
BOEING
THE BOEING COMPANY
2017 ENVIRONMENT REPORT
BUILD SOMETHING CLEANER

ABOUT US

Boeing begins its second century of business with a firm commitment to lead the aerospace industry into an environmentally progressive and sustainable future.

Our centennial in 2016 marked 100 years of innovation in products and services that helped transform aviation and the world. The same dedication is bringing ongoing innovation in more efficient, cleaner products and operations for our employees, customers and communities around the globe.

Our strategy and actions reflect goals and priorities that address the most critical environmental challenges facing our company, customers and industry. Innovations that improve efficiency across our product lines and throughout our operations drive reductions in emissions and mitigate impacts on climate change.

We're reducing waste and water use in our facilities, even as we see our business growing. In addition, we're finding alternatives to chemicals and hazardous materials in our products and operations, and we're leading the global development of sustainable aviation fuels.

Meeting climate change and other challenges head-on requires a global approach. Boeing works closely with government agencies, customers, stakeholders and research facilities worldwide to develop solutions that help protect the environment.

Our commitment to a cleaner, more sustainable future drives action at every level of the company. Every day, thousands of Boeing employees lead activities and projects that advance progress in reducing emissions and conserving water and resources.

This report outlines the progress Boeing made and challenges we encountered in 2016 toward our environmental goals and strategy.

In the face of rapidly changing business and environmental landscapes, Boeing will pursue the innovation and leadership that will build a brighter, more sustainable future for our employees, customers, communities and industry.

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and the 787 facility in North Charleston, South Carolina—are powered by electricity from 100 percent renewable sources.

Building on this momentum, last year we opened the 777X Composite Wing Center in Everett, Washington, to fabricate the longest composite wing Boeing has ever built. The lightweight wing will allow the 777X to reach unprecedented levels of fuel efficiency for a wide-body commercial airplane. We invested $1 billion in innovative carbon fiber technology manufacturing, housed in a facility built to a Leadership in Energy and Environmental Design (LEED) Silver standard. Compared to traditional construction, the center has improved energy and water efficiency, reduced emissions and better overall environmental quality.

Our environmental leadership extends beyond our facilities and products; we collaborate with numerous research institutions, customers, universities, nonprofit organizations and governments to develop technologies, solve problems and educate communities around the world about the importance of environmental protection and preservation. For instance, together we are testing green infrastructure solutions to mitigate pollution from storm water runoff and improve overall water quality.

Moving forward, we remain focused on taking our environmental performance to new heights. When we do, our company, our customers and the global communities in which we live and work all benefit.

Dennis Muilenburg
Chairman, President and
Chief Executive Officer

Ursula English
Vice President
Environment, Health & Safety

Understanding that a proposed expansion of Boeing South Carolina would impact wetlands, Boeing worked with several state, federal and local agencies as well as conservation organizations—including the U.S. Army Corps of Engineers, the South Carolina Department of Health and Environmental Control, LowCountry Land Trust, The Nature Conservancy and Open Space Institute—to develop a partnership to preserve about 4,000 additional acres of habitat, including 2,000 acres of wetlands and native plants as pictured above, that are at risk of development. Once wetlands enhancement activities are complete, this land will go to the United States Forest Service and the South Carolina Department of Natural Resources, ensuring long-term public access. This new preserve includes more than 10 times the acres of wetlands lost to construction and has received national attention as a model process for partnership and preservation. (Lowcountry Land Trust photo)

GLOBAL ENVIRONMENTAL LANDSCAPE

Aviation brings together people, countries and cultures. The air transport industry supports an estimated 63 million jobs and accounts for about 3.5 percent of global gross domestic product (GDP), according to the Air Transport Action Group.

As the industry grows, Boeing recognizes that population growth, natural resource scarcity and climate change are serious issues that require credible actions and global solutions.

Population Growth and Urbanization

The United Nations (U.N.) projects that the world population will reach 8.5 billion by 2030.

Growing population and urbanization will further boost demand for transportation globally, presenting the challenge to meet that demand without the corresponding growth of emissions and community noise.

Natural Resource Constraints and Vulnerable Ecosystems

Growing economic activity and population levels increase demand and competition for raw materials and other natural resources, such as food, land, fresh water and energy. In many areas, natural resource scarcity and ecosystem vulnerability, including lack of available water, have put extreme pressure on ecosystems and introduced regional political instability. Water resources, coastal infrastructure, agriculture, ecosystems and human health are expected to be challenged in virtually every region worldwide.

Climate Change

The U.N.'s Intergovernmental Panel on Climate Change reports that projected increases in carbon dioxide (CO_2) concentration will lead to rising global temperatures and more extreme weather events.

In its 2014 Quadrennial Defense Review, the U.S. Department of Defense notes, "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 abroad, such as poverty, environmental degradation, political instability and social tensions."

Wetlands are one part of Boeing's approach to stormwater management at its Everett, Washington, facility. (Boeing photo)

AEROSPACE INDUSTRY ANALYSIS

Boeing is committed to a healthy environment. The aerospace industry continually adapts to dynamic and changing market forces. Achieving our goals means collaborating as an industry on the issues that face us today—for a more sustainable future.

Environmental Regulation

Aerospace in general, and commercial aviation in particular, is a highly regulated industry, and environmental regulations are part of that. The number of regulations and environmental concerns affecting our industry is increasing and includes the following:

- Greenhouse gas (GHG) emissions.
- Airplane community noise.
- Local air-quality emissions for products and factory operations.
- Water quality and issues such as stormwater.
- Hazardous waste.
- Energy consumption and the use of renewable energy in operations.

Chemical Restrictions & Bans

Global regulation of chemical substances continues to grow exponentially. To illustrate, regulations expanded 50 percent per year from 2003 to 2013—more than 50 times overall. That trend continues as efforts to reduce chemical exposure from consumer products affect more industries, including aerospace.

Boeing complies with all applicable rules and regulations. We assess regulatory effects on the environment as well as our company and customers. As a global business operating in sectors with global operations, we seek global alignment in policies and standards where reasonable, practical and protective.

Commercial Aviation & Climate Change

According to the Intergovernmental Panel on Climate Change, aviation contributes approximately 2 percent of global CO_2 emissions. The industry has established a global sectoral approach to controlling these emissions and a set of goals aligned across the industry (see chart at right). As part of this strategy, two new global agreements were adopted by the International Civil Aviation Organization (ICAO), a United Nations agency, in 2016 that support achieving these goals:

- A new fuel-efficiency performance standard for aircraft.
- A global carbon offset program called Carbon Offset and Reduction Scheme in Aviation (CORSIA).

Implementation of these agreements into regulatory frameworks around the world is underway.

Global Aviation Commitments

2010	2020	2050
1.5% per year fuel efficiency	Carbon-neutral growth	–50% CO_2
Average 2.4%* from 2009–2014	CORSIA pilot program to begin in 2020	Airplane technology, sustainable fuels, operational efficiency

*Air Transport Action Group

Customer Requirements

The aviation industry's business goals of providing safe, cost-efficient travel and environmental goals of reducing CO_2 emissions are both achieved by constantly improving airplane fuel efficiency. Reducing emissions is aligned to our customers' strategic desire to decrease fuel use, a major cost and priority in their purchasing decisions. Our customers increasingly require that Boeing's products and services include environmentally progressive attributes that will help them address environmental concerns without sacrificing performance or increasing life-cycle costs.

GgovernanCE

Boeing'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.

Boeing employees are increasingly invested in ideas and programs that benefit the environment. Over the past year, there has been a 72 percent increase in employee projects focused on the environment. (Boeing photo)

The EHS Policy Council ensures that strategy and performance targets are set and monitored.

One EHS Policy Council meeting each year is focused on setting targets that are aligned with corporate long-range business planning; another annual meeting focuses on detailed planning and reviewing the company's environmental and safety performance.

A team of cross-functional executives meets twice a month to advance the strategy, plan and performance. Progress and status are reported in each of these venues in addition to other internal reviews across the company.

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 EHS team also works with our business unit and operational leaders to drive an integrated, enterprisewide strategy that includes our products, services, processes, operations, contractors and employees.

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

PRIORITIZATION STUDY

In 2016, Boeing completed a comprehensive third-party review and assessment of the company's most significant environmental priorities.

The analysis included direct input and perspectives from diverse stakeholders — such as customers, environment-focused non-governmental organizations (NGOs), and the company's global leadership — as well as research into industrial best practices and community requirements.

One of the assessment's main goals was to help Boeing identify and update its understanding of current and emerging environmental topics that are critical to the company and its stakeholders. The analysis supports a focused and dynamic global strategy to address the most important environmental priorities facing Boeing, its customers and communities around the world.

Most Significant Environmental Priorities

The assessment analyzed diverse viewpoints and organized environmental priorities by order of importance and influence on business strategy, as identified by Boeing and its external stakeholders. The topics relate to products, operations and a variety of other issues. Several topics were identified as highest importance and largest influence on business strategy by both Boeing and our external stakeholders and are explored at length later in this report. They include:

- **Products** Greenhouse gas (GHG) emissions: fuel efficiency, operational efficiency and sustainable aviation fuel.
- **Operations** GHG emissions: energy conservation, water management and solid waste management/waste to landfill.

Boeing named additional priorities — including managing hazardous materials in our operations and products and managing chemicals in our aircraft and production — as well as opportunities, like pursuing innovations in environmentally progressive buildings.

External stakeholders added supply chain practices and reporting and product noise as high environmental priorities.

Results of 2016 Prioritization Study

In September and October 2016, Boeing's most significant environmental priorities across its value chain were confirmed by assessing internal and external stakeholder perspectives. The results, in order of importance and influence on business strategy, are shown below:

Product Greenhouse Gas Emissions
- **Fuel Efficiency**
- **Operational Efficiency**
- **Sustainable Aviation Fuel**

Operations Greenhouse Gas Emissions
- **Energy Conservation**

Climate Adaptation

Operations Water Management

Operations Solid Waste Management & Landfill

Chemicals and Hazardous Material Management

Materials Innovation & Sustainable Building

Supply Chain Environmental Standards, Practices & Reporting

Product Noise

Remediation & Restoration

Pressure to Increase Transparency in Reporting

Product End of Service Disassembly & Disposal

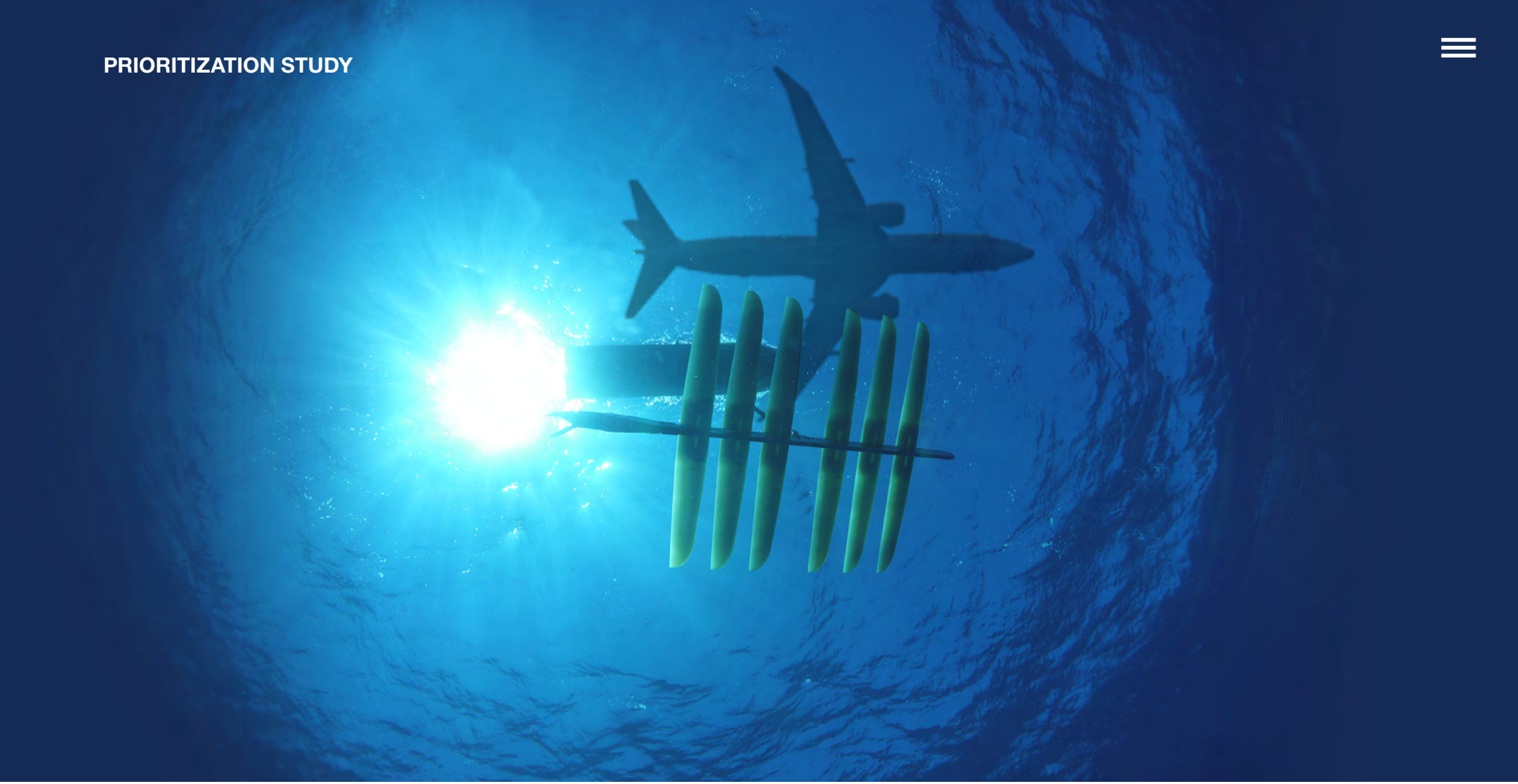
Non-Greenhouse Gas Emissions

Biodiversity

Product Water Use

Impact of Transportation Infrastructure

Text in **green** indicates topics explored in more detail in this report.



It's important to note that while topics are ranked, we are currently addressing all identified priorities in our global environmental strategy.

Global Environmental Concerns

The assessment reported current and emerging global trends that may affect Boeing's business, including climate change, resource scarcity, rapid urbanization, regional collaboration on environmental regulations and rapid innovation in new technology.

Environmental Leadership

The analysis concluded that Boeing has in place the policies and governance to address the most significant environmental priorities the company faces. Opportunities to strengthen our leadership include improving the measurement and reporting of progress made to environmental goals with increased transparency in communication to all stakeholders. Work has already begun on these fronts.

Liquid Robotics, a Boeing company, designs and manufactures the Wave Glider—a solar- and wave-powered autonomous maritime surface vehicle and its variant, the Sensor Hosting Autonomous Remote Craft (SHARC). This graphic illustration represents the role the long-endurance autonomous vehicle plays in a seabed-to-space data and information network. (Liquid Robotics image)

BOEING'S ENVIRONMENT STRATEGY

Boeing's commitment to environmental leadership and building a more sustainable future drives a global strategy with three main areas of focus:

Environmental Opportunities in the Product Life Cycle

This chart represents the various ways Boeing considers environmental improvements throughout the product life cycle. While the life cycle begins with design & development and ends at the end of service, it's important to note that those end of service opportunities are considered at the beginning of the cycle, forming a continuous circle of improvement.

Inspire Global Collaboration

Boeing works closely with industry, government agencies, NGOs and customers to reduce aviation's environmental footprint with a focus on reducing emissions. We engage in policy initiatives, research and development projects, collaborative technology road-mapping and more to further progress on our company and industry goals.

Design in Environmental Performance

Most aviation emissions in an aircraft's life cycle occur during its use by the airline or government customer. In addition to designing and building increasingly fuel-efficient products, Boeing uses innovative, environmentally progressive technology and manufacturing practices to reduce the environmental footprint and create market value for our customers.

Innovate for Sustainable Operations

Improving the environmental footprint of Boeing's factories, offices and other facilities requires continually assessing and updating technologies and processes to reduce greenhouse gas emissions, water intake, solid waste sent to landfills and the use of hazardous materials while increasing the use of environmentally progressive materials. Additionally, we are collaborating with experts outside of Boeing to help guide innovative and effective solutions to stormwater management and water-quality improvement. Boeing's remediation program focuses on using innovative approaches to cleaning up affected sites while relying on close collaboration with community members and environmental groups.

In 2017, Boeing will complete its current cycle of environment-based targets, and is in the process of developing new targets to run through 2025.

2016 GOALS & PROGRESS

Boeing's commitment to global environmental leadership is focused on key goals and targets, which reflect the three tenets of our environmental strategy.

Inspire Global Collaboration, Design in Environmental Performance and Innovate for Sustainable Operations support our core beliefs:

- Partnering with community, customers and employees to advance our 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.

The next three pages provide a summary of progress made to specific performance goals and targets.

A GEnx-2B engine is made ready for installation on a Boeing 747-8 at the Everett, Washington, factory. Continued innovation and new engine technology have led to significant efficiency gains with reduced fuel consumption and emissions across Boeing product lines. (Boeing photo)

Inspire Global Collaboration

GOAL	PROGRESS		
Work with customers and industry groups on testing and demonstrating advanced, environmentally cleaner technologies.	To speed up development of new technologies that enhance safety and reduce fuel use, emissions and noise, Boeing has completed four ecoDemonstrator flight-test programs in the past five years. The programs tested some 60 technologies using a 737 (2012), 787 Dreamliner (2014), 757 (2015) and an Embraer E170 regional jet (2016, and the first such collaboration between two airplane manufacturers). Boeing and Embraer tested several technologies, including: **Enhancing safety and efficiency**— An optical air data system called LIDAR, which stands for light detection and ranging, can potentially save weight and drag and provide a backup source for pitot tubes. These tubes protrude from the fuselage and measure air speed, atmospheric pressure, external temperature and other parameters. **Reducing noise** — A new design for leading-edge slats on the front of the airplane's wings reduced unsteady airflows, which lowers the noise level as the airplane is on approach. **Ice-phobic paint**— A new "ice-phobic" paint was shown to improve the airplane's ability to shed ice and would also require less washing. **Lowering emissions** — A 10 percent biofuel blend made from Brazilian sugar cane was used during all test flights. Scientific studies have shown that biofuels reduce life-cycle emissions by 50 to 80 percent compared with fossil fuel. Boeing is now planning for its 2018 ecoDemonstrator program, which will use a 777 for flight testing focused on a new lightweight compact thrust reverser and flight operations automation.
Support the development of a viable sustainable aviation fuel market.	Boeing continues to be a leader in the aviation industry for developing and commercializing sustainable aviation fuels, which represent aviation's greatest opportunity to reduce carbon emissions, meet the industry's environmental goals and support long-term sustainable growth. Substantial progress has been made on dozens of collaborative projects around the world with near- and long-term potential to deliver sustainable aviation fuel to airline customers. For example, in South Africa, Boeing partnered with South African Airways and low-cost carrier Mango to fly Africa's first flights powered by a 30 percent blend of biofuel produced from solaris, a nicotine-free tobacco plant grown by farmers in Limpopo Province, South Africa.		In the United States, Boeing supported the Port of Seattle and Alaska Airlines on a study that found the best initial solution to provide biofuel to every departure at Seattle-Tacoma International Airport is a small, on-site receiving and blending facility. In the coming years, we will accelerate our investment in the development of sustainable biofuels.
Support a global industrywide approach for aviation carbon dioxide emissions.	Through collaboration with global stakeholders over several years, Boeing supported development and adoption of two complementary global carbon emission–reduction measures agreed to in 2016 by ICAO. All new commercial aircraft types will be required to meet ICAO's fuel efficiency standards as they are implemented by member nations over the next several years. Our new commercial airplanes have been designed to meet and exceed the challenging requirements. Airlines flying between participating nations will begin adopting a market-based carbon-offset program known as CORSIA. So far, 65 nations have committed to participate, which represents more than 80 percent of the growth in emissions from international aviation after 2020. Offset credits purchased through the program, which will be assessed to ensure they meet stringent environmental integrity criteria, will finance projects to reduce CO_2 emissions, many in developing countries.		

Inspire Global Collaboration *continued*

GOAL	PROGRESS
Invest in organizations and projects that will benefit the environment globally and in the communities in which we operate.	Boeing has strong partnerships with community environmental leaders who help us ensure that projects support economic, social and environmental progress. In 2016, Boeing committed further resources to help The Nature Conservancy (TNC) scale the land-management community work they conduct in Indonesia for Brazil and Mexico. In addition, Boeing partners with TNC on domestic projects in Washington, Arizona, Missouri and South Carolina to help communities develop plans and models to improve the health and security 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. Additionally, we are working with experts in Puget Sound to test green infrastructure solutions to mitigate pollution from storm water runoff and improve overall water quality.

Design in Environmental Performance

GOAL	PROGRESS
Reduce the environmental footprint of Boeing products throughout the product life cycle.	Development of new, more efficient Boeing airplanes continues on schedule: • The 737 MAX entered service in 2017. The new aircraft, which includes a new winglet tested on the ecoDemonstrator, will be 20 percent more fuel efficient and have a 40 percent smaller noise footprint than the original Next-Generation 737. • The first 787-10 is in flight test. This airplane will achieve approximately 25 percent better fuel efficiency than the airplanes it replaces. • We opened the 777X Composite Wing Center and completed the first wing panel prototype. The 777X will reduce fuel consumption 18 percent compared to its closest competitor and significantly lower its noise footprint.
Improve operational efficiency across Boeing products and services.	We continue to make progress in reducing both emissions and noise through better flight operations. Boeing is implementing new airport arrival and departure procedures in several European and Asian countries that reduce miles flown and emissions. In 2016, we conducted demonstrations with Delta and United Airlines during multiple arrivals to San Francisco Airport highlighting the use of airplane technology, such as the Global Navigation Satellite System (GNSS) landing system (GLS). GLS integrates satellite and ground-based navigation data to provide the position information required for approach and landing guidance. This system significantly improves takeoff and landing capability at airports at lower cost, emissions and noise levels. The success of this demonstration enabled the airport to begin the process of installing the ground system for improved all-weather access to all runways and reduced environmental impacts.

Design in Environmental Performance *continued*

Work with aviation stakeholders to ensure that all Boeing products comply with chemical restrictions and bans.	We are continuing to monitor and assess global chemical regulations for potential impact to Boeing products. An example is complying with Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulations in the European Union. We are coordinating with our research and technology organization and across our supply chain for safe and sustainable alternatives to substances targeted for restrictions or bans. Where alternatives do not exist, we are continuing our research while communicating with regulatory agencies or applying for and supporting authorization for continued use until alternatives can be identified, rigorously evaluated for compliance with performance and safety requirements, and implemented. Boeing will continue to speed development and implementation of viable and environmentally responsible chemical alternatives. We also work with the aerospace industry through the International Aerospace Environmental Group (IAEG) to advance development of the Aerospace and Defense Declarable Substance List (AD-DSL) and the associated Materials Declaration Standard for Aerospace and Defense (IPC-1754) for supplier reporting. These resources enable our suppliers to report chemical content of supplier-designed parts more efficiently and help ensure our compliance with global chemical regulations. Internally, Boeing is implementing tools and processes, such as the Chemical Hazard Assessment, to enable engineers and technologists to compare hazards between alternative materials and select environmentally preferred solutions that meet design and performance requirements.		

Innovate for Sustainable Operations

GOAL	PROGRESS		
Protect human health and the environment by cleaning and restoring locations affected by past practices.	We made significant progress in 2016 on our inventory of 65 remediation sites, including advancing six projects — in Renton, Auburn and Everett, Washington; Santa Susana and Long Beach, California; and Pools Prairie, Missouri — by achieving key regulatory milestones. In addition, we furthered our site restoration goals by renewing or initiating habitat certifications at four sites, including the Santa Susana Field Laboratory in California, Plant 2 in Washington, and the Emery landfill and Chemical Commodities Inc. (CCI) projects in Kansas.	In June 2016, Boeing and other members of the Plant 2 Sediment Remediation and Urban Waterway Restoration project team accepted the World Organization of Dredging Associations' Environmental Excellence Award for Environmental Dredging for our Plant 2 dredging and habitat project.	
Maintain 2012 levels for greenhouse gas emissions, water intake, solid waste to landfill and hazardous waste.	In 2016, we out-performed our plan to be at or below 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.)	Boeing continues to focus on reducing the waste it sends to landfills by improving production processes to reduce the amount of material used, researching waste recycling methods and markets for excess carbon fiber, as well as continuing to expand our enhanced recycling program. We are currently developing our next set of targets for 2018 to 2025.	

2016 PERFORMANCE

Boeing is improving the environmental footprint of our diverse operations. We are on target to outperform our goal of zero growth in our four key indicators from our 2012 baseline through 2017.

Boeing generated fewer greenhouse gas emissions, used less water, sent less solid waste to landfills and generated less hazardous waste — all reduced from 4 to 19 percent in 2016 compared to the baseline set in 2012 — even with strong growth in production.

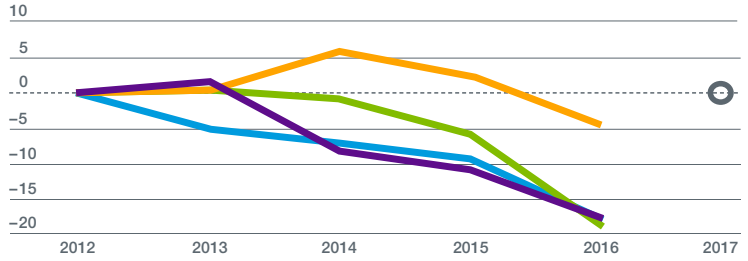
This year's Environment Report also reflects the U.S. Environmental Protection Agency's (EPA) 2016 recalculation of the National eGRID emissions factors, which represent the emissions footprint of all electric power sources. The EPA biannually recalculates the data and applies the results to the previous three years. A significant increase in the emissions factor was identified for the Northwest region. This was mainly caused by greater use of coal-derived electricity needed to meet the demands of a growing region. This resulted in Boeing's recalculation of 2014 and 2015 data, which caused an increase of the emissions previously calculated and reported for those years. Despite this change, we remain on track to exceed all goals.

2017 is the final year in Boeing's five-year plan of environmental performance goals and targets set in 2012. The company will implement new performance goals in 2018 that will demonstrate a continuing commitment to strengthening our global environmental leadership.

The accompanying charts and graphs show data rounded to the nearest decimal point and reflect the environmental performance of the majority of Boeing facilities, calculated against 2012 baseline values. (Note: hazardous waste generation targets are revenue adjusted.)

Boeing also submits environmental data to regulatory agencies and voluntary disclosure organizations, such as Australia's National Greenhouse and Energy Reporting Scheme, the United Kingdom's Carbon Reduction Commitment Energy Efficiency Scheme, the EPA's Toxics Release Inventory, the European Union's Emissions Trading System and Canada's National Pollutant Release Inventory.

2016 Environmental Performance
Data Representative of the Majority of Boeing Facilities
(Percent Performance to 2012 Baseline)

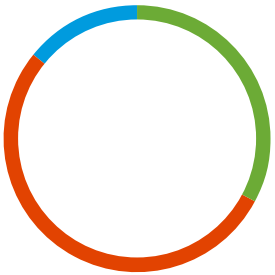


Hazardous Waste*	–17.4%
GHG Emissions	–4.9%
Solid Waste	–19.1%
Water Intake	–17.6%

2017 Target: 0% absolute growth — water, GHG and solid waste; 0% revenue-adjusted growth — hazardous waste

*Normalized to revenue

Greenhouse Gas Corporate Inventory



Scope 1 Emissions	33%
Scope 2 Emissions	53%
Scope 3 Emissions	14%

Greenhouse Gas Scope 1 Emission Sources

Natural Gas	54%
Jet Fuel	27%
Fugitive Emissions	15%
#2 Diesel	2%
Other Fossil Fuels	2%

AWARDS & RECOGNITION

Boeing's environmental leadership and actions have earned awards and recognitions for factory and facility operations as well as for our products.

Awards received in 2017 and 2016 include:

The 2017 ENERGY STAR Partner of the Year—Sustained Excellence Award from the U.S. Environmental Protection Agency (EPA) for the company's continued leadership in protecting the environment through superior energy efficiency. This is the seventh consecutive year the company has received an ENERGY STAR award.

The 2017 Pretreatment Excellence Award from Gresham, Oregon, for Boeing Portland's achievement in reaching 100 percent compliance with the site's Industrial Wastewater Discharge permit, the 15th consecutive year of perfect compliance.

The 2017 Blue Marble Award from NASA for collaboration on the Environmentally Responsible Aviation (ERA) Program for studies on blended wing body/structures and technologies tested on the 2015 ecoDemonstrator program's 757 platform.

The 2016 Crystal Cabin Award from the Crystal Cabin Award Association for excellence in aircraft interior innovation. The award for "Greener Cabin, Health, Safety and Environment" category recognized Boeing's prototype lavatory that uses ultraviolet (UV) light to sanitize all lavatory surfaces without the use of chemicals.

The 2016 Gold Award from King County for maintaining zero industrial wastewater compliance violations at several facilities in Puget Sound. North Boeing Field in particular has received its fourth consecutive Commitment to Compliance Award for earning a Gold Award for five consecutive years.

The 2016 ENERGY STAR National Building Competition: BOOTCAMP! Award from the EPA for a competition among several buildings at the Renton, Washington, site that significantly improved energy conservation.

The 2016 Energy Champion Award from the California Energy Efficiency Industry Council for "excellence in advancing energy efficiency." The award recognizes Boeing and its consultant partner Nexant for implementing measures that achieved more than 4.5 million kWh (16,200 gigajoules) of verified energy savings annually in 70 Boeing buildings, with an additional 4 million kWh (14,400 gigajoules) of potential savings identified and being implemented.

Membership in the Environmental Excellence Program with the South Carolina Department of Health and Environmental Control (renewed in 2016). The program's goal is to "promote and practice pollution prevention, energy and other resource conservation, and to strive for continuous environmental improvement."

The 2016 Green Business Award from *Utah Business* magazine, recognizing Boeing Salt Lake's programs and practices that promote environmental sustainability.

The 2016 Resource Conservation Management Award from Seattle-based utility Puget Sound Energy for reducing energy consumption with low-cost conservation projects and recognizing the conservation efforts of maintenance teams at the Renton, Washington, site.

The 2016 Conservation Leader of the Year Award from the Snohomish County, Washington, Conservation District for initiatives to recycle unused carbon fiber, retrofit the Auburn, Washington, site with a rain garden and engage employees and local communities around stormwater solutions.

The 2016 Environmental Excellence Award from the World Organization of Dredging Associations for the restoration and remediation of the Duwamish Waterway in Seattle, Washington.

The 2016 Secretary of Defense Environmental Award for Boeing's KC-46 air refueling tanker for the U.S. Air Force. The award recognizes "exceptional environmental achievements and innovative, cost-effective environmental practices."

The 2015 Chief of Naval Operations Environmental Award (received in 2016) for the P-8A Poseidon maritime patrol aircraft. The award cites the aircraft's compliance with international, federal, state and local environmental laws and regulations.

LEADERSHIP PROFILE

Dana Hullinger

As a supply chain leader for Boeing's Defense, Space & Security business unit, Dana Hullinger helps drive the effort to improve performance and use data analytics to gain new insights into Boeing's complex and diverse network of suppliers.

Supplier performance metrics include a wide range of environmental issues. Dana discusses some of the sustainability challenges and opportunities throughout the supply chain.

Can you describe Boeing's supply chain?

More than 13,000 active suppliers account for more than $60 billion in goods and services to build Boeing products. We have suppliers in every state in the U.S. and 48 countries.

What are the main environmental and sustainability issues in supply chain activity?

They vary by region, but the issues fall into broad categories of social justice and environmental stewardship. One of the most talked about global social justice issues is conflict minerals, which refers to specific minerals mined in the Democratic Republic of Congo and its surrounding countries. The mining is done with coerced labor under often harsh and unsafe conditions, and their sales are used to finance armed conflicts in the region. The minerals, including tin, tantalum, tungsten and gold, are widely used in electronics and consumer products.

The U.S. and other nations have regulations against the use of products made with conflict raw materials. Boeing is a leader in working with government agencies and industry groups on ensuring compliance throughout the supply chain.

Other human rights issues involve human trafficking and the use of child labor in manufacturing in many parts of the world. Boeing trains its employees to be aware of conditions or situations that could indicate a lack of supplier compliance with laws protecting human rights.

For the environment, there is growing regulation of hazardous chemicals and greenhouse gas emissions in products and manufacturing in the European Union and other regions. Energy and water conservation also are important sustainability issues.

How does Boeing address these and other global environmental issues?

We require our suppliers to comply with all global, national and local laws that protect human rights, guard against human exploitation and protect the environment. Period. It's in the terms and conditions of their contract and it is a basic requirement to do business with Boeing. That means we need to be diligent to ensure the supply chain remains aligned with our principles and our practices, especially as we enter new markets around the world.

On key environmental issues, Boeing works closely with governments, suppliers and partners on setting industrywide standards. We are a founding member of the International Aerospace Environmental Group and the Defense Industry Initiative on Business Ethics and Conduct, which promotes a culture of ethical conduct throughout the military supply chain.

READ MORE ▶

LEADERSHIP PROFILE

Adi Singh

Adi Singh leads Boeing's Frederickson, Washington, site, one of the company's 12 major facilities that fabricate parts and structural components for Boeing commercial and military aircraft.

Adi's team pursues a robust strategy and vision for the site's environmental footprint, including striving for "net-zero energy" consumption. Adi discusses some of the team's successes and challenges.

The Frederickson facility plays a key role in the manufacture of Boeing aircraft. What are the site's major activities?

Our manufacturing is organized around two main business units that focus on different materials: composites, through the Composite Manufacturing Center, and metal, through Skin and Spar. The site produces composite horizontal stabilizers and vertical fins—together known as the empennage at the aircraft's tail—and metal wing components.

What are the challenges with each material as you look for ways to reduce waste, conserve resources and find alternatives to hazardous chemicals?

They're very different. With metal parts and components, we use chemicals to help detect flaws and prepare surfaces for painting. Chemicals and paint add to the site's hazardous waste. How can we reduce and even eliminate chemicals in our processes?

With composites, we use raw material, such as carbon fiber, to manufacture the parts and components. Can we use less raw material? Finding new ways to recycle and reuse excess composite material and keep it out of landfills is a big focus and opportunity for innovation.

Reducing the site's energy use and overall carbon footprint also is a major part of our environmental strategy.

What are some of the successes and progress so far?

Thanks to a very creative team, site-wide improvements include:

- Significantly reducing hazardous waste by reducing the amount of paint used on parts, cutting back the frequency of replacing large quantities of chemicals needed in some processes, and recycling oils in equipment
- Mitigating the risk of groundwater pollution with a stormwater management system that has received the highest recognition available from the local county government for five consecutive years.
- Switching to reusable containers for parts sent from local suppliers, reducing shipping waste and costs.
- Reducing the amount of raw material required and the waste generated in the manufacture of composite parts.
- Expanding recycling of waste streams at all levels to conserve resources and energy.
- Reducing waste by switching to filtered water stations in some locations instead of bringing in large bottles of water.

As we look to the future, new technology will take us to the next level.

READ MORE ▶

LEADERSHIP PROFILE

Doug Christensen
Antonini Puppin-Macedo
Luiz Nerosky

Boeing began the ecoDemonstrator program to speed up development of new technologies that enhance safety and reduce fuel use, emissions and noise. The program has tested 60 technologies in the past five years on a variety of aircraft.

A first-of-its-kind partnership in 2016 brought together Boeing and Brazilian aircraft maker Embraer for a unique ecoDemonstrator experience. The team included Boeing's Doug Christensen (top) and Antonini Puppin-Macedo (middle), and Embraer's Luiz Nerosky (bottom). The three discussed the project's benefits and surprises.

What brought Boeing and Embraer together for this unique collaboration?

Christensen: Boeing and Embraer share the passion to accelerate safety and environmental technologies. The ecoDemonstrator program provides the stage to bring the companies together to collaborate on advanced technologies.

Puppin-Macedo: Boeing and Embraer have a history of successful collaboration. We began working together on sustainable aviation fuel in 2012 through a series of workshops that brought together all stakeholders in Brazil. This led to the publication of the comprehensive "Roadmap for Sustainable Aviation Biofuels in Brazil" in 2014.

Together we launched the Joint Research Center for Sustainable Aviation Biofuels, right next door to the Boeing Research & Technology (BR&T) Center in São José dos Campos, Brazil. This positive crescendo of collaborations on biofuels, a key environmental element in aviation today, paved the way for us to join forces on the ecoDemonstrator program.

BR&T-Brazil led research on two technologies: biofuels and the slat cove noise reduction. By collaborating on flight tests, we can speed up getting these technologies ready for certification and implementation.

Nerosky: Both companies share the industry's commitment to reduce the environmental footprint of aircraft transportation worldwide and aim for a sustainable industry by applying new technologies in future aircraft. Working with Boeing on the ecoDemonstrator program in testing new technologies reinforces, once again, Embraer's commitment in that sense.

What are the benefits of two airplane manufacturers working together on advanced technologies to enhance safety and make flying more efficient?

Christensen: It's a powerful approach to bring together the best and brightest engineers from both companies to accelerate advanced technologies.

Puppin-Macedo: Together, we can focus on benefits for the aviation industry and society as a whole and share different perspectives on global issues, such as reducing our carbon footprint and increasing the "global reach" of our collaborative actions. We can lead the industry, steer advocacy and accelerate innovation.

Nerosky: The ecoDemonstrator collaboration expands a relationship that began in 2012 when Boeing and Embraer signed a cooperation agreement to benefit their customers, companies and the global aviation industry.

READ MORE ▶

LEADERSHIP PROFILE

Kim Smith

Kim Smith is vice president of Attack Helicopter Programs and leads the Boeing site in Mesa, Arizona, which produces the AH-64 Apache and AH-6i Little Bird helicopters for the U.S. Army and allied defense forces around the globe.

Boeing in Mesa also makes electrical and composite components for other commercial and military aircraft and supports developmental flight testing for multiple programs. The site has a robust record of improving the environmental footprint of its operations and products. Kim discusses Boeing Mesa's environmental progress, challenges and opportunities for continuing improvement.

Boeing in Mesa is a big and complex manufacturing site. How would you describe its environmental strategy?

Boeing in Mesa is fortunate because environmental stewardship has become fundamental to how we do business; it's not a separate activity. Site leaders continually look for creative ways to conserve resources, reduce waste, save energy and strengthen community partnerships. Over time, it's become part of the culture and our way of life.

A key part of our strategy relies on a fundamental feature of the culture, which is the amazing passion of our employees for environmental action. For example, since 2012, we reduced our water use — one of the site's key performance targets — by 35 percent. Employee teams suggested some of the more innovative projects for conserving water, such as slow-closing irrigation valves that reduce irrigation line breakage and leaks by minimizing hydraulic shock, and a sand filter backwash collection and recovery system at the Central Cooling Plant that saves 12,500 gallons (47,318 litres) of water a day.

Our employees also come up with creative community projects, from collecting rainwater at the Desert Botanical Garden in Phoenix, to supporting sustainable gardens at Sunshine Acres, a Mesa home for children at risk.

The leadership here in Mesa gets behind and supports employee involvement in finding new projects to improve efficiency, reduce waste and expand recycling.

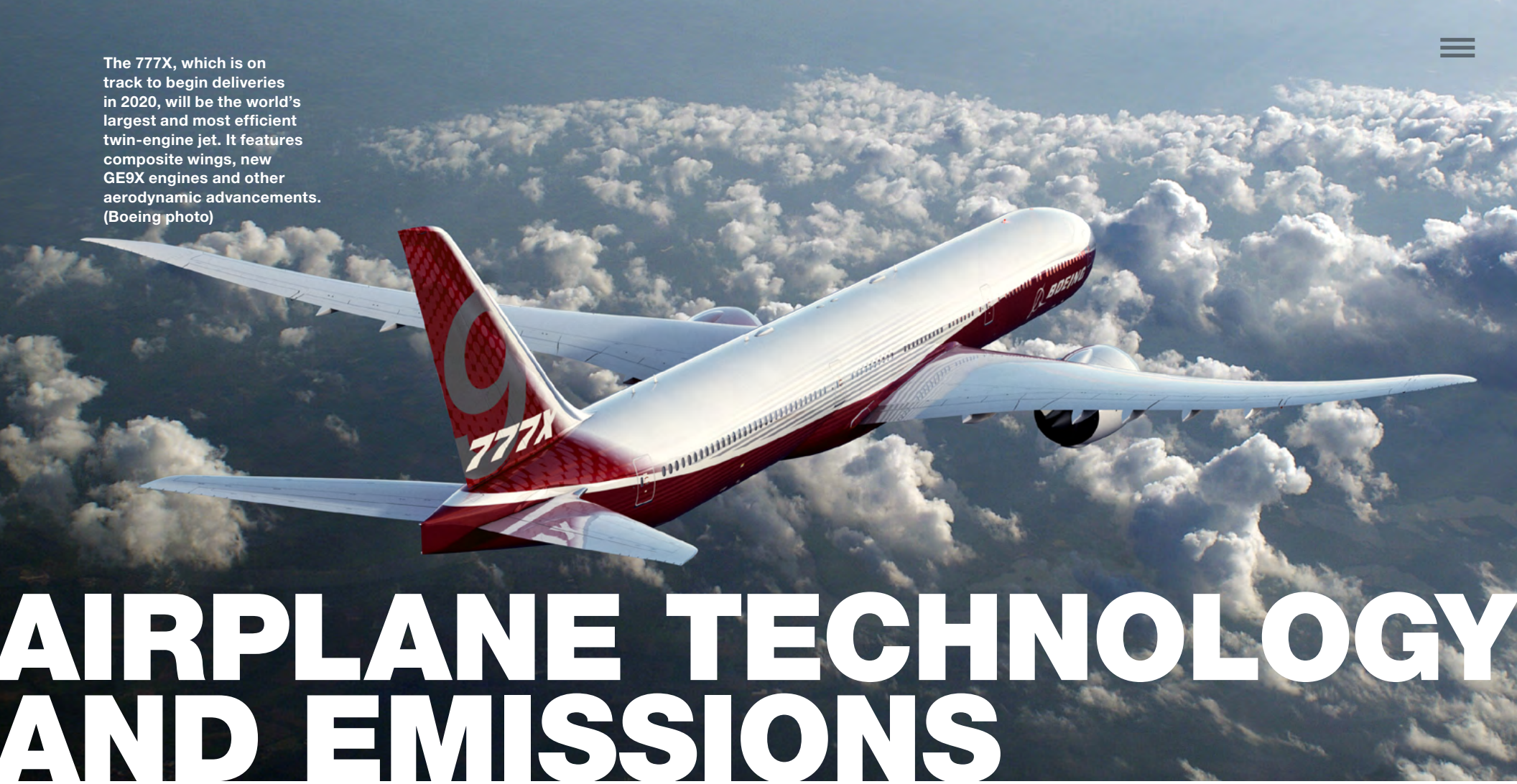
Partnerships and collaboration are critical to environmental progress. We share best practices with the U.S. Environmental Protection Agency and work closely with state agencies on a variety of pollution prevention programs.

What sort of environmental improvements have you seen with the site's main product line, the Apache helicopter?

Our government customers are interested in improving the efficiency and the overall environmental impact of military platforms. The Apache was among the first military aircraft to use a paint primer free of hexavalent chromium, a hazardous chemical commonly used to resist corrosion. Boeing has made substantial investments in finding environmentally cleaner alternatives to chrome and other chemicals used on its aircraft.

An Apache also was the first rotorcraft to fly on biofuel, by the way, in a 2010 test flight conducted by one of our customers, the Royal Netherlands Air Force.

READ MORE ▶



The 777X, which is on track to begin deliveries in 2020, will be the world's largest and most efficient twin-engine jet. It features composite wings, new GE9X engines and other aerodynamic advancements. (Boeing photo)

AIRPLANE TECHNOLOGY AND EMISSIONS

Our products connect people, protect nations, explore space and sea and inspire the world. Boeing is committed to making the world's best airplanes with the smallest environmental footprint and working with industry stakeholders on climate protection.

Avianca took delivery of Boeing's 500th 787 Dreamliner in December 2016. (Boeing photo)

The 787-10, the largest of the Dreamliner family, rolled out in February 2017 and made its first flight on March 31. (Boeing photo)

ENVIRONMENTAL

BENEFITS INCLUDE REDUCTIONS IN FUEL CONSUMPTION, CO_2 AND NOISE LEVEL

Reducing the environmental impact of our products starts with good design. We strive to use lightweight materials such as composites, which make up half of the 787 Dreamliner's primary structure, including the fuselage and wings. We integrate highly efficient engines and incorporate other engineering innovations on all of our airplanes to achieve superior aerodynamics.

Our talented employees design and build the world's most fuel-efficient commercial aircraft. The 737 MAX reduces fuel use and carbon dioxide emissions by 20 percent compared with the original Next-Generation 737 and has a 40 percent smaller noise footprint than today's single-aisle airplanes. The fastest-selling airplane in Boeing's history, the 737 MAX had its first deliveries in the spring of 2017.

The revolutionary 787 Dreamliner family improves fuel use 20 to 25 percent compared with the airplanes it replaces. The efficiencies are due to new engines, lightweight composite materials, more efficient systems applications and modern aerodynamics. The 787 Family has saved airlines more than 14 billion pounds (6.4 billion kilograms) of fuel since it was introduced in 2011.

Technologies on the 787 also ensure that no sound louder than 85 decibels — about the level of loud traffic heard from the side of the road — leaves the airport boundaries. The 500th Dreamliner was delivered in 2016 and the first 787-10, the largest model, rolled out in February 2017.

The 777X, which is on track to begin deliveries in 2020, will be the world's largest and most efficient twin-engine jet. With 12 percent lower fuel consumption than competitor airplanes, the 777X will have the world's largest composite wing, aerodynamic improvements and a highly efficient GE9X engine.

To speed up development of new technologies that enhance safety and reduce fuel use, emissions and noise, Boeing has completed four ecoDemonstrator flight-test programs since 2012. Some 60 technologies have been tested, most recently in 2016 aboard an Embraer E170 regional jet — the first such collaboration between two airplane manufacturers (more details on page 17).

Software products such as Direct Routes and Wind Updates use real-time traffic and weather information to help pilots take advantage of the most efficient route or altitude during their flight. (Boeing photo)

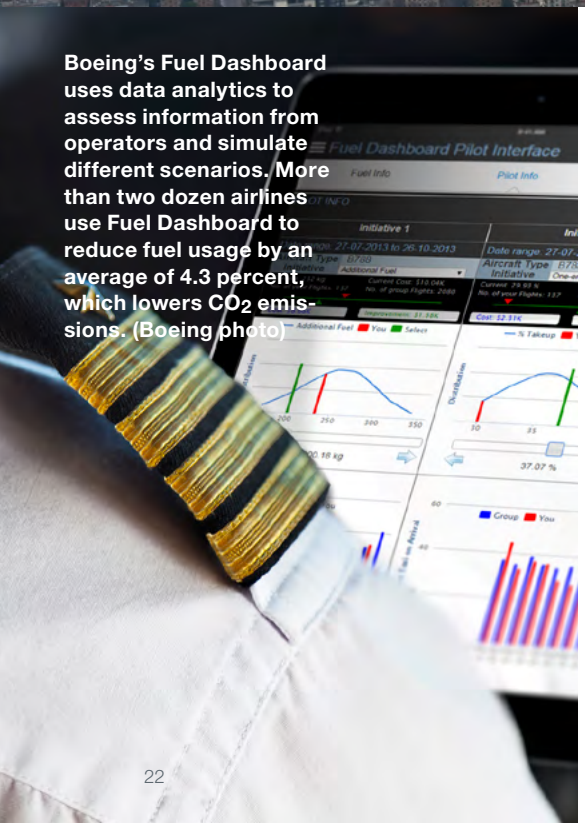
OPERATIONAL EFFICIENCY

To help airlines fly as efficiently as possible, Boeing offers a variety of products and services to improve the operational performance of our airplanes.

FUEL DASHBOARD

AND AIR TRAFFIC MANAGEMENT SOLUTIONS LOWER FUEL CONSUMPTION AND CARBON EMISSIONS

The 737 MAX reduces fuel use and emissions by 20 percent compared with the original Next-Generation 737 and has a 40 percent smaller noise footprint than today's single-aisle airplanes. (Boeing photo)



Boeing's Fuel Dashboard uses data analytics to assess information from operators and simulate different scenarios. More than two dozen airlines use Fuel Dashboard to reduce fuel usage by an average of 4.3 percent, which lowers CO_2 emissions. (Boeing photo)

To improve the operational efficiency of the in-service fleet, we offer services including a tool called Fuel Dashboard, which is powered by data analytics. Boeing analyzes data from airline operations and simulates different scenarios to assess the amount of fuel required for a given flight. These comparisons enable airlines to identify and implement opportunities for improvement throughout their operation, using descriptive and diagnostic analytics. More than two dozen airlines use Fuel Dashboard and are reducing fuel use by an average of 4.3 percent, which proportionately lowers carbon dioxide emissions.

We also collaborate on air traffic management modernization efforts to improve airspace efficiency and accommodate the growth in air travel. We engage with airlines, airports and air navigation service providers around the world to integrate our airplanes' onboard capabilities, such as satellite-based navigation, with ground technologies. Our efforts in the United States, Europe, China, Panama and Turkey include analyzing operational and environmental benefits, developing new procedures, and recommending airspace redesigns that can better use our airplanes' capabilities.

In 2016, Boeing collaborated with Delta and United Airlines to fly several unique landing approaches into San Francisco International Airport aimed at reducing flight delays, saving fuel and lowering emissions and noise levels. The improvements come from new satellite-based navigation technology on the airplane and on the ground, which allows for more precise, shorter approaches. In addition to environmental benefits, the technology allows for landing in low visibility, which improves safety and airline reliability.

While flight planning systems identify the most optimal route before take-off, Direct Routes scans real-time operations to ensure optimization continues throughout the flight. Pilots receive advisories on more efficient routings that arise because of changes in wind, air traffic and other factors.

Similarly, Wind Updates provides timely information to pilots during the flight to help them take advantage of the most efficient route or altitude.

These virtually nicotine-free tobacco plants grown by farmers in South Africa served as feedstock for Africa's first flights powered by a blend of sustainable aviation fuel in 2016. (Boeing photo)

SUSTAINABLE AVIATION FUEL

Boeing is an industry leader in fostering sustainable aviation fuel development around the world. Biofuel represents a significant, untapped opportunity to reduce aviation emissions, meet the industry's environmental goals* and support long-term sustainable growth.

*See details on page 4.

The countries shown in white indicate where Boeing is participating in sustainable aviation fuel initiatives. **Click here to enlarge the map and get more detailed information on each country.**

A variety of source materials, or feedstocks, are used to produce sustainable aviation fuels. These feedstocks include waste cooking oil and animal fat, farm and forest residuals, purpose-grown sustainable crops, and waste gases from industrial facilities. Scientific studies have shown that biofuels reduce life cycle emissions by 50 to 80 percent compared with fossil fuel. Biofuels have also been shown to perform as well as or better than petroleum jet fuel while cutting sulfur emissions, soot and particulates.

Boeing works closely with airlines, research institutions, nongovernmental organizations, governments and other stakeholders around the world to advance biofuel development (see map above). All of these efforts adhere to principles established by the Roundtable on Sustainable Biomaterials, which address sustainability's three pillars: social, environmental and economic performance.

Since 2009, the international standards body ASTM has approved five production methods, or pathways, for fuels that are "drop-in" substitutes for petroleum fuels and require no modification to airplanes or engines. Since approval of the first fuel production pathway in 2011, airlines have flown more than 5,000 commercial flights worldwide powered by a blend of biofuel and Jet A. In 2016, Los Angeles International Airport and Norway's Oslo Airport Gardermoen began regularly utilizing biofuel for every departure — an historic first for commercial aviation.

Our collaborations in 2016:

Billion-gallon supply: Worked with fuel producers (including Neste and Renewable Energy Group), the U.S. Federal Aviation Administration and other stakeholders to gain approval for HEFA-Plus. Known as renewable diesel or green diesel when used in ground transport, production exceeds one billion gallons (about 4 billion litres) annually. The fuel's performance was previously tested on the Boeing ecoDemonstrator program's 787 Dreamliner and 757 flight-test airplanes.

Tobacco for fuel: Partnered with South African Airways and Mango to fly Africa's first biofuel flights. The flights were powered by a 30 percent blend of biofuel produced from Solaris, a virtually nicotine-free tobacco plant developed by SunChem SA and supplied by SkyNRG, grown sustainably by farmers in South Africa's Limpopo Province.

Biofuel in Brazil: Powered the ecoDemonstrator flight-test program aboard an Embraer E170 on a biofuel blend made from Brazilian sugar cane. This approved fuel pathway is a proof point for Boeing's strategy of supporting regional biofuel production around the world. Our support in Brazil includes the Boeing-Embraer Joint Research Center for Aviation Biofuels in São José dos Campos.

Salicornia and seawater: The Masdar Institute's Sustainable Bioenergy Research Center (SBRC) launched its pilot facility in Abu Dhabi. The SBRC produces biofuel feedstock from salt-tolerant salicornia seeds and raises shrimp and fish that cleanse and nourish the plants and water. This work helps address the United Arab Emirates' goals to transform coastal deserts into productive farmland. SBRC was founded by Boeing, Etihad Airways, the Masdar Institute and Honeywell UOP.

Salicornia and sludge: Formed a partnership with Mexico's government and AeroMexico to support a biofuel program involving 17 institutions that will consider jatropha, salicornia and sewage sludge as potential feedstocks. This program results from Mexico's biofuel production roadmap called Plan de Vuelo.

Capturing waste for fuel: Partnered with the United Kingdom's Virgin Atlantic and U.S. fuel producer LanzaTech, which has produced 1,500 gallons (5,678 litres) of biofuel made from steel mill waste industrial gases. Ethanol-based Lanzanol, created through a fermentation process, is estimated to reduce carbon dioxide emissions by 65 percent compared with conventional fuel and could be produced globally.

Biofuel on every flight: Participated with the Port of Seattle and Alaska Airlines to complete a $250,000 feasibility study identifying short- and long-term solutions to provide a blend of biofuel on every departure from Seattle-Tacoma International Airport. The study's initial announcement and public discussion of its results signaled further market interest in sustainable aviation fuels to producers.

Employees inspect and clean space solar panels at Spectrolab, a wholly owned Boeing subsidiary in Sylmar, California Spectrolab's solar panels have provided clean electric power to more than 600 satellites and the International Space Station. (Boeing photo)

ENERGY CONSERVATION & EMISSIONS

Boeing takes a life cycle approach to our environmental footprint, which means we look at more than the effects of our products on the planet. We also carefully review how our products are manufactured and the effects of our operations. Reducing factory and facility emissions is a core part of our strategy and focus of innovation.

ALTERNATIVE

TECHNOLOGY PROVIDES SOLUTIONS FOR CLEANER PRODUCTS AND OPERATIONS

From partnering with the Department of Energy in 1974 on pioneering wind-powered generators to developing innovative fuel-cell systems and leading the world in photovoltaic technology, Boeing has long been a leader in developing technology that reduces operational emissions and provides cleaner options for manufacturing.

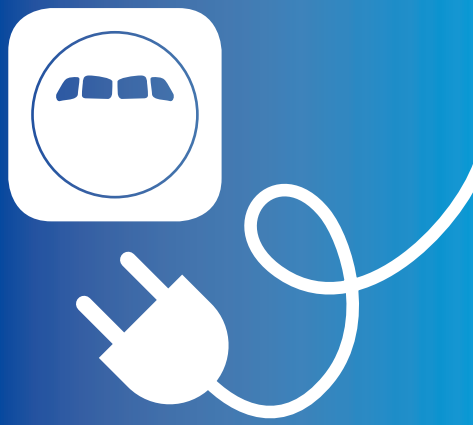
Boeing research in energy technologies and their application has grown in sophistication since the 1970s. Our work raises the bar on energy and resource efficiency standards.

For the past 60 years, Boeing's wholly owned subsidiary Spectrolab Inc. has led the industry in solar-cell technology for both space- and Earth-based applications. Spectrolab is the largest continuously operating solar company in the world and the leading manufacturer of space-qualified multi-junction solar cells and panels.

Boeing's new Solid Oxide Fuel Cell (SOFC) system, now operating in Port Hueneme, California, is demonstrating the sustainable value of using solar power to generate hydrogen gas from seawater. It then stores the hydrogen until it releases the gas into a fuel cell stack to produce electricity, heat and water.

These marketplace solutions are hard at work at Boeing facilities. On-site solar systems provide energy at Boeing plants in North Charleston, South Carolina, and Salt Lake City, Utah; and Boeing is a major purchaser of green power at several of its other facilities. Internal conservation efforts have resulted in significant accomplishments in 2016:

- Over the past five years, as our commercial airplane production has increased by nearly 25 percent, our absolute energy use has decreased by 5.9 percent.
- Achieved absolute energy reduction in 2016 of 802,000 mmbtu (million British thermal units).
- Improved energy efficiency by 13 percent since 2012.
- In 2016, expanded the company environmental engagement platform to include more information on energy, water conservation and recycling efforts to inspire replication.
- Also in 2016, commissioned a new chiller plant at the Everett, Washington, site to support the world's largest building by volume, gaining a 36 percent efficiency improvement.



We reduced our absolute energy consumption in 2016 by enough to power 22,000 average U.S. homes.

WATER MANAGEMENT

Boeing is a careful steward of one of the planet's most precious natural resources: water. In our operations, we focus on innovative ways to protect and improve water quality for the benefit of the environment and the communities where we live and work.

Boeing's leadership in stormwater management includes collaborating with numerous research and nonprofit groups such as The Nature Conservancy, the Washington Stormwater Center, Los Angeles Conservation Corps, Washington State University, the University of Alabama and the University of California, Los Angeles, on technology and green infrastructure solutions that can mitigate storm-water pollution.

OPPORTUNITIES

FOR PARTNERING DRIVE CONTINUOUS INNOVATION

Boeing supports protecting and improving water quality for the benefit of the community and environment. We also share knowledge about stormwater management, source control and restoration for the betterment of the communities where our employees live and work.

We save about 25 million gallons (95 million litres) of water at our Huntington Beach, California, campus by irrigating with repurposed water.

Boeing applies a wide range of water-management strategies in keeping with our unique and long-standing legacy of applying innovative technologies to water conservation. In the early 1970s, for example, Boeing was a pioneer in developing practical, large-scale water purification systems that are still in use around the world to supply clean water to some of the most arid regions on the planet.

That tradition continues today, across our enterprise.

For instance, a Boeing team based in Huntington Beach, California, recently took on the challenge of reusing available water for site irrigation. The team found a way to use the filtered and treated water from the site's groundwater extraction and treatment system to irrigate the grounds. About 80 percent of the 188-acre (76 hectare) campus is now irrigated with this nonpotable, repurposed water.

Boeing has also continued to develop many innovative technologies for natural biofiltration of stormwater. We have considerable experience in various types of water treatment, ranging from advanced treatment like reverse osmosis to sustainable green infrastructure such as biofilters. We also work with experts outside of Boeing to help guide innovative and effective solutions to stormwater management challenges and to improve water quality.

Boeing selects partnering opportunities that generate benefits in the following ways:

- Advance the science and innovative technology of green infrastructure.
- Provide employee and community engagement opportunities.
- Leverage past projects, other partnerships or both.

Projects in 2016 include:

- Continued the research with Washington State University and the Washington Stormwater Center to strengthen permeable pavement with cured carbon fiber composite material.
- Partnered with The Nature Conservancy by funding several green infrastructure application projects in Puget Sound as well as water-wise plant research at an outdoor laboratory in Southern California.
- Funded a rain barrel project for the Snohomish Conservation District (SCD) in Snohomish County, Washington, where the Boeing Everett site is located. The project to assemble rain barrels encouraged water conservation throughout the region and also created an environmentally focused volunteer opportunity for Boeing employees.

  Partnering with SCD has resulted in direct improvement of stormwater management at Boeing sites. For example, SCD shared its expertise in the design and construction of a rain garden at Boeing's Auburn facility.

  SCD honored Boeing with the 2016 Conservation Business of the Year award to recognize Boeing's leadership in stormwater management and the company's permeable pavement research.

Employees at Boeing's South Carolina site use a one-for-one exchange program, which allows them to swap one consumable item, like batteries, headlamps or safety glasses, for a new one. The initiative has reduced consumption of consumables by 50 percent at the site. (Boeing photo)

SOLID WASTE

Today's major manufacturers can be measured by their commitment to optimal management and reduction of solid waste produced by their operations. Boeing is no exception.

Our goal is to stay at or below 2012 levels of waste sent to landfills while continuing to grow our company. In fact, even with revenues up more than 15 percent since 2012, we have reduced our absolute waste to landfills by nearly 19 percent.

The Boeing strategy places priority on reducing the use of resources by designing processes to minimize or reuse materials. When that is not possible, we seek to recycle or compost those materials, or use them as an energy source.

Boeing's Enhanced Recycling program is an example of that strategy in action. At each facility where it has been implemented, Boeing employees separate waste into color-coded bins labeled for mixed recycling, composting, and waste to landfill (or incineration). The system is designed to divert up to 80 percent of waste from landfill or incineration.

Enhanced Recycling is now being used in locations that, added together, house more than 45 percent of our workforce. Plans are in place for extensive expansion of the program by the end of 2017.

The first conservation priority, however, is to find ways to reduce or reuse resources. Boeing has a number of projects that work to make change at the source of waste.

Boeing employs "roaming print" technology on 4,200 network office printers (and growing). By only printing jobs when an employee actually goes to the printer to pick it up, Boeing has reduced unnecessary printed paper as well as reducing energy use and using fewer toner cartridges.

Boeing Supplier Management is adding more stringent oversight to purchasing of nonproduction products and services. To date, this process change has resulted in a 35 percent reduction in orders processed.

As we use more carbon fiber to develop lighter aircraft and reduce product emissions, we are finding ways to reduce excess material creation. We are calibrating our production processes to use less material. We're exploring and implementing ways to reuse or recycle the remaining material.

Currently, we sell uncured material on our surplus sales website at below-market cost. We're also collaborating with business partners to test ways to recover and recycle fibers. (Cured carbon fiber presents a greater challenge because of manufacturing requirements and technology barriers.)

Boeing is also reducing materials through additive manufacturing. This is a process of creating an object by adding material, usually layer upon layer (like 3D printing), whereas subtractive manufacturing methodologies cut material away, resulting in greater waste.

These processes significantly minimize volumes of excess materials. Robotic Automated Fiber Placement (AFP) and similar technologies enable better use of material and more efficient fabrication of large-scale parts at higher production rates.

"Roaming print" technology at Boeing's network printers reduces wasted paper by 800,000 sheets per year.

A large suspended tool applies carbon fiber tape to fabricated aircraft parts at Boeing's Composite Manufacturing Center in Frederickson, Washington. The center has reduced waste by using less composite material upfront. (Boeing photo)

INNOVATION

IS USED TO REDUCE WASTE GENERATION AT THE SOURCE

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 those 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.

Since 2009, the number of annual events to celebrate Earth Day and World Environment Day increased by 345 percent. In 2016, employees participated in more than 240 such events in 19 countries. (Boeing photo)

FOOTNOTES

Footnotes for Performance Summary Chart and Graph

- "Environmental fines" represent total fines paid in 2012, 2013, 2014, 2015 and 2016, 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 Phoenix, Arizona (Data Center), are included.
- 1 metric ton = 2,204.62 pounds.
- Carbon dioxide equivalent, or CO_2e, means the number of metric tons of CO_2 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.
- 2014–2015 emission numbers are recalculated based on new eGRID2014 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 eGRID sub-region 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: 1,381,000 tons (1,252,000 metric tons) CO_2e (2016).
- RECs were applied to the GHG calculation for the following locations: North Charleston, South Carolina, and Renton, Washington. In 2016, these Boeing locations made arrangements to purchase RECs to offset around 147,000 tons (133,000 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 *continued*

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 2015–2016 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 carbon dioxide (CO_2e).

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, CO_2 emissions from Boeing subsidiary Jeppesen U.K. Ltd. and Aviall U.K. Inc. are included in the Boeing U.K. CRC report.

Fourteen sites report TRI and NPRI releases and transfers: Auburn, Washington; Charleston, South Carolina; El Paso, Texas; El Segundo, 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; and Winnipeg, Canada.

2016 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 1,696 buildings in 42 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 CO_2e, means the number of metric tons of CO_2 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 Australian National Greenhouse and Energy Reporting Act 2007
  - The United Kingdom's CRC Energy Efficiency Scheme
- Scope 2 emissions are calculated using the market-based method. Location-based method calculated emissions are 1,183,000 tons (1,074,000 metric tons) CO_2e. 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 2016, these Boeing locations made arrangements to purchase RECs to offset around 146,000 tons (132,000 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 *CO_2 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)
Australia	**Australian Capital Territory** Canberra **New South Wales** Bankstown Sydney Williamtown Yerriyong **Northern Territory** Gladesville **Queensland** Alderley Archerfield Brisbane Cairns Coominya **South Australia** Adelaide **Victoria** Melbourne Mentone Tullamarine **Western Australia** Jandakot
Bahrain	Manama
Belgium	Brussels
Brazil	**Distrito Federal** Brasília **São Paulo** Sao José dos Campos São Paulo
Canada	**Alberta** Calgary **British Columbia** Richmond Vancouver **Manitoba** Winnipeg **Ontario** Mississauga Ottawa

Footnotes *continued*

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

Country	State/City (Site)
Canada	Montréal
China	Beijing Hong Kong Shanghai
Denmark	Copenhagen
Egypt	Cairo
Ethiopia	Addis Ababa
France	Blagnac Paris Roissey-en-France
Germany	Berlin **Bavaria** Munich **Hesse** Neu-Isenberg **North Rhine-Westphalia** Cologne
Greece	N. Smirni
Hungary	Papa
India	**Andhra Pradesh** Hyderabad **National Capital** New Delhi
India	**Karnataka** Bangalore **Maharashtra** Navi Mumbai **Tamil Nadu** Chennai
Ireland	**Leinster** Banbridge Dublin
Israel	Tel Aviv
Italy	Massa Rome
Japan	**Chubu** Nagoya Tokoname
Japan	**Tokyo** Tokyo **Kanto** Yokohama
Kazakhstan	Almaty
Kenya	Nairobi
Korea	Seoul Yeongcheon-si
Luxemburg	Luxemburg
Malaysia	Kuala Lumpur
Mexico	Mexico City
Netherlands	Amsterdam Nieuw Vennep Schiphol-Oost, Noord-Holland
New Zealand	Auckland
Norway	Egersund
Oman	Muscat
Poland	Gdańsk Warsaw
Qatar	**Doha**
Russia	Moscow Skolkovo St. Petersburg Tyumen
Saudi Arabia	Riyadh
Singapore	Singapore
South Africa	Johannesburg
Spain	Madrid Villacarrillo
Sweden	Göteborg Stockholm
Taiwan	Taipei
Turkey	Ankara Istanbul
Ukraine	Kiev
United Arab Emirates	**Abu Dhabi** Dubai
United Kingdom	**England** Bristol Camberley Corsham Crawley Farnborough Feltham Fleet Gatwick Gosport Knaresborough London Milton Keynes Oxford Stockport Welwyn Garden City Yeovil **Scotland** Perth
United States	**Alabama** Daleville Huntsville Madison **Alaska** Anchorage **Arizona** Mesa Phoenix **California** Costa Mesa El Segundo Huntington Beach Long Beach Mountain View Palmdale Pleasanton Rancho Cucamonga Sacramento San Diego San Jose San Luis Obispo San Mateo
United States	**California (cont.)** Santa Susana Santee Seal Beach Sylmar Taft Torrance Van Nuys Ventura Victorville **Colorado** Aurora Centennial Colorado Springs Englewood **Connecticut** East Windsor **Florida** Cape Canaveral Fort Walton Beach Ft. Lauderdale Jacksonville Kennedy Space Center Miami Orlando Shalimar Tampa Titusville **Georgia** Atlanta College Park Macon Peachtree Warner Robins **Hawaii** Honolulu Kihei **Illinois** Chicago Fairview Heights Mascoutah Rolling Meadows Schaumburg St. Charles Swansea

Footnotes *continued*

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

Country	State/City (Site)
United States	**Indiana**
	Crown Point
	Gary
	Kansas
	Kansas City
	Wichita
	Louisiana
	Bossier City
	Lafayette
	Maine
	Bangor
	Maryland
	Aberdeen Proving Ground
	Annapolis Junction
	California
	Germantown
	Patuxent River
	Massachusetts
	Lexington
	Michigan
	Waterford
	Minnesota
	Eagan
	Mississippi
	Starkville
	Missouri
	Berkeley
	Bridgeton
	Earth City
	Florissant
	Fort Leonard Wood
	Hazelwood
	Maryland Heights
	Portage Des Sioux
	St. Charles
	St. Louis
	Montana
	Glasgow
	Helena
	Nebraska
	Omaha
	Nevada
	Las Vegas

Country	State/City (Site)
United States	**New Jersey**
	Berkeley Heights
	Parsippany
	New Mexico
	Albuquerque
	New York
	New York
	North Carolina
	Fayetteville
	Havelock
	Kings Mountain
	Morrisville
	Ohio
	Brookpark
	Cincinnati
	Fairborn
	Heath
	Oklahoma
	Oklahoma City
	Oregon
	Arlington
	Boardman
	Gresham
	Hood River
	Portland
	The Dalles
	Wilsonville
	Pennsylvania
	Eddystone
	Langhorne
	Lemont Furnace
	Pittsburgh
	Ridley Park
	Smithfield
	South Carolina
	Charleston
	Ladson
	North Charleston
	Tennessee
	Cordova
	Memphis
	Texas
	Austin
	Dallas

Country	State/City (Site)
United States	**Texas (cont.)**
	Dyess AFB
	El Paso
	Houston
	Irving
	Richardson
	San Antonio
	Universal City
	Utah
	Hill AFB
	Layton
	Salt Lake City
	West Jordan
	Virginia
	Arlington
	Chantilly
	Fairfax
	Herndon
	Leesburg
	Newington
	Newport News
	Virginia Beach
	Washington
	Anacortes
	Auburn
	Bellevue
	Bingen
	Bothell
	Enumclaw
	Everett
	Issaquah
	Kent
	Moses Lake
	Mukilteo
	Olympia
	Puyallup
	Quincy
	Renton
	SeaTac
	Seattle
	Tukwila
	Vancouver
	White Salmon

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