Digital factory of the future

Boeing is utilizing an industry-leading technology to transform the way we design, test and build airplanes. Today, Boeing engineering teams are studying how recent lessons learned from across the company could shape the factory of the future — with digital transformation as a major driver.

Why it matters: Stability and optimized performance is happening.

- Boeing's T-7A Red Hawk team was able to build the first several aircraft in simulations before production even started and then join the aft and forward fuselages in less than a half-hour, a process that would normally take days.
- Although commercial airplanes are larger and production requirements are different from military aircraft, Boeing teams will apply those learnings to future programs. That knowledge, combined with more than a century of development experience on other programs, will guide future production.

It comes down to this: This will enable Boeing to predict performance of the production system and see how changes in the airplane design affect that performance, or vice versa. It will also allow teams to "build" the first several aircraft in a simulation, flattening the learning curve. Supplier readiness and success around first-time quality enables Boeing to operate more sustainably as a business.

By driving quality within the supply chain, Boeing demonstrates its commitment to sustainability by reducing rework and/or delayed parts in the value stream to minimize time lost and waste.

Video: Take a look at our future factory.

"Creating a digital twin of our factory operations will help to increase stability and optimize performance prior to physically building a product. We have long used models to predict aircraft performance and refine them with test data as it comes available. Similarly, we will build models to predict production system performance and refine them as systems come online."

Howard McKenzie, chief engineer and executive vice president of Engineering, Test & Technology

A simulated view of what a future commercial factory could look like. The concept builds off of lessons learned from how the T-7A program operates in St. Louis — no fixed tooling, no holding fixtures. The part becomes the tool, which is a revolutionary concept. (Boeing image)

Sustainable Operations

Boeing appreciates sustainable aerospace starts inside our four walls. We are focused on continuous improvements in pursuit of the sustainable product life cycle across key elements including greenhouse gas emissions (Scope 1 and Scope 2), energy usage, water and waste management. We take action to decrease our impact through renewable energy procurement, targeted infrastructure and equipment investments, efficiency standards and conservation initiatives that include deployment of best practices and employee engagement strategies. Core to this strategy is the ongoing engagement of our employees each year through education and initiatives focused on ways in which they can reduce their environmental impact at work, and at home. Boeing's environmental strategy is guided by a comprehensive review and assessment of the most significant environmental challenges and risks facing the company, and our environmental priorities are set with internal and external stakeholders. The analysis includes direct input and perspectives on industry best practices and community requirements from diverse stakeholders, such as customers, environment-focused nongovernmental organizations (NGO) and the company's global leadership. The information helps Boeing identify and update our understanding of current and emerging sustainability issues that are critical to the company and our stakeholders. It also informs our next-generation environmental strategy and targets.

Since 2020, Boeing has achieved net-zero GHG emissions at manufacturing and work sites by expanding conservation and renewable energy use while securing carefully selected, third-party-verified offsets for the remaining greenhouse gas (GHG) emissions.

787 final assembly. (Boeing photo)

Operational Targets Progress

Boeing invests in sustainable operations to reduce the impact of our manufacturing sites and is focused on conserving resources. We prioritize reducing emissions, energy, water and waste throughout our global operations and have set 2025 waypoints toward 2030 goals to share our progress and remain accountable as we increase production. Boeing's sustainable operations strategy is managed within the Global Enterprise Sustainability organization, in close partnership with stakeholders across the enterprise. Through our Sustainable Operations subcouncil, we track performance across the enterprise and at the site level to assess our progress, identify challenges and opportunities, and share best practices.

Performance Area[1]	2025 Targets vs. 2017[2]	2022 Progress Toward 2025 Targets and Drivers	2030 Targets[3]
Greenhouse Gas Emissions	Reduce emissions by 25%[1]	**31% Reduction** Procurement of renewable energy and renewable energy credits, low commercial production activity and infrastructure investments.	• Net-zero emissions.[4] • 55% GHG reduction from 2017. • 100% renewable electricity.
Energy[5]	Reduce energy consumption (natural gas, other fuels and electricity) by 10%	**11% Reduction** Conservation initiatives, infrastructure investments, remote working conditions and reduced production activity.	• 10% energy reduction from 2025.
Water[6]	Reduce water withdrawal by 20%	**19% Reduction** Increased water intake efficiencies and low production activity.	• 5% reduction from 2025.
Solid Waste[7]	Reduce solid waste to landfill by 20%	**40% Reduction** Conservation initiatives, vendor management and remote working conditions.	• 30% reduction in solid waste produced from 2025. • Over 90% diversion from landfill or incineration. • Zero solid waste to landfill certification where applicable at major sites.
Hazardous Waste[8]	Reduce hazardous waste by 5%	**9% Reduction** Projects to reduce unused and expired materials, and partnerships to reduce waste generation.	• 5% hazardous waste reduction from 2025.

1. Operational goals shown are absolute targets and not indexed to production levels or growth. 2022 performance was affected by changes associated with occupancy and operations during the COVID-19 pandemic, as well as conservation and changes in how Boeing purchases energy. The targets were established against a 2017 base year. The 2025 goals will act as a milestone to guide actions and progress to the 2030 goals.
2. All 2025 reduction goals were set with an operational boundary of the Core Metric Sites, which represent the majority (70%) of Boeing's operations, and includes emissions from electricity use and natural gas.
3. The 2030 reduction goals set with an operational boundary of The Boeing Company and includes all Scope 1 and Scope 2 emissions.
4. The net-zero achievement covers Scope 1 and Scope 2 emissions for all manufacturing and work sites within the company's operational control as well as Scope 3, business travel. This is achieved by expanding conservation and renewable energy use while securing carefully selected, third-party-verified offsets for the remaining greenhouse gas (GHG) emissions.
5. Energy includes natural gas, other fuels and electricity.
6. Water data represents approximately 84% of operations square footage.
7. Solid waste numbers represent values determined from scale-weighed containers as well as calculated weights. Nonhazardous solid waste is sent to landfill for disposal. This measure applies to all waste streams where Boeing is responsible for waste disposal service as a normal part of daily operations (excludes remediation and construction-related waste).
8. Hazardous waste is determined from U.S. EPA hazardous manifest or equivalent government shipping documents. All types of hazardous wastes that are generated at a facility and are discarded from the site for disposal, and would be considered part of the environmental footprint of the site. Actual tons of all Production or routine wastes shipped as hazardous waste (excludes remediation and construction-related waste).

Addressing Climate Change

We consider climate change to be an urgent issue. We support the goals of the Paris Agreement and encourage our value chain partners to do the same. Boeing achieved net-zero carbon emissions at manufacturing and other work sites and in business travel in 2022 for the third consecutive year, by expanding conservation and renewable energy use while securing carefully selected, third-party-verified offsets for the remaining greenhouse gas (GHG) emissions. Boeing strives to reduce operational GHG emissions, both during times of growth and during times of challenge. Our strategy for Scope 1 and Scope 2 emissions, which we detail in the following section, aligns to a 1.5 degrees Celsius global warming potential scenario, in support of the global climate goals.

To achieve our goals related to the climate and to GHG, we actively monitor emissions, fuel use and energy efficiency. We have set 2030 targets for performance in each of these areas that aim to reduce absolute emissions, maintain net-zero emissions for Scope 1 and Scope 2, and increase our adoption of renewable energy sources. As part of Boeing's business continuity program, we also monitor the length and severity of business interruptions. The scope of monitoring includes damaging weather, natural disasters, pandemics and public health crises. It helps us understand how to increase resiliency in light of a changing climate.

Enterprise GHG emissions from operations are calculated after the conclusion of the reporting year. However, the emissions from natural gas and electricity usage at Core Metric Sites are calculated and monitored on a monthly basis through the use of utility bills and are continuously validated and updated throughout the reporting year. The emissions factors for these energy sources are validated at least annually and updated when appropriate following guidance from the World Resources Institute GHG Protocol. The energy data and emissions factors are verified as part of a third-party limited assurance process.

For the third year in a row, Boeing has achieved net-zero GHG emissions at manufacturing and work sites by implementing high-impact conservation investments, emphasizing and incentivizing conservation practices by employees, and increasing renewable electricity use while securing carefully selected, third-party-verified offsets for the remaining GHG emissions.

In 2022:

- **2025 GHG Target Progress:** Boeing had a 31% reduction in GHG emissions compared to 2017. GHG emissions were 8% lower than anticipated for the year. Procurement of renewable energy and renewable energy credits, low commercial production activity and infrastructure investments contributed to reduction in emissions from the operational footprint. The implementation of long-lasting infrastructure improvements and the contracting of renewable energy allow us to build on emissions reductions each year.
- **2025 Energy Reduction Target Progress:** Boeing had a 11% reduction in energy consumed compared to 2017. Energy consumption was 6% lower than anticipated for the year due to the impact of conservation initiatives, infrastructure investments, remote work and reduced production activity.

Boeing's Pollinator Prairie in Kansas. (Boeing photo)

"Sustainability is something everyone should be thinking about. What kind of planet do you want to leave behind for future generations?"

Gregory Kurth, Mesa site facility maintenance engineer, Facilities & Asset Management

Boeing facilities prioritize conservation, energy efficiency and renewable energy

As energy consumption gives rise to GHG emissions, conservation and energy reduction measures help achieve both energy and GHG reductions.

Creating sustainable facilities:

Germany: Boeing's new distribution center in Hamburg meets high sustainability standards and will be seeking Gold certification from the German Sustainable Building Council. To minimize the environmental footprint, the building is equipped with a heat pump and a photovoltaic system will be installed on the roof in the later half of 2023.

U.S.:

- Mesa, Arizona, recently completed construction of a new composites manufacturing facility. A quarter of the electricity used at the site is solar power. This partnership between Boeing and the Salt River Project brings the company closer to achieving its 2030 goal of 100% renewable electricity.
- Switching to LED lighting in Boeing's Everett, Washington; Frederickson, Washington; and El Segundo, California, facilities is driving an annual recurring savings of 25.3 million kilowatt-hours, which is equivalent to powering more than 2,300 U.S. homes per year.

India: Boeing's new engineering and technology campus in Bengaluru will leverage multiple design elements, including efficient ventilation systems, LED lighting, rainwater recovery and solar power generation.

Boeing expanded its strong presence in Europe with a new state-of-the art distribution warehouse near Hamburg, Germany. (Boeing photo)

It comes down to this: Boeing will continue to invest in conservation and renewable energy projects to advance the company's operational environmental goals.