes Product Development organization is working with several airlines, airport authorities and regulators to implement new arrival procedures that will reduce fuel use. (Boeing photo)

Operational Efficiency Services

The Operational Efficiency team within the Boeing Commercial Airplanes Product Development organization is actively helping the aviation community operate airplanes as efficiently as possible.

It works with key aviation stakeholders such as airplane operators, air navigation service providers and national regulators to institute new procedures that take advantage of existing airplane technologies to reduce fuel use during all phases of flight, from takeoff to landing.

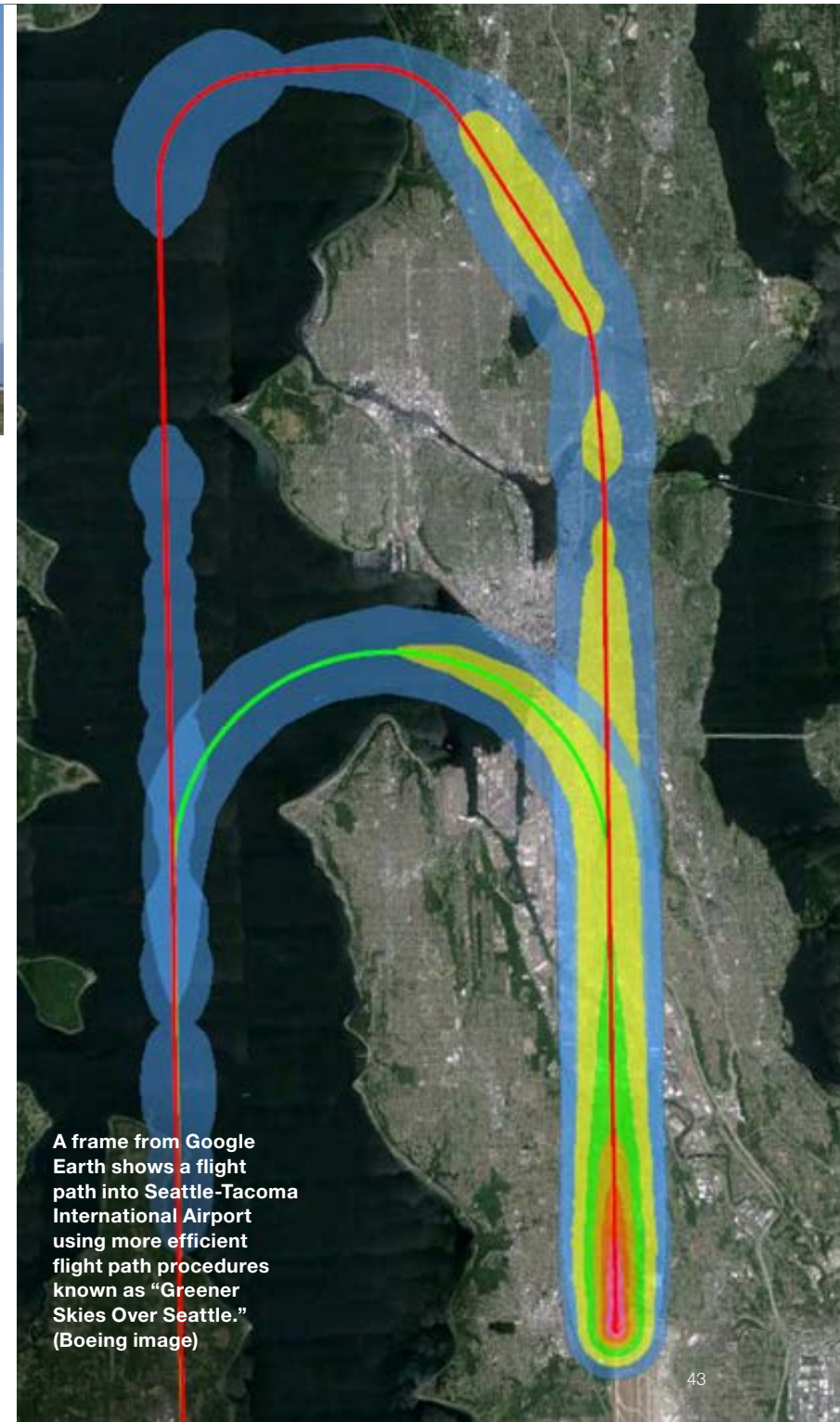
For example, this group is working with several airlines, airport authorities and regulators to implement new arrival procedures at various airports that will reduce fuel use by 400 to 600 pounds (180 to 270 kilograms) for every arrival. This equates to cutting carbon dioxide emissions by up to 1,900 pounds (863 kilograms) per

arrival, which adds up to thousands of tons of emissions reduction annually at each airport.

In addition to emissions reduction, this group is working with airlines and operators to develop new takeoff and landing procedures that also reduce community noise.

Slightly higher descent angles (on the order of one half of one degree) — also known as two-segment descents — or slightly displaced landing thresholds can reduce community noise by one to three decibels while also saving an additional 20 to 40 pounds (9 to 18 kilograms) of fuel.

Boeing also worked with the [Civil Air Navigation Services Organisation](#) and the [Airports Council International](#) to publish “[Managing the Impacts of Aviation Noise.](#)” This international guide for airport operators and air-space controllers addresses ways the aviation community can reduce noise.



A frame from Google Earth shows a flight path into Seattle-Tacoma International Airport using more efficient flight path procedures known as “Greener Skies Over Seattle.” (Boeing image)

SWISS Maintenance Optimization

In February 2016, Boeing and Swiss International Air Lines (SWISS) signed agreements to increase efficiency and streamline maintenance performance tasks across the airline's global operations.

The tools from Boeing — Airplane Health Management, Maintenance Performance Toolbox and Loadable Software Airplane Part Services — leverage real-time information to optimize SWISS airplane maintenance performance operations. SWISS will implement these Boeing fleet and maintenance tools with its new fleet of Boeing 777 airplanes.

Boeing Airplane Health Management services improve operational performance by using airplane data to advise maintenance staff and engineers on actionable solutions that can reduce delays, cancellations and diversions through better decision making.

The Maintenance Performance Toolbox modules chosen by SWISS will reduce the time needed to access aircraft-specific technical information and establish digital maintenance record keeping, eliminating paper-based materials. The toolbox solutions also establish a searchable library of fleetwide maintenance data, including customized maintenance documents created by SWISS, to meet their specific operational needs.

The first SWISS Boeing 777-300ER takes off from Geneva Cointrin International Airport. (SWISS photo)



Holly Murphy, SES-15 program manager, holds a model of the 702SP all-electric satellite. (Boeing photo)

Cleaner Satellites

In the past, most satellites were the size of small school buses and used liquid chemical propellants. Ground fueling required careful handling operations.

Today's satellites have more features, require less space and are more fuel efficient. Boeing's 702SP (small platform) all-electric propulsion satellites shed the liquid propellant and associated plumbing system in favor of clean, electric propulsion.

Currently there are two all-electric satellites in orbit powered by xenon and sunlight. From a weight and density standpoint, xenon was an obvious fuel choice. It's nonhazardous, lightweight and clean. Propulsion is generated using electric power from high-efficiency solar panels, which ionizes the xenon using magnetic fields. The xenon ions are fired out of the thrusters at about 60,000 mph (97,000 kph). Xenon propulsion is 10 times more efficient, requiring only hundreds of pounds of inert gas as opposed to thousands of pounds of traditional liquid propellant.

Last year, Boeing built and SpaceX boosted the world's first pair of all-electric satellites into orbit in a piggyback configuration. In addition to reducing emissions from what would otherwise be two separate launches, the dual launch was a cost saver.

F/A-18 Super Hornet

When engineers working on the F/A-18 Super Hornet heard about a thermoplastic material being used elsewhere at Boeing, they saw an opportunity to develop a stronger, less expensive part that would be just as effective at helping the fighter jet be less visible to radar as the old one.

They succeeded on all fronts by developing a new blade seal using organic material. The seal, which bridges the gap between the nose landing gear doors and the aircraft's adjacent skin, helps reduce the plane's radar cross section.

The new part is more flexible, more durable and less toxic than a previous one manufactured by a Boeing supplier. It also doesn't require any time in a giant oven, or autoclave, resulting in energy savings.

Reducing the Super Hornet's impact on the environment began more than 20 years ago, an effort acknowledged with a string of awards for environmental excellence from the U.S. Navy.

Renewable-Energy Storage System

Boeing asked the question, "How do you store renewable energy when the sun goes down or the wind stops?"

A team from Boeing's Electronic & Information Solutions division in Huntington Beach, California, invented a way to catch sunlight using a reversible fuel cell. The result was a self-contained shipping-container-sized unit that can take the H out of H₂O.

"Not only do we make jets, satellites and unmanned vehicles, but we also do good things for the environment," said Mark Kosko, who manages the program for Boeing. "We are helping the U.S. Navy explore solar- and wind-power systems as part of its 'Go Green' initiative."

Boeing's first-of-its-kind technology uses electrolysis to produce and store clean-burning hydrogen. An electrical current running through seawater breaks the seawater down into hydrogen and oxygen gas, which is compressed and stored as energy during the day. At night, the system reverses itself and uses the stored gas to produce electricity. The only byproduct is water.

The unit can produce up to 50 kilowatts, enough to light up 500 100-watt bulbs. One unit won't change the world, but imagine if we built something bigger. Twenty fuel cells could provide a megawatt of power. Two hundred units could produce 10 megawatts, enough to help power a small city.



The next step for the powerful fuel cell is in situ testing at a remote location. The fuel cell will be connected to a solar-energy supply and allowed to run autonomously for a year, providing constant, clean power.

Producing alternative power and fresh water is one of the ways this exciting new technology gives our customers the reliability and flexibility they need to address their most complex challenges.

Top: The F/A-18 Super Hornet is a twin-engine, supersonic, all weather multirole fighter jet that is capable of landing on and taking off from an aircraft carrier. (Boeing photo)

Bottom: Boeing's reversible solid oxide fuel-cell system in operation in Huntington Beach, California. (Boeing photo)

End of Service

Young trees, shrubs and other vegetation are part of Boeing's project to restore habitat near its former Plant 2 site along a stretch of the Lower Duwamish Waterway near Seattle. (Boeing photo)

At the far end of the product life cycle is end of service. What happens to products at the end of use is an important part of our environmental footprint.

We're looking at ways that entire aircraft can be dismantled and the parts reused or recycled at the end of service. It's a big job, so we're working with organizations such as the Aircraft Fleet Recycling Association (AFRA) to understand it better.

We value the communities, regions and countries in which we operate, as well, and have programs designed to promote environmental protection, education and more.

We have a robust remediation and restoration program that works to restore and bring back to public use lands that have been production, test, operation or waste sites. We're proud of our work. In 2015, the National Oceanic and Atmospheric Administration (NOAA) recognized us for these efforts at one of our sites.



Restoration Recognized in Seattle

“Boeing has chosen to step up and lean in to the restoration of the lower Duwamish here. And it didn’t need to make that choice,” said Will Stelle, regional administrator for NOAA Fisheries. “Reflecting good business sense and good environmental stewardship, Boeing decided not only not to avoid it, but to embrace it and get it done.”

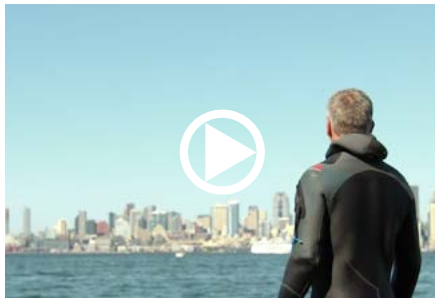
On June 19, 2015, NOAA honored Boeing with its national Excellence in Restoration award in recognition for Boeing’s work on demolishing, dredging and restoring a one-mile (1.6 kilometer) stretch of waterway next to the company’s Plant 2 site along the Lower Duwamish Waterway in Seattle.

The award is given annually to recognize leaders in coastal restoration who are not only focused on ecological value, but the importance of effective collaboration with project partners.

The massive three-year project was undertaken as part of the Lower Duwamish Waterway Group, a partnership among the City of Seattle, King County, Port of Seattle and

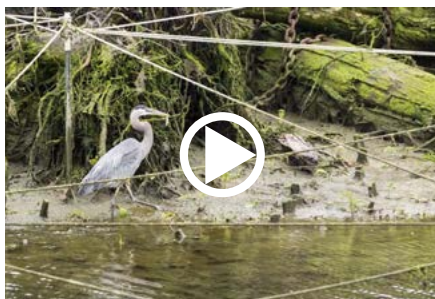
Boeing, and included a three-step restoration model of cleanup, site development and habitat creation.

The remediation team began by tearing down the former Boeing Plant 2 facility, home to the B-17 during World War II. The team then cleaned up the waterway by removing 265,000 cubic yards (203,000 cubic meters) of sediment — enough to fill 4,000 rail cars — and replenishing the bed with clean sand. Finally, they carved out intertidal wetlands and brought in 170,000 native plants to provide food and refuge for fish and wildlife, improving the Puget Sound salmon runs and creating a valuable wildlife habitat.



Boeing remediation leader Brian Anderson inspects a portion of the habitat restoration project along the Lower Duwamish Waterway close to the former Plant 2 site near Seattle, Washington. (Boeing photo)

Watch: Swimming with salmon



Watch: Turning the tide



Field Testing at Santa Susana

In 2015, Boeing Associate Technical Fellow Mike Bower led the conclusion of two three-year studies for the Department of Toxic Substance Control (DTSC) — one testing seeps and springs at and around the Santa Susana site, and the other testing a state-of-the-art application for a technology designed to remediate subsurface contaminants.

The goals of the seeps and spring study were to inventory where seeps and springs are located across and surrounding the site, to understand how long the water had been in the ground and to see if the water contained mobile contaminants like trichloroethylene (TCE).

The effort covered the entire 2,850 acres (1,150 hectares) of the mountainous Santa Susana site, surrounding hillsides and difficult-to-access land, including areas in neighborhoods off the site. No groundwater contaminants were found, affirming the safety of the public and nearby residents.

Mike Bower tests a well on the property of the Santa Susana Field Laboratory in Simi Valley, California. The testing is part of identifying and planning appropriate remediation for contaminants at the site. (Boeing photo)

The other study used In Situ Chemical Oxidation (ISCO) remediation technology, a technique that can be used to destroy targeted chemical contaminants in groundwater.

“It’s a world-class feat in environmental engineering,” Bower said.

The team of environmental engineers identified an area with high groundwater concentrations of TCE and installed six new monitoring wells. One of the wells was used to inject potassium permanganate at a rate of at least two gallons per minute for five consecutive days. Seven of these injection events took place over about 10 months, adding up to a total of 37,000 gallons (140,000 liters) of potassium permanganate injected over the duration of the study.

The team was testing to see if the potassium permanganate would combine with the TCE to oxidize it into harmless byproducts. Results indicate that this treatment technology did not significantly lower the levels of contaminants in groundwater because of the unique characteristics of the fractured rock.

“The results of this study will be used to evaluate the potential effectiveness of treating contaminants in fractured rock at Santa Susana as well as other sites around the world,” Bower said.



Photo, top: Forest Park Forever's Nature Works program in St. Louis is engaging students, teachers and community partners in educational programs and conservation job development initiatives for youth. (Boeing photo)

Photo, bottom: Students in Italy participate in Svitati per l'Ambiente (Crazy for the Environment), a program that guides their learning through a global tour of good environmental habits. (Boeing photo)

Environmental Protection, Preservation and Education

Boeing partners with communities and organizations around the globe to help them advance environmental protection, preservation and education. These partnerships focus on sustainable aviation fuel development, water and energy conservation, habitat preservation and restoration, green infrastructure and water quality.

Boeing has a longstanding relationship with The Nature Conservancy (TNC) and other organizations that support projects that revitalize and protect forests and wetlands — and strengthen communities that depend on these resources.

In Missouri, for example, TNC is working to protect and restore the Meramec River basin, which is a critical natural resource for the state and serves as the water source for more than 75,000 St. Louis-area households. In South Carolina, we are working with TNC and the Low Country Land Trust to protect and restore acres of wetlands. In Puget Sound, Boeing focuses support on green infrastructure approaches to improving water quality as well as land management practices to benefit wildlife, waterways and humans with marine spatial planning, a science-based approach to ensuring sustainable use of the ocean's resources.

Boeing and other supporters are helping these partnerships preserve more than 6.5 million acres (2.6 million hectares) of land worldwide.

Education is vital to change behavior, and Boeing helps train and equip teachers to integrate environmental sustainability principles into their curricula. In Los Angeles, the Environmental Charter School's Green Ambassador Institute has trained more than 230 educators in 70 public schools, transforming their instructional practices to foster a shared commitment to protecting the environment.

Boeing invests in the South Carolina-based Sustainability Institute and its Energy Conservation Corps Program. The program provides workforce development training to at-risk youth and veterans in energy-efficiency services while providing energy-saving retrofits to income-qualified families in the Charleston region. After one year of training, participating Corps members will obtain two professional certifications, graduate from on-the-job training and secure employment while more than 30 houses will be energy assessed and retrofitted — producing a minimum energy cost reduction of 25 percent per home.

Last year, Boeing contributed \$76 million in charitable donations to support environmental and other causes, while employees channeled their passion and innovation to improve communities around the globe.



Boeing and the Earth Restoration Service

Since 2011, Boeing in the United Kingdom has supported the Earth Restoration Service (ERS), a British nonprofit organization that has a nationwide program of initiatives to restore natural ecological habitats.

Boeing has provided the ERS with grants totaling more than \$300,000 to work with schools in England, Scotland, Wales and Northern Ireland to create tree nurseries in unused spaces, growing native tree saplings to maturity and replanting them in degraded urban environments.

Through its work with schools and local organizations, the ERS has planted 50,000 native trees and wildflowers with Boeing's support. The ERS is also Boeing's long-term partner for an annual Earth Day sustainability drive, enabling hundreds of employees to volunteer at local schools to help with tree planting and educating young people about ecology and the environment.

Through these partnerships, Boeing is able to make a positive, long-lasting impact on the global communities where our teams live and work.

Volunteers from Boeing subsidiary CDG, based in Welwyn Garden City, U.K., pose for a group shot at Panshanger Primary School where they planted native tree saplings in 2012 in partnership with the Earth Restoration Service. Employees lifted the trees in March and replanted them in a national forest where they can reach full maturity. On Earth Day, April 22, the employees went back to the school to plant a wildflower meadow where the trees used to be, completing the project's cycle. (Boeing photo)



EMPLOYEE PROFILE

Isabel Aguirre

Residents of Mesa, Arizona, who enjoy visiting the recreation areas at beautiful Canyon Lake have Isabel Aguirre and a team of employee volunteers from Boeing's Mesa facility to thank.

Aguirre leads the site's Green Team — employees who volunteer their time on environmental projects — which brings together resources several times a year to help maintain and clean up the lake's public areas.

Conservation at Tanjung Puting National Park

Southeast Asia's largest national park, Tanjung Puting National Park in the heart of Central Kalimantan, Indonesia, is home to wildlife such as orangutans, gibbons, sun bears and hundreds of bird species. Because of the impact of palm oil plantations, logging and gold mining, deforestation has taken its toll on the national park.

Friends of the National Parks Foundation (FNPF), a local nongovernmental organization, and Boeing have been working together to conserve the national park since 2010.

Through Boeing's support, FNPF has reforested 1,026 acres (415 hectares) of national park and wildlife conservation in Central Kalimantan on the island of Borneo.

FNPF works closely with the local community, imparting expert advice on how to make a living through ecotourism, agroforestry and organic farming. This includes the reforestation of plant saplings along a corridor that is more than 18 miles (29 kilometers) long that hugs the fringes of Central Kalimantan. Additionally, FNPF works closely with the local schools and education authorities to create awareness and spread the word on forest and wildlife conservation.



Photo, top: A volunteer with Friends of the National Parks Foundation works to reforest Tanjung Puting National Park. (Boeing photo)

Photo, bottom: The ecoDemonstrator 757, shown here during the recycling process, provided information about building an airplane with recycling in mind. (Boeing photo)

Airplane Recycling

Boeing advanced research in airplane recycling this past year by partnering on the disassembly of the ecoDemonstrator 757, a test airplane that had reached end of service.

Boeing teams monitored the two-month recycling process and final disassembly to capture learning about better ways to reuse more of Boeing airplanes in the future. During the recycling project, valuable components — including landing gear and avionics — were overhauled, recertified and returned to service. High-value metals and material parts were also removed and sold on the secondary market. Only recyclable aluminum and unusable material remained.

The data gathered from this project gave Boeing valuable insight about using better materials to build the airplane, with recycling in mind, or creating a better design that allows the airplane to be disassembled more easily.

The remaining pieces of material (mostly aluminum) were sent to a company in Tacoma, Washington, where they were sold for reuse in other regions of the world.

Boeing is a founding member of the Aircraft Fleet Recycling Association (AFRA), a trade organization made up of more than 70 member companies. AFRA promotes the use of best management practices for environmentally responsible and safe aircraft dismantling.

Appendix



The Phantom Eye is a long-endurance unmanned vehicle designed to stay airborne for up to four days powered by clean-burning hydrogen, which leaves only water in the atmosphere. The Phantom Eye is an example of Boeing's enduring innovation that is creating a more sustainable future for aerospace and building a better planet for generations yet to come. (Boeing photo)

Footnotes for Performance Summary Chart and Graph

- ✈ “Environmental fines” represent total fines paid in 2012, 2013, 2014 and 2015, respectively.
- ✈ 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 Metric 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 also have 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
 - Missouri: St. Charles, St. Louis
 - Ohio: Heath
 - Oregon: Gresham
 - Pennsylvania: Ridley Park
 - South Carolina: Charleston, Ladson
 - Texas: Houston, San Antonio
 - Utah: Salt Lake City, West Jordan
 - Washington: Auburn, Bellevue, Tukwila (Developmental Center, Duwamish Towers), Everett, Frederickson, Kent (Space Center), Seattle (North Boeing Field, Plant 2, Thompson, South Park), Renton (737 Assembly, Longacres), SeaTac (Spares Distribution Center)
 - Canada: Winnipeg
 - Australia: Fishermans Bend

- Site changes: Anaheim, California (closed in 2012; 2012 data only); Bankstown, Australia (closed in 2013; 2012 and 2013 data only); Wichita, Kansas (reduced scope in 2015, now reports only hazardous waste).

Footnotes for Greenhouse Gas Emissions

- ✈ In addition to data from Boeing’s 37 Core Metric Sites, data from Portland, Oregon (PDX Paint Hangar), and the Phoenix, Arizona, Data Center also included.
- ✈ 1 metric ton = 2,204.62 pounds.
- ✈ Carbon dioxide equivalent, or CO₂e, means the number of metric tons of CO₂ emissions with the same global warming potential as one metric ton of another greenhouse gas (in accordance with EPA 40 CFR Part 98 Mandatory Greenhouse Gas Reporting).
- ✈ GHG emissions are calculated based on consumption of electricity, natural gas and No. 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.
- ✈ 2012–2014 emission numbers are recalculated based on new eGRID2012 factors.
- ✈ 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 U.S. EPA GHG Mandatory Reporting Rule. Scope 2 emissions from purchased electricity are calculated using the market-based method and eGRID2012 factors, since residual mix is not available in the U.S. For the Canada site, Scope 1 emissions are calculated using the emission factors provided in U.S. EPA GHG Mandatory Reporting Rule; Scope 2 emissions are calculated using the market-based method and the supplier-specific emission factor. For the Australia

sites, Scope 1 emissions are calculated using the emission factors provided in the National Greenhouse and Energy Reporting (NGER) Scheme, and Scope 2 emissions are calculated using market-based method and the emission factors provided in the National Greenhouse and Energy Reporting (NGER) Scheme, since residual mix is not available in Australia. Emissions calculated with location-based method are: 1,280,000 tons (1,161,000 metric tons) CO₂e (2015).

- ✈ RECs were applied to the GHG calculation for the following locations: North Charleston, South Carolina, and Renton, Washington. In 2015, these Boeing locations made arrangements to purchase RECs to offset around 80,000 tons (73,000 metric tons) of GHG emissions.

Footnotes for Water Intake

- ✈ In addition to data from Boeing’s 37 Core Metric Sites, data from Portland, Oregon (PDX Paint Hangar), also included.
- ✈ 1 U.S. gallon = 3.79 liters.

Footnotes for Solid Waste to Landfill

- ✈ Includes data from Boeing’s 37 Core Metric Sites.
- ✈ 1 U.S. ton = 2,000 pounds.
- ✈ Solid waste numbers represent values determined from scale-weighed containers as well as calculated weights.

Footnote for Hazardous Waste Generation

- ✈ In addition to data from Boeing’s 37 Core Metric Sites, data from Portland, Oregon (PDX Paint Hangar); Jacksonville, Florida (Cecil Field); El Paso, Texas; Macon, Georgia; Wichita, Kansas; and Sylmar, California, are included.

Footnotes for Global Reporting

Australia National Greenhouse and Energy Reporting footnote: This comprehensive report must be completed by registered corporations that meet specified energy use and greenhouse gas emission thresholds. For the 2014–2015 reporting period, the Australian government’s Clean Energy Regulator released data for companies emitting more than 55,000 tons (about 50,000 metric tons) of equivalent carbon dioxide (CO₂e).

United Kingdom Carbon Reduction Commitment footnote: Boeing U.K. operations consist of multiple units and subsidiaries. Boeing U.K. Training and Flight Services Ltd. operates flight simulators for training on Boeing aircraft at several locations throughout the U.K. Boeing Defense U.K. Ltd. has employees located at multiple locations throughout the U.K., supporting Ministry of Defense and U.S. military programs. Additionally, CO₂ emissions from Boeing subsidiary Jeppesen U.K. Ltd. and Aviall U.K. Inc. are included in the Boeing U.K. CRC report.

Sixteen sites report TRI and NPRI releases and transfers: Auburn, Washington; Charleston, South Carolina; El Paso, Texas; El Segundo, California; Palmdale, California; Everett, Washington; Frederickson, Washington; Seattle, Washington (North Boeing Field, Plant 2); Gresham, Oregon (Portland Fabrication); Portland, Oregon (PDX Paint Hangar); Renton, Washington; St. Louis, Missouri; Sylmar, California; Wichita, Kansas; and Winnipeg, Canada.

2015 data will be submitted to the U.S. and Canadian governments after the publication of this report.

Footnotes for Greenhouse Gas Corporate Inventory

- ✈ The greenhouse gas (GHG) emissions reported represent 1,681 buildings in 43 countries where Boeing has operational control. Refer to the Site Listing Footnotes for Corporate GHG Inventory Chart for cities included.
- ✈ Scope 3 emissions only include emissions from business travel.
- ✈ Scope 1 “Other gas types” include CH₄, N₂O, NF₃ and PFCs emissions.
- ✈ Scope 1 “Other fossil fuels” include No. 6 fuel oil, gasoline, aviation gasoline, propane and LPG.
- ✈ 1 metric ton = 2,204.62 pounds.
- ✈ Carbon dioxide equivalent, or CO₂e, means the number of metric tons of CO₂ emissions with the same global warming potential as one metric ton of another greenhouse gas. (In accordance with EPA 40 CFR Part 98 Mandatory Greenhouse Gas Reporting.)
- ✈ Accounting protocol: This GHG inventory is prepared using the following protocols:
 - *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Revised Edition)*
 - The Scope 2 Guidance
 - *GHG Reporting Guidance for the Aerospace Industry (IAEG)*
 - The Australia National Greenhouse and Energy Reporting Act
 - The United Kingdom’s CRC Energy Efficiency Scheme

✈ Scope 2 emissions are calculated using the market-based method. Location-based method calculated emissions are 1,079,000 tons (979,000 metric tons) CO₂e. Residual mix is only available in E.U. countries; therefore, other grid average emissions factors are used in all other countries. In the market-based methodology, RECs were applied to the GHG calculation for the following locations: North Charleston, South Carolina, and Renton, Washington. In 2015, these Boeing locations made arrangements to purchase RECs to offset around 80,000 tons (73,000 metric tons) of GHG emissions.

✈ Other calculation factors: Data source of global warming potentials (GWP) is U.S. 40 CFR Part 98 subpart A, table A-1. For GHG inventory in North America, emission factors for combustion sources come from U.S. 40 CFR Part 98, subpart C, table C-1. For GHG inventory in the U.K., emission factors from the CRC Energy Efficiency Scheme are used. For GHG inventory in Australia, emission factors from the National Greenhouse and Energy Reporting Act are used. For GHG inventory in locations where energy data are not accessible, 2012 CBECs factors are used to estimate the energy consumption and emission factors from the International Energy Agency’s *CO₂ Emissions From Fuel Combustion Highlights 2013* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories* are used to calculate the emissions.

Site Listing Footnotes for Corporate GHG Inventory Chart

Country	State/City (Site)	Country	State/City (Site)	
Australia	Australian Capital Territory Canberra	Canada	Québec Boisbriand Montréal	
	New South Wales Bankstown Sydney Yerrilyong		China	Beijing Hong Kong Shanghai
	Northern Territory Gladesville	Denmark	Copenhagen	
	Queensland Alderley Archerfield Brisbane Cairns Coominya	Egypt	Cairo	
	Victoria Malvern Melbourne Mentone Tullamarine	France	Blagnac Paris	
	Western Australia Jandakot	Germany	Berlin Hesse Neu-Isenberg North Rhine-Westphalia Cologne	
	Bahrain	Manama	Greece	N. Smirni
	Belgium	Brussels	Hungary	Papa
	Brazil	Distrito Federal Brasília	India	Andhra Pradesh Hyderabad National Capital New Delhi Karnataka Bangalore Maharashtra Navi Mumbai Tamil Nadu Chennai West Bengal Calcutta
		São Paulo Sao José dos Campos São Paulo		
Canada	Alberta Calgary	Ireland	Leinster Banbridge Dublin	
	British Columbia Richmond	Israel	Tel Aviv	
	Manitoba Winnipeg	Italy	Massa Rome	
	Nova Scotia Enfield			
	Ontario Mississauga Ottawa			

Site Listing Footnotes for Corporate GHG Inventory Chart (cont.)

Country	State/City (Site)	Country	State/City (Site)	Country	State/City (Site)
United States	Missouri (cont.) St. Charles St. Louis	United States	Pennsylvania (cont.) Pittsburgh Ridley Park Smithfield	United States	Washington (cont.) Everett Issaquah Kent Moses Lake Mukilteo Olympia Puyallup Quincy Renton SeaTac Seattle Tukwila Vancouver White Salmon
	Montana Glasgow Helena		South Carolina Charleston Ladson North Charleston		
	Nebraska Omaha		Tennessee Memphis		
	Nevada Las Vegas		Texas Austin Dallas Dyess AFB El Paso Houston Irving Richardson San Antonio Universal City		
	New Jersey Berkeley Heights Millville Parsippany		Utah Layton Salt Lake City West Jordan		
	New Mexico Albuquerque		Virginia Arlington Chantilly Fairfax Herndon Leesburg Newington Newport News Reston Springfield Virginia Beach Yorktown		
	New York New York		Washington Anacortes Auburn Bellevue Bingen Bothell Enumclaw		
	North Carolina Fayetteville Havelock Morrisville				
	Ohio Brookpark Cincinnati Fairborn Heath				
	Oklahoma Oklahoma City				
	Oregon Arlington Boardman Gresham Hood River Portland Wilsonville				
	Pennsylvania Doylestown Eddystone Langhorne Lemont Furnace				

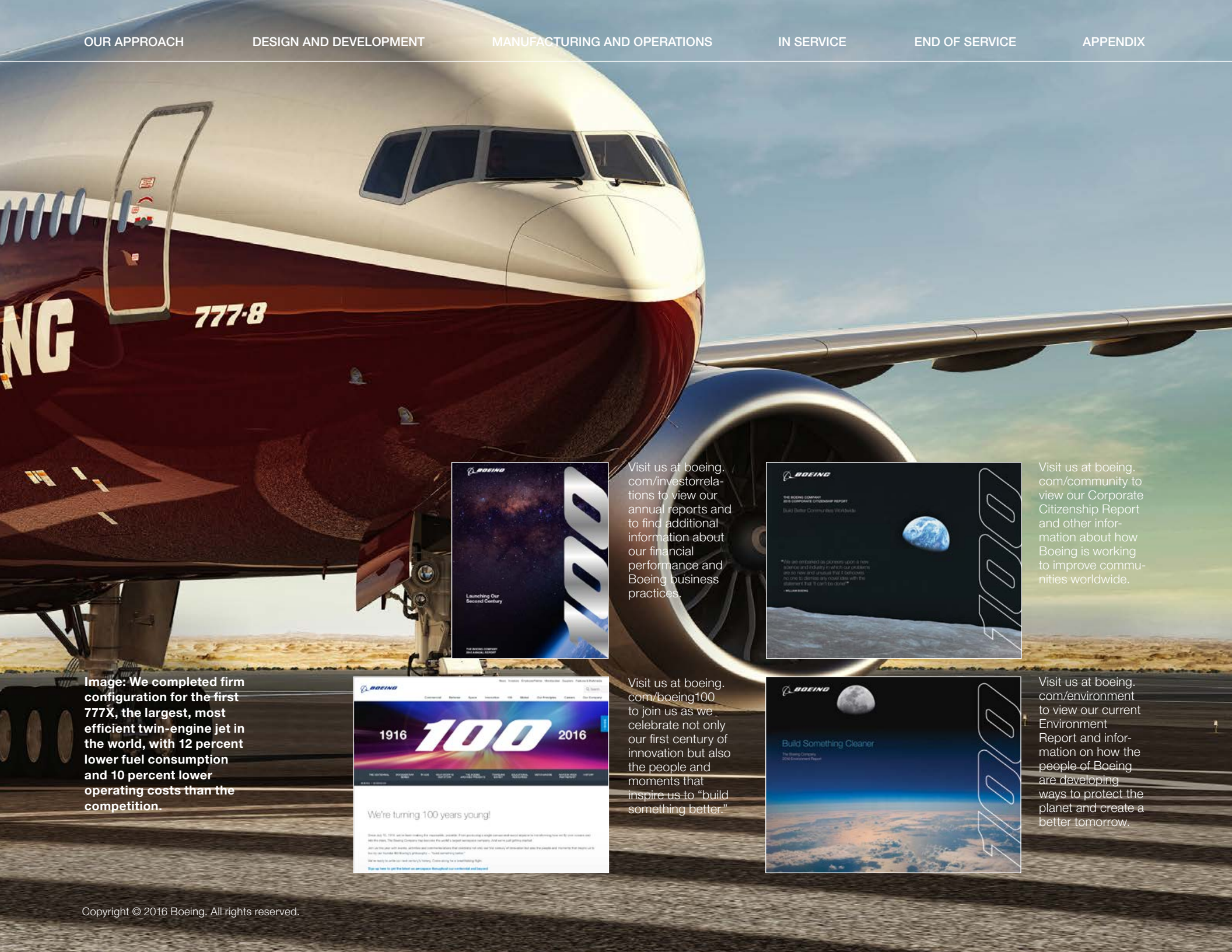


Image: We completed firm configuration for the first 777X, the largest, most efficient twin-engine jet in the world, with 12 percent lower fuel consumption and 10 percent lower operating costs than the competition.



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



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



Visit us at boeing.com/boeing100 to join us as we celebrate not only our first century of innovation but also the people and moments that inspire us to "build something better."



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



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