

- Contents
- Introduction
- Approach & Governance
- People
- Products & Services**
 - Global Aerospace Safety
 - Sustainable Product Life Cycle
 - Innovation and Clean Technology
 - Fleet Renewal
 - Operational Efficiency
 - Renewable Energy
 - Advanced Technology
 - Partnerships
- Operations
- Communities
- Reporting

Fond childhood memories propel a passion for possibility and sustainable fuel

Boeing’s SAF feedstock expert Onofre Andrade witnessed the transformative economic power sustainable biofuels had on his job-deprived rural village, while growing up in central-west Brazil.

When he was a young boy, his father joined with other farmers to form a co-operative that built a sugar cane ethanol plant. It still operates today. Prior to this co-op being developed, the sole source of jobs was farm labor.

“The sugar cane ethanol co-op provided much-needed jobs, and that sparked hope in the lives of many people I care about,” said Andrade. “The success of the ethanol plant catalyzed other co-ops and sparked capacity-building opportunities — including a co-op-led school started by my mother.”

Andrade joined Boeing before SAF was a hot topic, but his early experience continues to give purpose to him and his family.

Boeing’s SAF feedstock expert Onofre Andrade was inspired by seeing good jobs come to his rural village in Brazil when his father started a sugar cane ethanol co-op. (Onofre Andrade photo)

“I hope to inspire my kids the way my dad inspired me.”

Onofre Andrade, sustainable aviation fuel feedstock expert



Carissa Pajel at Boeing SAF lab. (Boeing photo)



Peter Nease and Clarence Santiago fueling ecoDemonstrator with SAF. (Boeing photo)

Advanced Technology

To meet the commercial aviation industry’s net-zero ambition by 2050, it will take an approach that includes SAF and other advanced technologies. Boeing has extensive experience on the “and,” through research, studies, testing and partnerships. The future of flight will incorporate the latest digital design, test and production tools, airframe, propulsion and systems technology, and different power and energy solutions will apply to different market segments and aircraft sizes.

Informed by the company’s extensive evaluation and testing of alternative propulsion sources and renewable energy and its research partnerships, and supported by Boeing’s expertise in commercial aircraft design and history of innovation on alternative energy and propulsion systems, Boeing has launched a new effort to conceptually design and assess the potential environmental impacts of “Future Flight Concepts.” These concepts are exploring applications of technologies including electrification and alternative fuels, such as hydrogen.

NASA awards sustainable flight program to Boeing and partners

In January 2023, NASA selected Boeing and its industry team to lead the development and flight testing of a full-scale Transonic Truss-Braced Wing (TTBW) demonstrator airplane through the Sustainable Flight Demonstrator (SFD) program. Through this unprecedented public-private partnership with NASA, Boeing and its industry partners are contributing more than half of the funding needed to shape the demonstrator program.

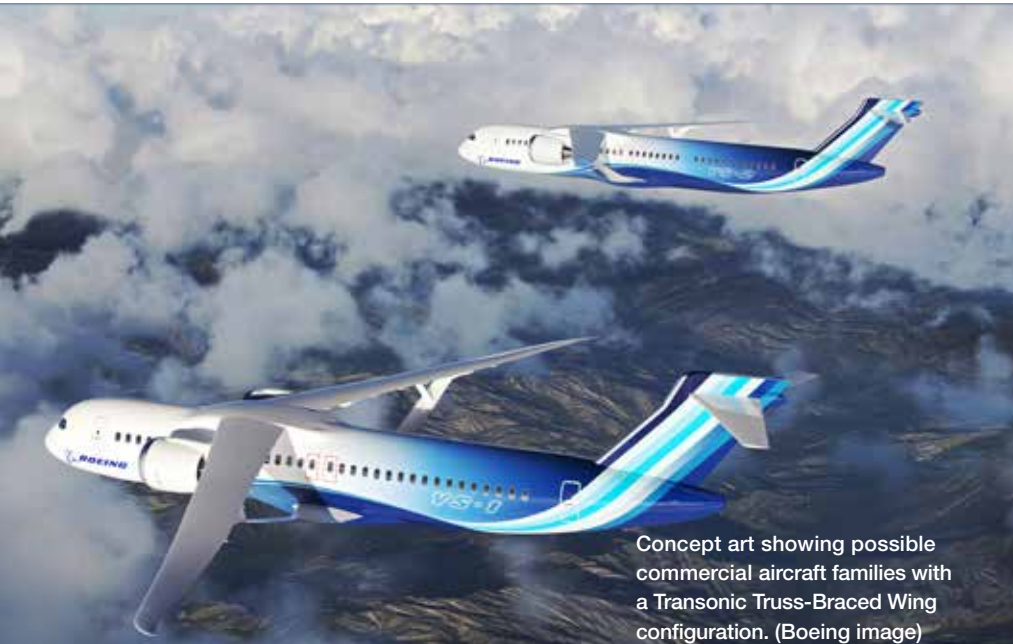
Why it matters: The technologies demonstrated and tested will inform future designs and could lead to breakthrough aerodynamics and fuel efficiency gains.

When combined with expected advancements in propulsion systems, materials and systems architecture, a single-aisle airplane with a TTBW configuration could see reduced fuel consumption and emissions of up to 30% relative to today’s most efficient single-aisle airplanes, depending on the mission.

Years in the making: The TTBW airframe concept is the result of more than a decade of development supported by NASA, Boeing and industry investments. Under previous NASA programs, including the agency’s Subsonic Ultra Green Aircraft Research program, Boeing conducted extensive wind tunnel testing and digital modeling.

“One of the key outputs of this activity is really the learning, the knowledge. What at the integrated airplane level ... will the benefits be? And depending on the results of this effort, and market conditions — that’ll dictate whether this shows up on a future commercial product.”

Todd Citron, Chief Technology Officer



- Contents
- Introduction
- Approach & Governance
- People
- Products & Services
 - Global Aerospace Safety
 - Sustainable Product Life Cycle
 - Innovation and Clean Technology
 - Fleet Renewal
 - Operational Efficiency
 - Renewable Energy
 - Advanced Technology
 - Partnerships
- Operations
- Communities
- Reporting

Wisk unveils self-flying, eVTOL aircraft

Wisk, a technology joint venture, is developing its 6th Generation aircraft. Designed with the **highest safety standards**, it will be the first candidate for certification of an autonomous, passenger-carrying electric vertical takeoff and landing (eVTOL) aircraft in the U.S. The Gen 6 aircraft has room for four passengers, carry-on luggage and personal items, can fly 90 miles (145 kilometers) and recharges in 15 minutes.

Why it matters: Wisk will be the first candidate for certification of an autonomous, passenger-carrying electric vertical takeoff and landing (eVTOL) aircraft in the U.S.

“Wisk is excited to partner with Boeing on the development of this autonomous aircraft. Our combined experience uniquely positions Wisk to succeed in this exciting new mobility market.”

Brian Yutko, CEO, Wisk



Wisk 6th Generation autonomous, passenger-carrying electric vertical takeoff and landing aircraft. (Wisk photo)



Space Launch System in flight.
(Boeing image)

Taking a SAF and other advanced technology approach

It will take a “SAF and” approach, not a “SAF or” approach, to achieve the **commercial aviation industry’s net zero ambition by 2050**. As part of our approach, which includes **SAF and other technologies**, Boeing continues to advance the **safety and viability of other energy carriers and their use on aircraft**. Since the mid-2000s, Boeing has conducted **six hydrogen technology demonstrations with crewed and uncrewed aircraft using hydrogen fuel cells and combustion engines**. Boeing successfully tested a cryotank designed for space with the capacity to hold 16,000 gallons of **liquid hydrogen** or the energy equivalent of the Jet A fuel in a typical regional jet.

Boeing was reminded of the challenges and opportunities associated with hydrogen with the recent Artemis mission. Chris Raymond, Boeing’s chief sustainability officer dives into more detail in this [Fortune article](#).

- Contents
- Introduction
- Approach & Governance
- People
- Products & Services
 - Global Aerospace Safety
 - Sustainable Product Life Cycle
 - Innovation and Clean Technology
 - Fleet Renewal
 - Operational Efficiency
 - Renewable Energy
 - Advanced Technology
 - Partnerships
- Operations
- Communities
- Reporting

Sustainability test bed turns 10

The Boeing ecoDemonstrator marked its 10-year anniversary in 2022 — accelerating innovation by taking promising technologies out of the lab and rigorously testing them in an operational environment.

By the numbers:

The program has tested over 225 technologies to help enhance safety, decarbonize aviation and improve operational efficiency and the passenger experience.

- Nine platforms served as flying test beds:
 - 2012: American Airlines 737-800.
 - 2014: Boeing 787-8 Dreamliner.
 - 2015: TUI 757.
 - 2016: Embraer E170.
 - 2018: FedEx 777 Freighter.
 - 2019: Boeing 777-200.
 - 2020: Etihad Airways 787-10.
 - 2021: Alaska Airlines 737-9.
 - 2022-2024: Boeing 777-200ER (Extended Range).
- Approximately one-third of those technologies progressed onto Boeing’s products and services, including:
 - More aerodynamically efficient winglets on the 737 MAX.
 - iPad apps that provide real-time weather and other information to pilots, enabling them to improve fuel efficiency and reduce emissions.
 - Custom approach path information to lower community noise.
 - Flight deck touch-screen displays and a camera system on the 777X that will enhance safety by helping pilots avoid ground obstacles.



“I am proud of the ecoDemonstrator’s role in pioneering the use of sustainable aviation fuel (SAF) for the industry. Not only has almost every one of our platforms flown on SAF, we conducted the industry’s first commercial flight on 100% SAF in both engines in 2018 with FedEx Express and tested SAF emissions with NASA. That is what we do — partner across the industry to help safely decarbonize aerospace.”

Rae Lutters, ecoDemonstrator program manager

The 2022 Boeing ecoDemonstrator, a 777-200ER (Extended Range) flies on a blend of 30% SAF and 70% conventional jet fuel. (Boeing photo)

 **Video:** [See flying lab.](#)

- Contents
- Introduction
- Approach & Governance
- People
- Products & Services
 - Global Aerospace Safety
 - Sustainable Product Life Cycle
 - Innovation and Clean Technology
 - Fleet Renewal
 - Operational Efficiency
 - Renewable Energy
 - Advanced Technology
 - Partnerships
- Operations
- Communities
- Reporting

Partnerships

Boeing partners for a clean energy economy

Throughout 2022, Boeing joined forces with innovative partners from around the world to scale renewable energy and sustainable technologies for a more sustainable aerospace and future.

Why it matters: Boeing is aware that no one entity can decarbonize the commercial aviation industry alone. It will take “everyone” to achieve the industry’s net zero ambition by 2050. We recognize the significant capital investment required in the journey and appreciate the partnership and support of the financial community to channel liquidity into the ongoing transition pathway.

- **Avolon and SkyNRG:** Boeing partnered with Avolon, ORIX Aviation, SFS Ireland and SkyNRG to identify opportunities for a commercial-scale SAF production facility in Ireland. The country is a global leader in aviation finance and airline operations with a planned growth of renewable energy sources. The study will be completed in 2023.
- **Alder Fuels:** Boeing has committed to support testing and qualification of Alder Fuels-derived SAF on its airplanes to further grow the global SAF market. This technology enables the conversion of sustainable forest and agricultural residues into a low-negative carbon “greencrude” for jet fuel conversion — displacing the typical jet fuel need by up to 75% in the U.S. The first plant will be completed in 2024.
- **ACT FOR SKY:** Boeing is a member of ACT FOR SKY, a voluntary organization of 19 companies that works to commercialize, promote and expand the use of SAF produced in Japan.



At the Farnborough Airshow in June 2022, Boeing and Mitsubishi Heavy Industries announced we will build on our decades-long partnership. (Boeing photo)

- **Mitsubishi Heavy Industries (MHI):** Building on their decades-long partnership, Boeing and MHI agreed to study sustainable technologies for a low-carbon society. Their focus areas include green hydrogen, carbon capture, electrification, sustainable materials, emissions propulsion technologies, new aircraft design concepts as well as new feedstocks and technologies for SAF production.
- **NASA:** Boeing and NASA continued their partnership testing the emissions from SAF. This year, the team conducted tests on the 2022 Boeing ecoDemonstrator, a 777-200ER (Extended Range) with Rolls-Royce Trent 800 engines and a 787-10 with GENx-1B engines ([see Page 44](#)).
- **Rocky Mountain Institute and Five U.S. Airlines:** Boeing, along with five major U.S. airlines and others, joined the Contrail Impact Task Force led by the Rocky Mountain Institute to explore the formation, impact, and mitigation of persistent condensation trails, or “contrails,” and their climate effects.
- **Roundtable on Sustainable Biomaterials (RSB):** Boeing has been a member of the Board of Directors since 2021 and has chaired RSB’s SAF Policy Platform to advance stakeholders’ collaboration on renewable energy.
- **SpiceJet, Council of Scientific and Industrial Research-Indian Institute of Petroleum (CSIR-IIP):** Boeing partnered with these organizations to explore SAF use in India, supporting the country’s environmental goals and self-reliance initiative. Boeing is currently assisting in the certification process for SAF developed by CSIR-IIP by providing review and support.
- **Virgin Atlantic:** In December 2022, partnering with Boeing, Virgin won the UK Department for Transport’s 100% SAF Trans-Atlantic Flight Fund Competition. This UK government initiative, which will see a 787 cross the Atlantic on 100% SAF in 2023, will showcase the spectrum of sustainable aviation approaches to the flying public and inform our journey toward routine commercial industry 100% SAF flights by 2030.

What’s next: The commercial aviation industry’s ambition is to achieve net-zero carbon emissions for global civil aviation operations by 2050, while also growing the societal benefits of air transportation. Boeing will continue to work across sectors and industry to ensure the benefits of aerospace remain available for generations to come.