

## Aviation industry examines alternative fuels

By Erica Gies

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**SAN FRANCISCO:** Aviation emits 2 percent of carbon dioxide emissions worldwide, and 3 percent of total greenhouse gas emissions, according to the Intergovernmental Panel on Climate Change, the scientific body set up by the United Nations and the World Meteorological Organization to review the evidence on human-induced global warming. And according to environmental advocates, including some scientists, greenhouse gases released at high altitude may trap more heat than the same gases released on the ground.

Before the current economic downturn global air travel was growing about 5 percent a year, according to the International Air Transport Association, which represents 230 airlines worldwide that carry 93 percent of passenger traffic. The association says that it expects the industry will recover and that growth will continue at least through 2011. In the United States the Federal Aviation Administration also is still predicting growth of 4 percent to 5 percent through 2011 and beyond.

Against that background, the aviation industry is scrambling to improve fuel efficiency, in part by researching alternative fuels.

At a meeting in Geneva in April, aircraft and engine manufacturers, fuel suppliers, airlines and airports signed a voluntary declaration committing them to work toward carbon-neutral growth, and, ultimately, an aviation industry that, over all, expels no carbon dioxide into the atmosphere. While the document did not set a target date, the airline association has challenged the industry to achieve zero emissions in 50 years. Companies and organizations have made a variety of interim commitments.

The declaration highlights four areas for improvement: technology, operations, infrastructure and economic instruments. According to Airbus Industrie, the leading European plane maker, the target is an extension of ongoing efficiency improvements. Over the last 40 years the aviation industry has reduced CO2 emissions from aircraft by 70 percent and the dumping of unburned fuel by 90 percent, it says.

One technology initiative is to find a replacement for kerosene jet fuel, derived from crude oil.

"Only about 5 percent of a barrel of oil is a candidate for commercial aviation fuel," said Bill Glover, managing director of environmental strategy for Boeing. "Up to 40 percent of a barrel of plant oil can be converted into aviation jet fuel. So the chemistry is closer to what we need."

In searching the plant world for fuel sources, the industry has set guidelines.

"The biomass should not compete with food production in terms of land and water use," said Ross Walker, program manager for alternative fuels for Airbus. "Nor should it compete with existing carbon sinks such as rainforests or temperate forests."

Some plant-based fuels are out of contention: Ethanol cannot be used because it freezes in the upper atmosphere, interacts chemically with material finishes on planes and lacks the necessary energy content.

Among leading possible candidates as fuel feedstocks are algae; halophytes, a group of salt-tolerant plants; and *Jatropha curcas*, a bush native to Central America that can grow in poor soils. Some Asian countries, including India and Myanmar, are already growing *Jatropha* for biodiesel.

Besides meeting environmental and performance criteria, any potential fuel must win approval from airframe and engine manufacturers and government safety authorities.

"Safety is No.1," said Steve Lott, the North American spokesman for the airline association.

Another consideration is compatibility with current systems. Walker, the Airbus official, said, "It's important that the fuel is a drop-in replacement, so there's no major changes required to the air frames, the air engines, or the infrastructure because that would be very expensive and also would generate its own CO2 emissions in changing everything."

Milton Sommerfeld, a professor at Arizona State University, has studied algae for more than 40 years. At the university's algae research laboratory, he and a colleague, Qiang Hu, conducted preliminary research last year on converting algal oil to aviation fuel for the U.S. Defense Advanced Research Projects Agency.

Algae "fits into the existing processing system quite well because it mimics the oil that we mine from the earth," he said, adding that "there are theories that the oil that we are taking out of the ground had its origin in algae."

The industry is conducting trials to test the efficacy of various fuels. Approval by manufacturers can help make the business case for production.

Walker at Airbus said, "Unless we have the fuel certified, it's unlikely that somebody will invest the billions of dollars necessary for an industrial plant."

The Virgin Green Fund, which has a \$3 billion commitment over the next decade from Richard Branson, the founder of Virgin Atlantic Airways, is investing in alternative fuel and solar power companies. Other airlines and aircraft manufacturers have arrangements with university researchers and entrepreneurs.

Boeing and Airbus both tested hydrogen fuel cell technology this year, with an eye toward use in the auxiliary power units that supply backup power, electricity and compressed air.

Airbus flew an A380, the world's largest passenger aircraft, on a gas-to-liquid fuel derived from converting natural gas to liquid kerosene, a conversion process similar to the one that extracts liquid fuel from plant biomass.

Virgin Atlantic flew an experimental flight in February on a Boeing 747, using a blend of babassu palm and coconut oils although, since both are used in food, those oils will not be pursued as a long-term solution.

Air New Zealand plans a test this year on a Boeing 747 using *Jatropha* oil. Japan Airlines and Continental Airlines are also planning tests, on a Boeing 747 and a Boeing 737, respectively. Neither airline has yet selected a biofuel.

Emissions reports on these tests, which involved feeding biofuel, or a biofuel-kerosene mix, to just one engine of the aircraft, are eagerly awaited.

At this stage, elements of the industry are sharing research. "The airline industry is very competitive like any other industry," said Lott, the industry spokesman. "But when it comes to something like this,

it's important that there's transparency and sharing of information because that's the only way we can keep momentum."

Paul Charles, communications director for Virgin Atlantic Airways, spoke of a time beyond fuel. "Ultimately, the ideal solution would be a plane which runs on solar power," he said. "Solar panels on the wings could take the sun's energy and regenerate it through the aircraft.

"If I were Boeing or Airbus, that's precisely what I'd be working on."

In the nearer term, though, Sommerfeld, the Arizona State University researcher, hopes to see commercial algae facilities in three to five years. Although he has been working on algae as a transportation fuel source for 20 years, he said that limited capital investment had hindered progress in the past.

"If the price of oil continues at the current rate or increases, that's going to bring things in faster than if we have a significant price drop," he said. "When the price gets high, we begin to look for alternatives; when the price drops, we stop."

While reducing emissions is a factor, industry insiders concede that the high price of oil is the strongest motivator in the search for an alternative fuel.

"Every dollar increase in the price of crude oil leads to \$1.6 billion additional cost to the industry worldwide," said Lott.

Or, as Charles put it: "If you ever needed a real incentive, oil at \$138 a barrel is it."