PLANTING HOPE

The aviation industry is embracing biofuels as the solution to its carbon concerns, but insists that governments must assist in their development

NIALL O'KEEFFE LONDON

Both of the major commercial airframers have joined forces with industry peers to pursue new biofuel research initiatives, reflecting an intensification of concern about future availability of alternative fuels in the quantities required by aviation.

In January, Qatar Airways revealed plans to work with Airbus and other Qatari state entities to draw up "a detailed engineering and implementation plan for economically viable and sustainable biofuel production". At an event marking the launch of the Qatar Advanced Biofuel Platform consortium, airline chief Akbar al Baker hailed its European project partner as "more proactive than Boeing in experimenting with alternative fuels".

SEAWATER FARMING

Barely a week later, details of Boeing's own Middle Eastern biofuels venture emerged. The airframer is participating in the establishment of a biofuel-focused research institute in Abu Dhabi, along with Honeywell fuel technology subsidiary UOP and two local partners: the Masdar Institute of Science & Technology and Etihad Airways. The Sustainable Bioenergy Research Project (SBRP) will explore the potential of seawater farming as a means of growing mangrove forests and salicornia, a salt-tolerant plant, as a biofuel feedstock.

The project seems timely, given that it was shortages of salicornia that forced Mexico's Interjet to postpone biofuel demonstration flights that had been scheduled for early 2010. Global Seawater, a "special adviser" to the SBRP team, was originally lined up to supply the required feedstock, but Interjet is now considering other suppliers, including Mexico City-based Grupo KUO.

Interjet's biofuel project, in which Airbus is a partner along with aeroengine manufacturer CFM International, is the first alternative fuel project involving a Latin American airline, and follows biofuel demonstration flights conducted by Air New Zealand, Continental, Japan Airlines, KLM and Virgin Atlantic.

Iata/Airbus

Salt-tolerant salicornia: a fuel cornucopia?

Issues with feedstock availability are hardly confined to Latin America. JetBlue Airways' planned demonstration flight, also scheduled for early 2010, has also been postponed. Partnering Airbus and International Aero Engines, the New York-based low-cost airline has considered a range of potential feedstocks, including jatropha, algae, waste forest residues, organic waste streams and the non-edible component of corn, corn stover.

"We do not have a revised projection of when enough second-generation biojet might be produced to conduct a meaningful flight, but we will continue to monitor potential suppliers in the pursuit of our objective," the airline told Flightglobal's *Air Transport Intelligence* online news service.

There is "a long list of airlines who would like to do a biofuel flight" with Airbus, says the airframer's senior vice-president of public affairs Rainer Ohler. "The problem is the availability of biofuel."

With the calls for aviation to clean up its act growing ever more clamorous, some industry players have been exercised by a perceived lack of biofuel-related support from nation states. At an Airbus A380 event in Geneva in January, International Air Transport Association secretary general Giovanni Bisignani took aim at aviation's fuel suppliers as well as political leaders.

"We are a bit disappointed with governments and oil companies," said Bisignani, whose organisation believes that biofuel's lifecycle greenhouse gas emissions could be 80% lower than those of traditional jet fuel. "Look at the car industry," he said. "They have received billions of dollars of bailout. We are working hard to have a greener kind of environment in aviation and we have not received one penny from governments [for] testing biofuels."

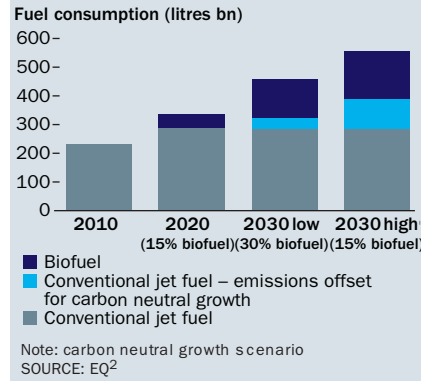
Turning his sights on the oil companies, Bisignani estimated that aviation's annual fuel bill of $120 billion yielded a refinery margin of $9 billion. He suggested some of these funds could be devoted to the "small entrepreneurs" developing biofuel farms "to help them speed the process".

The pace at which aviation biofuels can reach scale production is a general concern, since certification of such fuels appears likely to be secured by the end of the year. Airbus is confident of biofuel availability within "five or 10 years", but believes governments need to nominate aviation as a "preferred biofuel user" with a priority of access to fuel over other industries. "Aviation simply has no alternatives to biofuel," argues Ohler.

Boeing takes a similar line. "It's not like we're going to be flying airplanes on solar power or long extension cords any time soon," notes Billy Glover, managing director of environmental strategy at Boeing. "If you think about how much biofuel it would take to power electricity generation or cars and trucks... it doesn't make sense to produce enough feedstock for all that." Echoing his peers, Glover identifies a need for governments to "take a more proactive stance towards developing sustainable aviation biofuels".

The accord between Airbus and Boeing comes as no surprise given that the two airframers have signed a pledge to work more closely on environmental matters. With that agreement, signed at the third Aviation & Environment Summit in Geneva in 2008, the environment joined safety among issues considered to transcend the competitive joust between the companies. "We are not competing

FUTURE ESTIMATED GLOBAL CONSUMPTION OF JET FUEL



Note: carbon neutral growth scenario
SOURCE: EQ^2

KLM

KLM flew a 747 with one engine running on a mix of a camelina-based biofuel and traditional Jet-A. It is pursuing biofuels in a new joint venture

on engine technologies and we're not competing on the fuel," says Ohler. "We're competing on the best aircraft."

As to the burning issue of which feedstock is best suited as a source of aviation biofuel, there appear to be points of consensus among the stakeholders. One is that multiple feedstocks and a distributed process will be required, since aviation's requirement is huge, and the ease with which a particular feedstock can be grown varies by region and climate. As Glover puts it: "A good feedstock for Abu Dhabi is not the same as a good feedstock for the southern USA – or China."

Another widely shared view is that feedstocks must be of the so-called second or third generation: in other words, their production must not interfere with food or freshwater supply, unlike first-generation fuels such as those based on sugar, corn, palm oil or soya.

This constraint presents a conundrum, identified by Jennifer Holmgren, general manager of the renewable energy and chemicals business unit at UOP. "We're sort of in a catch-22," says Holmgren. "If you're going to use biofuels based on feedstocks that are not used for food… why the heck would a farmer grow a feedstock that isn't for food?"

FEEDSTOCK AVAILABILITY

Commercial producers, meanwhile, cannot justify investment in a production facility until guaranteed availability of sustainable feedstock, Holmgren adds. "If the governments don't step in and take a step that incentivises both sides [farmers and commercial producers], you're sort of in this hole of who's going to take that first move," she concludes.

The ultimate goal is to have "large units producing commercial quantities and eventually getting to commercially viable cost", and getting there will require the use not just of numerous feedstock types, but of innovative farming methods, by Holmgren's account.

"If you have enough good geographic solutions, the aggregate of those will create the biomass necessary to have a real impact," she says, while explaining UOP's role in the salicornia-focused SBRP initiative. "This particular case [involves] growing the feedstock in land that would not be traditionally used for feedstock growth. Nobody grows feedstock in the desert, basically. This is in a coastal plain area, on seawater, using seawater, so you're not competing for land, you're not competing for fresh water, and you're growing something where normally you would not grow something."

> **"We are a bit disappointed with governments and oil companies"**
>
> **GIOVANNI BISIGNANI**
> IATA secretary general

UOP has repeatedly leveraged its expertise in the technology of converting feedstock into biofuel, producing about 227,000 litres (60,000USgal) of the latter to assist both the commercial and military aviation industries in "platform certification" projects. In the normal run of its business, UOP tends not to produce fuel itself, but rather license its technology to refining customers such as Shell and ExxonMobil. Within the nascent biofuels business, however, UOP has looked to take the initiative and produce fuel itself. "I didn't want to have to sell the vision to a refiner," says Holmgren.

Yet Holmgren dissents from the doom and gloom that often attends discussion of biofuel availability. "There are so many available, sustainable feedstocks," she says. "I get extremely nervous that this discussion of lack of feedstocks is, in some ways, almost a call for inaction." She adds: "That's what this Masdar project is about; it's saying: 'Here's a place nobody thought about – we can create feedstocks here.' That doesn't mean that every feedstock has to be developed. There's already a sustainable outturn of crops."

The flowering plant pennycress is an example of a feedstock that is "available in hundreds-of-millions-of-gallon quantities and can be at the billion-gallon level in the next two to three years", says Holmgren. She cites also the fact that the camelina and jatropha plants have been successfully deployed as feedstocks for biofuel test flights.

Both featured in the fuel mix that powered a Japan Airlines flight conducted in January 2009, while in November, KLM operated a Boeing 747 flight with one engine running on a 50:50 mix of a camelina-based biofuel and traditional Jet-A. Subsequently, the Dutch carrier unveiled a new joint venture, SkyEnergy, which it is pursuing with compatriots North Sea Petroleum and strategy consultancy Spring Associates. SkyEnergy is tasked with creating a commercially viable alternative jet fuel that, in adherence with the prevailing orthodoxy, does not jeopardise the food chain or cause deforestation or excessive water consumption.

Striking a familiar note, KLM chief Peter Hartman says: "Government, industry and society at large must now join forces to ensure »

» that we quickly gain access to a continuous supply of biofuel."

There is still work to be done on the genetic development of suitable strains of plant-based, oil-seed-bearing feedstocks such as jatropha and pongomia. "Most work has been done to date using essentially wild strains and it's no surprise that you run into difficulty on yields and therefore economics," says Phil Hopton, a partner in Seattle-based biofuel research company Verno Systems. "The issues around those plant-oil-based fuels are all around, essentially, the agronomy of growing the plant."

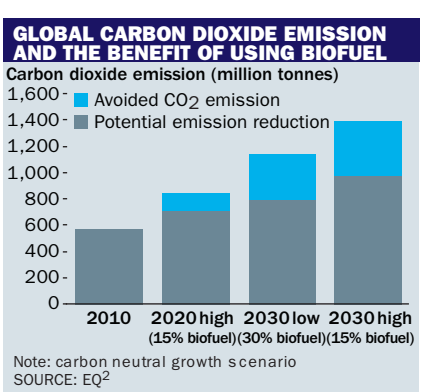
The attraction of algaes and cyanobacteria as feedstocks is that, as microorganisms, they "constantly reproduce and therefore grow", adds Hopton. Here, however, physical constraints apply, as the open ponds required to grow algae have a high surface area. Additionally, specialised technology is required to facilitate photosynthesis. There are also obstacles to overcome in the area of dewatering, which "can be an expensive and not very environmentally friendly process", says Hopton. "There's a whole range of challenges," he concludes. "They all require investment, clearly."

ALL GO

The progress of algae-based biofuel gained a burst of momentum in July 2009, when ExxonMobil disclosed plans to ally with biotech company Synthetic Genomics to research and develop fuels based on photosynthetic algae. The programme budget anticipated $600 million of investment by ExxonMobil, which vowed to lend engineering and scientific expertise "throughout the programme, from the development of systems to increase the scale of algae production through the manufacturing of finished fuels".

Algae is certainly a feedstock considered by many to offer vast potential as a source of aviation biofuel, albeit on the more distant horizons of an industry in which long-term time scales are taken as read.

At a briefing at last year's Paris air show, Boeing's Glover singled out algae as a "very promising" feedstock, but admitted that scale



UOP

Algae is a feedstock considered by many to offer vast potential as a source of aviation biofuel

production was eight to 10 years away. UOP's Holmgren similarly considers availability of algae in mass quantities to be up to a decade away, although she specifies a more optimistic five- to 10-year time frame and says: "There's a couple of people who may surprise us and come in a little bit under."

In its own contribution to algae's emergence, UOP developed an algae-based diesel to power a Mercedes-Benz E-Class sedan that was displayed at the United Nations Framework Convention on Climate Change conference in Copenhagen in December.

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> Verno Systems partner

Back in the aviation sphere, Airbus parent EADS has revealed plans to assess the potential of microalgae over a 12-month period, in partnership with Singapore's Agency for Science, Technology and Research (ASTAR). As part of the project, unveiled earlier this month, EADS and ASTAR will also investigate methods of converting the microalgae oil to fuel.

When the commercial phase of biofuels does kick in, a debate about pricing is likely to flare up. Hopton lists questions to be answered. "Will biofuels sell at the same price as crude-oil-based fuels? Will they sell at a premium in that they're carbon neutral? And who will control that pricing?"

However, there may be grounds for optimism. As aviation is quite a focused consumer – albeit a global and dispersed one – feeding biofuels into this industry, as compared with many others, may be relatively uncomplicated.

Certainly, there are significant financial incentives for successful adoption of aviation biofuels, to judge from a report issued this month by "sustainability economics" UK consultancy EQ2 Insight. One incentive identified by the report, titled *Sustainable Flying*, arises from savings under the European Union's Emissions Trading System. "Based on the current EU ETS price for carbon in 2012 of €15 ($20) and 2009 average jet fuel price of $1.69/USgal, every gallon of jet fuel burned would incur carbon costs of an additional $0.21, which is a total cost of $1.34 billion across the industry," it calculates. "This is a premium of 12.4% that would not apply to biofuel."

Looking further out, it estimates that – based on the Air Transport Action Group's assumption that biofuels' share will be 15% in 2020 and 30% in 2030 – the EU aviation industry could avoid 35 million tonnes of CO_2 emissions in the former year and 100 million tonnes in the latter. The savings on carbon expense would be, respectively, $2.01 billion and $5.83 billion.

Clearly, biofuels could offer the airline industry a bottom-line boost. The questions now are: can governments afford to take a long-term view and support their development? And can they afford not to? ■

Additional reporting by Megan Kuhn and Brendan Sobie in Washington DC