

# Movement improvement

Commercial Airplanes takes  
'design for the environment' approach

By DEBBY ARKELL

Which is more fuel efficient, jet travel or auto travel? The answer might surprise you. Motorized travel in all its forms has an effect on the environment. Jet travel is no exception. Boeing continues to design and improve its products to mitigate impact and since the late 1990s has taken a strategic approach to its environmental efforts. These improvements can be called "green" not only because they're better for the environment, but also because they help the company's financial bottom line.

While technological improvements greatly contribute to better environmental performance for air travel, it doesn't stop there. Partnerships with businesses, agencies and industries worldwide also are fundamental to Boeing's environmental efforts.

"We are all responsible for taking the initiative and taking the lead on environmental issues," said Nicole Piasecki, Boeing Commercial Airplanes vice president of Marketing and Business Strategy, at an environmental conference earlier this year in Geneva. "As individual stakeholders, we each have unique leadership roles to play."

Four strategies stand out as major factors in making the next generation of air travel even greener:



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**FUEL EFFICIENCY**

With oil prices hovering at record highs, carriers are paying close attention to fuel efficiency, which is a major driver in airplane purchase decisions.

Commercial airliner fuel efficiency has improved more than 70 percent over the last 40 years, which cuts carbon dioxide emissions. Still, Boeing is taking every opportunity to improve fuel use further.

Long-term, Boeing is advocating research into more efficient and more available fuels such as hydrogen, ethanol and other biofuels. Greater fuel efficiency can be achieved in the near term through better airplane designs, helping airlines operate efficiently and helping develop more-efficient air-traffic-management systems.

“Boeing’s newly designed products—namely the 787 and 747-8—have fuel efficiency built in,” said Bill Glover, Commercial Airplanes Environmental Performance Strategy director. According to Glover, studies show the 747-8 and 787 airplane families will have fuel efficiency comparable to other forms of mass transit—and will be significantly more fuel-efficient than traditional automobiles, at levels comparable to hybrid vehicles (see chart below).

How carriers operate their aircraft also affects fuel consumption. Commercial Airplanes’ product strategy clearly supports lower fuel consumption, as point-to-point travel can save 25 percent or more in fuel over hub-and-spoke flight patterns. Takeoffs and landings use the most fuel, and the hub-and-spoke connecting flights entail more takeoffs and landings.

The most immediate means of reducing aviation emissions of all types comes from improving efficiency of air-traffic-management systems. For instance, according to the Intergovernmental Panel on Cli-



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**Chevrans, the jagged edges on the rear of engine nacelles, ultimately reduce jet rumble noise for the community during takeoff. Their development represents one of many efforts Boeing is involved in to reduce noise.**

mate Change, if airlines were allowed to fly the most direct routes and spend less time in holding patterns, fuel burn and emissions could be reduced 6 to 12 percent.

“We’re actively working with air traffic management groups, airports, the [U.S.] Federal Aviation Administration, Eurocontrol and airlines to help develop and implement guidelines that enhance procedures for arrival and departures,” said Glover.

**QUIET, PLEASE**

Ask anyone who lives or works near an airport: Noise can affect the quality of life of those nearby. That’s why Boeing has worked with customers and suppliers on a program called the Quiet Technology Demonstrator to reduce airplane noise—both inside the cabin and in the community.

“Most noise stems from a form of turbulence,” said Belur Shivashankara, QTD program manager. “Any time air doesn’t flow smoothly around an airplane, it reduces the airplane’s efficiency. Noise reduction efforts really are a motivator to build a better airplane.”

Working closely with technology partners, the QTD program has yielded efficient, quiet design solutions for the 787 and 747-8. One solution is to build the sound-absorbing acoustic engine inlet nacelle barrel in one piece without joints. In current airplanes, the inlet acoustic barrel is built in two pieces and joined together. The new liner dramatically lowers forward cabin noise and community noise—and it weighs less, to boot.

Boeing, General Electric and NASA also have partnered on a new design for the rear of engine nacelles, called chevrons. These jagged edges affect the way air mixes when

**Easy does it**

How fuel-efficient is air travel? The Boeing 787 and 747-8 airplanes will be comparable to other forms of mass transportation—and significantly better than most automobiles.

Vehicle	Liters of gas used per 100 passenger kilometers *
Sport utility vehicle	10.7
Car	6.4
Train	2.0–3.8
747-8	2.5–3.7
787	2.3–3.6

\* A passenger kilometer represents moving one person a distance of one kilometer.



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All Nippon Airways last year let Boeing use one of its 777-300ER (Extended Range) airplanes to gather data on airplane noise and test technologies that would help reduce it—such as chevrons seen here at the back of the nacelle and the engine exhaust nozzle.

coming from an engine's exhaust, reducing turbulence and therefore noise. Chevrons ultimately reduce jet rumble noise during takeoff, as well as reduce the low-frequency rumble heard in the aft cabin.

"The QTD programs have helped Boeing and its partners develop new low-noise solutions for both the cabin and the community," said Shivashankara.

#### USING RESOURCES WISELY

Boeing researchers are also focused on using less-toxic materials in manufacturing and maintenance, and improving production processes at the same time.

Commercial Airplanes' production system transformation has resulted in positive environmental effects by eliminating waste and reducing the use of energy and chemicals—at Boeing, within the supply chain, and in its customers' maintenance activities. Boeing research and development groups continuously evaluate alternative materials both in the lab and in the field for durability and usability.

"We're looking into a replacement for materials such as chrome, copper, beryllium and cadmium," said Robin Bennett, Environmental Performance Strategy team member. "These are some materials

Boeing and suppliers prefer not to use."

Much progress already has been made. For example, a non-chrome-based solution is now available for anodizing aluminum parts, and smog-forming chemicals have been greatly reduced in primers and topcoats. A number of other alternatives are undergoing implementation, replacing "tried-and-true" materials with new ones in careful steps to ensure flight safety while gaining environmental benefits.

Bennett said the 787 program is leading the way in developing suitable alternatives, noting the results likely will propagate to other in-production Boeing models. "What we incorporate in the design phase of a new airplane program benefits the life cycle of all of our products. Suppliers often will ask us to use the improvements on other airplane programs," she said.

Boeing takes its use of hazardous materials and environmental compliance seriously, and the Everett, Wash., site is stepping up to implementing an international standard called ISO 14001. It provides a framework for managing and demonstrating an effective environmental program.

In addition, Boeing's continuing Lean efforts benefit the environment. Through case-study work done with the Environmental Protection Agency, Boeing has demonstrated a synergy between Lean and the environment. Consider the following:

- Lean manufacturing results in a decreased facility footprint as inventory is delivered just in time. This releases resources for use by others.
- Smaller footprints decrease energy requirements and water usage, and cut the impact from storm water runoff from building roofs and parking lots.
- Lean efforts such as kitting result in decreased chemical usage. Kits contain just what's needed, and there's no waste from overstock spoilage.

"The Boeing Renton (Wash.) site had a significant reduction in chemical use right away as Lean was implemented," said Glover. "Boeing has reduced chemical use by more than 20 percent there."

#### THE LIFE (RE)CYCLE

To everything there is a season—even airplanes. Commercial airplanes typically average a life cycle of 30 years or more. But with tens of thousands of jets flying today, and an industry backlog in the thousands, there's a tremendous opportunity to effectively dispose of airplanes that have reached the end of their life cycle.

"By being able to efficiently separate the various grades of aluminum and other materials from an airplane at the end of its life



This aerial shot of Boeing's Renton, Wash., site shows how Lean manufacturing helps the environment. The blue area represents Renton's current footprint. The buildings in the red area have been demolished. The parking lot in the green space will be chopped up soon, and this land will be sold. Lean leads to a smaller facility footprint—which releases resources for use by others. It also cuts energy requirements, water usage and storm water runoff.

cycle, you can increase the residual value of that aircraft," said Bill Carberry, BCA Airplane and Composite Recycling project manager. Case in point: According to Carberry, properly salvaged scrap composites can fetch between \$20 and \$25 per pound.

Carberry said it's challenging to effectively separate the variety of aluminum alloys used in airplane manufacturing, especially where riveted together. With cars and house siding, up to 90 percent can be separated by alloy type (thus increasing value). But with airplanes, only about 30 to 40 percent of metals can be separated.

Boeing has a titanium reclamation process through which it is working to get salvage to a high enough grade. Titanium's the highest-value metal, and Boeing would like to take titanium scrap and introduce it back into the supply. The technology already exists to reclaim material that can be used in

high-grade commercial applications. Boeing hopes soon to achieve a level of quality that can be used in aerospace applications.

Airplanes built with composites and aluminum will in time be even more recyclable than those built from aluminum alloys, Carberry said. "Segregation will be

better, and there will be a greater return from that separation."

A recently formed group called the Aircraft Fleet Recycling Association will help improve airplane recycling efforts worldwide. AFRA is a new international association formed by 11 businesses in the United Kingdom, France and the United States with specific interests in recycling and older fleet management. Boeing is a member, providing strategic support. By year-end AFRA, whose members currently process more than 150 planes a year, expects to expand to nearly 30 firms focused on collaboration and sharing best practices.

### SAVING GREEN

Many people believe that if you adopt processes to reduce environmental impact, you're going to add cost. However, Boeing is finding that environmental responsibility is saving another form of "green." Boeing is committed to using fewer and safer chemicals in manufacturing because it's good for the environment, but using less also costs less. Noise reduction is inherently good, but it also results in a better, more fuel-efficient product. Metal and composite reclamation generates revenue and returns reusable materials to the supply chain.

"The reality is that environmentally responsible activity is an economic issue helping to sustain the business," said Shivashankara.

"There's a difference between saying you're a leader and being a leader. We demonstrate leadership by how we behave," Glover said. "Designing green is a good value proposition in and of itself." ■

*debra.j.arkell@boeing.com*



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