Europe’s ETS raises more questions than answers

There is no silver bullet for reducing the effect of business aviation on the environment, most industry analysts agree, but the combination of new technology—such as engines and airframe components—improved ATC techniques and biofuels promises to dramatically reduce business aviation’s carbon footprint. Governments have also stepped in with legislative restrictions, such as Europe’s emissions trading scheme, in an attempt to make aviation more environmentally friendly.

Support for the EU’s emissions trading scheme (ETS) plumbed new depths this past year, leaving operators on both sides of the Atlantic questioning the validity of the industry’s continued participation. The situation became so precarious, in fact, that in May the European Business Aviation Association (EBAA) openly called the directive “a mess” and threatened to advise its members to withdraw support. In spite of some positive developments in recent weeks, some operators—particularly those in the U.S.—are beginning to wonder if non-compliance is an option.

The chief complaint among operators is that the directive favors the airlines and places business aviation—especially small, private operators—at a disadvantage. A particular bone of contention is the exemption threshold: all non-commercial operators must register, even if they emit as little as one ton of CO2 per year in an EU aerodrome. Commercial operators, meanwhile, are exempt from the reporting process if they emit less than 10,000 tons of CO2 annually (or fly fewer than 243 flights in three consecutive four-month periods).

Unfortunately, it’s unlikely that non-commercial operators will be given an exemption anytime soon, according to EBAA president and CEO Brian Humphries. A change in the status of non-commercial operators would require support from each of the EU’s member states to change the “mother” directive. “Our only hope is that the member states will become fed up spending 80 percent of their time looking after thousands of small emitters [who
produce] less than 1 percent of the emissions,” Humphries said. “But we’re not hanging our hats on that.”

Although the situation isn’t likely to change for non-commercial operators, the exemption threshold for commercial operators might increase. According to Humphries, Eurocontrol will be making changes to the monitoring, reporting and verification (MRV) guidelines as early as next year. It’s possible, therefore, that the commercial threshold—which isn’t as difficult to change—will be increased to 25,000 tons of CO2 per year. “It’s not as high as we would like, but it is higher than 10,000,” Humphries said.

Bizav Disadvantaged

Another area of concern is the carbon credit auction process. Currently, carbon credits are available at auction in blocks of 500—a daunting figure for a small operator that might need only 15 or 20 credits per year. Carbon credits cost approximately €14 ($18), and each credit offsets a metric ton of CO2, or roughly 1,100 pounds of fuel.

The industry had originally lobbied for one-credit auctions for small emitters, but the idea was dismissed. “If you talk to any economist, [a one-credit auction] would have driven the price of carbon credits through the roof,” said Adam Hartley, Universal Weather & Aviation’s supervisor of regulatory services. “The European Commission would rather see an intermediary buy 500 credits and distribute them.”

EBAA, meanwhile, is “not happy” the threshold has been set at 500 credits and is considering the possibility of becoming a handling or distribution agent for its members, or identifying reputable companies that are willing to act as handling agents. “Obviously we don’t want people buying 500 tons on the open market and then selling them for much higher prices in small packages,” Humphries said. “But we are looking at ways in which we can support our members. I can’t give you anything specific yet, but that’s rolling forward.”

Even if the industry finds a solution, however, small operators will still be at a disadvantage, Hartley said. “They aren’t traders and stockbrokers. Big corporations have entire departments that have been doing this for years and will be able to get those credits at a reduced cost. But the small private operator will just be trying to thumb his way through as he navigates the markets.”

Business aviation operators are also at a disadvantage in terms of free credit allowances, according to David Carlisle, CEO of ETS Aviation. The current system allows operators to apply for free credits, based on an aircraft’s payload weight and the distance flown. Because the scheduled airlines and freight companies carry so much weight, they can get a “large, substantial portion” of their carbon allowance for free.

Business aircraft, meanwhile, don’t carry as much weight. Business aviation will get a lower proportion of credits compared to the airlines,” Carlisle said. “That’s quite unfair.”

Airlines and freight companies could get as much as 87 percent of their carbon allowance for free, according to Hartley. The best estimate for business operators is 5 to 10 percent. “If you’re flying into Europe only once a year, you’ll never save enough money in free allowances to make up even the initial application fee [for the free allowances],” Hartley said. “In corporate aviation, we’re always going to come out as losers.”

Regulators should consider the percentage of occupancy, rather than weight and distance, Carlisle said. “If the aircraft is full, you should get a good amount of your emissions back in free credits, just as the airlines do.”

Although business aircraft operators are at a huge disadvantage in several different areas, there is hope in one regard: Humphries is “quite encouraged” and believes “it won’t be long now” before the ETS Support Facility is approved and finalized (see article on page 10). The support facility is a development of Eurocontrol’s so-called Pagoda model for calculating emissions, based on data from flight plans logged in the ATM agency’s Central Flow Management Unit. The support facility also provides verification of the data, thereby eliminating the need to pay for expensive independent verification.

Earlier this year, EBAA was going to advise its members to withdraw their support for the ETS if the support facility was not approved. “If there had been no tool at all, we would have advised members [not to support the ETS],” Humphries said. “But because the tool is under development and it looks as though it will go ahead, at the moment we’re saying, ‘Stick with it.’”

In April, the UK High Court ruled that a lawsuit filed by the Air Transport Association (ATA) could be referred to the European Court of Justice for a preliminary ruling on the validity of the EU directive that established the ETS. Although the ruling doesn’t actually change anything, it was a victory for operators that the European Commission views something that has been done in the U.S. as an equivalent approach, in theory it could decide that the ETS would not apply to U.S. operators,” he said.

The U.S. is also considering so-called “energy” legislation, but nothing is finalized, and no one is sure how the bill will affect aviation. “The legislation isn’t that specific yet,” Brown said. “It’s even unclear to what extent the legislation will affect transportation as a whole. It’s far too early in the discussion, it could go either way.”

Given these developments, operators in the U.S. know there are a number of possible outcomes regarding the ETS: First, the ETS will go into effect in 2012, and U.S. operators would be forced to comply. “This assumes that no legislation passes in the U.S., there is no recognition in Europe of an equivalent approach, and the legal challenges to the ETS have failed,” Brown said. “All of that is seen as being unlikely.”

Another possibility is that the U.S. passes legislation that Europe views as an equivalent approach. “In that case, the ETS would not apply,” Brown said.

And third, the legal challenges currently in the European Court of Justice are successful, and the ETS is found to be illegal in the context of the Chicago Convention and international aviation rules.

“Operators are following the challenges and national legislation to see what happens over the next year-and-a-half,” Brown said, adding that the aviation industry recognizes the value in reducing its impact on the environment. “That, coupled with the reality that there always has to be an eye on cost benefits, is the point of view people have. The aviation industry wants to have minimal impact on the environment, but whatever is done to accomplish that should be cost effective. There’s broad opinion that the ETS does not fit that criterion.”

The Cost of Compliance

One of the biggest frustrations for operators in the U.S. and Europe is the question of cost. “The carbon credit market is generally seen as a young or immature market,” Brown said. “It hasn’t been around for a long time, and prices have varied quite a lot in the time it has been open. So knowing what the price of a credit might be in 2012 is pretty speculative; it’s difficult to estimate what the cost might be. It’s a good question, but nobody really knows the answer.”

Although the cost of the actual carbon credits is unknown, operators are already getting a taste of the administrative costs. The UK, for example, charges £750 ($1,185) to submit the original MRV plan, as well as...
Next-gen ATC promises environmental rewards

The benefits of implementing NextGen and its European counterpart, the Single European Sky ATM Research (Sesar), are three-fold: not only will the new procedures and technologies improve safety and efficiency, but they will also yield environmental benefits. The ultimate goal is to increase air-space capacity while reducing fuel burn, emissions and noise.

To that end, the FAA is “moving forward aggressively,” according to Michael Romanowski, director of NextGen integration and implementation. “The infrastructure is starting to emerge, and we’re seeing a lot of success with early operational demonstrations and deployments.”

The operators involved in transoceanic “gate-to-gate” demonstrations of NextGen capabilities (oceanic trajectory-based operations) are saving significant amounts of fuel, for example. “We’re routinely seeing 2 to 3 percent fuel savings per flight,” Romanowski said. “On the Atlantic side, we’ve saved two tons of CO2 per flight. And by saving fuel, you’re reducing your environmental impact and seeing a reduction in carbon emissions.”

The demonstrations involve not only the FAA and various operators, including American Airlines, Air France, Lufthansa, Qantas and Singapore Airlines, among others, but they also require cooperation among various service providers and agencies. This cooperation will continue into the future, as well.

In fact, the U.S. and the European Commission on June 18 signed an agreement allowing the FAA and Eurocontrol to work together to provide consistent air traffic service, such as avionics, communication protocols and procedures, and operational methods, to aircraft on transatlantic flights. “The systems will not be identical, but they need to be interoperable,” Romanowski said.

Eurocontrol, meanwhile, recently announced that it has taken “major steps forward” in several key areas over the past year. Most important, the agency has cleared the European satellite navigation system, the European Geostationary Overlay Service (Egnos), for final safety certification by the European national supervisory authorities. In collaboration with the FAA, the agency is also moving forward with the aeronautical information exchange model (AIMX-S), the basis for worldwide digital Notams.

“Gate-to-gate” navigation actually begins long before the aircraft leaves the airport gate or begins to taxi. “The FAA is putting a lot of emphasis on being able to make decisions early,” said Bruce Carmichael, director of the aviation programs application at the National Center for Atmospheric Research (NCAR). “In fact, it would really like to begin many of the traffic management and flight planning exercises as much as 24 hours ahead of time.”

Using NextGen technologies and procedures, such as collaborative departure management (CDM), NextGen airports will be able to coordinate traffic on the ground, thereby eliminating takeoff delays and ground holds. ASDE-X is a satellite-based surveillance tracking system that gives air traffic controllers an enhanced view of ground traffic, presented as a color display on a map of the airport. It is scheduled for deployment at 35 U.S. airports by year-end.

Traffic Coordination

CDM, meanwhile, involves collaborative decision making by controllers, operators, airport officials and the FAA, among others, based on common knowledge of the aircraft on the ground. The concept proved successful during initial demonstration work in Memphis. “Just by sharing information with the operators, and helping them understand what’s happening on the ground, they can save 1.5 to 4.5 minutes per flight per aircraft,” Romanowski said. “You start seeing dramatic savings in fuel burn and emissions.”

This past summer, the Port Authority of New York and New Jersey established a CDM command center to manage traffic flow at JFK while the airport’s main 14,572-foot runway was closed for repairs between March and June.

“In the past, it was not uncommon to see 40 to 80 aircraft lining up for departure,” Romanowski said. “Using CDM, [controllers] were able to keep a constant stream of eight to 10 aircraft at the end of the runway. Even with the most significant runway closed, the airport did not experience delays.”

The FAA, however, has not set a target for when it will begin to deploy NextGen traffic management into the future, as well. “The Port Authority is estimating that operators are saving five million gallons of fuel per year at JFK,” Romanowski said. “It has functioned from the beginning as a way to go around the FAA’s airspace configuration.”

In terms of the actual departure, more airports will be using RNAV departures. “With the level of precision they provide, RNAV departures make it easier to use runway capacity much more efficiently,” Romanowski said, adding that RNAV departures have been in place at Dallas/Fort Worth for a number of years. “We’ve seen a 45-percent delay reduction using RNAV departures. And they save in terms of efficiency and fuel burn, in the amount of $30 million.”

Following taxi and takeoff, aircraft will be able to take advantage of NextGen concepts for climb-out and cruise. “The idea with climb and cruise is to be the most fuel efficient for the aircraft,” Carmichael said. “To do that requires that all the trajectories for all the aircraft fit together like a jigsaw puzzle.”

The system we use today is too reactive, Carmichael said. “It is based on a large number of asynchronous events that happened independently. We work out the problems when we run into them. We’re trying to move away from that, to a more synchronized operation where the pieces of the puzzle fit together just so.”

The FAA will make use of technologies such as automatic dependent surveillance-broadcast (ADS-B) and the traffic management advisor (TMA). Coverage will be nationwide in 2013.

Satellite-based procedures, such as RNAV, can also be used for arrivals. The procedures are being used at Dallas/Fort Worth and Phoenix Sky Harbor International Airport, Romanowski said. “With RNAV arrivals, we’re saving 700,000 gallons of fuel per year and 6,700 tons of carbon. And this is just using it part-time.”

Europe’s ETS raises questions

Continued from preceding page

Emissions from a transatlantic flight are taking a back seat to the latest ETS reporting and monitoring requirements. Airports, airlines, the aviation industry, are all trying to figure out what the program entails and what the requirements are.

Although the cost to comply with the ETS might seem excessive, this is not much compared to the cost of non-compliance. In the UK, the fine for not submitting the MRV report could total up to £5,000,000 (€6,700,000) per year and 6,700 tons of carbon. This is not an option, Hartley said. “This is a regulatory requirement. We are required to report our emissions.”

The UK has already started sending warning letters to operators who have not submitted their initial reports, according to Universal’s Laura Everington, manager of regulatory services. “The letters are official and can get pretty ugly,” she said. “We’ve seen a couple of these. We’re thinking that the number is just a number and it’s not a small amount.”

In essence, non-compliance is not an option, Hartley said. “This is a mandatory regulation; it’s on the books,” he said. “Regardless of what the future holds for this program, we have to live in the here and now. There is no optional compliance. You’re looking at fines, fees and penalties, including exclusion from EU airspace or confiscation of your aircraft in lieu of paying fines. It’s a mandatory requirement, and the industry needs to treat it as such.”

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Business Aviation & the environment
Turbofan manufacturers continue ‘green’ efforts

by Kirby J. Harrison

Turbofan manufacturers are developing cleaner, quieter and more environmentally friendly engines that will meet current and future regulatory requirements. That fact should come as no surprise, since they have been doing this all along as the natural byproduct of efforts to build more fuel-efficient and quieter turbofans for a market that demands nothing less. And they were doing so long before government agencies and environmental watchdog groups began taking such an interest in aircraft propulsion.

“We’ve been reducing emissions and increasing turbine efficiency for twenty-five years,” said Walter Di Bartolomeo, v-p of engineering for Pratt & Whitney Canada.

These days, there is the additional motivation provided by a flurry of regulations coming from government agencies in the U.S. and abroad, from the EU Emissions Trading Scheme to the so-called cap-and-trade proposal in the U.S. Not to mention aircraft noise level restrictions set by the FAA, ICAO and thousands of local municipalities. And there are public groups such as the Government Accountability Project, which has criticized the FAA for “intention to greenhouse emissions,” warning of the “harmsful effects on the future of U.S. aviation if action is not taken.”

As a result, manufacturers are spending billions of dollars on research and development projects to create more reliable and efficient engines that will reduce both GHG (greenhouse gas) emissions and noise. The technology advances include everything from improved fan core and exhaust-nozzle designs to composite materials.

This summer, GE Aviation was one of many engine manufacturers that received an award open-rotor technology and flight management and air traffic management systems. The Taps II lean-burn/low emissions combustor is at the center of GE’s eCore hot section, and the company began testing it in June 2009. It will be at the heart of the couple of CFM International’s Leap-X engine for single-aisle aircraft as well as the company’s next generation of regional and business jet engines.

CFM started running phase one of the eCore demonstrator on schedule last year, and phase two was completed this year. Testing of the eCore demonstrator two and the 10-stage compressor and two-stage turbine is scheduled to begin next year. “This is a core that ‘wants’ to run,” said a CFM spokesman. She added that the result will be an engine that produces a ground noise footprint 75 percent smaller than a comparable current-production engine, keeping noise within the confines of the airport.

GE expects the new core will provide up to 16 percent better fuel efficiency than the best it has in service today.

General Electric’s new GENx engine program will produce a turbofan for widebody aircraft and features the latest in carbon-fiber composite materials in both the fan blades and fan case. Their use in the fan case alone will reduce the engine weight by 300 pounds. With such improvements as a 23:1 pressure ratio, pre-mix nested fuel nozzles, four fewer stages and 30 percent fewer parts, the engine is expected to produce emissions 95 percent below current requirements and 15 percent better fuel consumption.

GE began experimenting with the open rotor, or unducted fan, design in the 1980s, when the price of fuel was climbing. Like other open-rotor programs, it was put on a back bench when the price of fuel fell. But with growing emphasis on fuel efficiency and greenness, these programs have seen a revival in recent years.

By applying advanced data acquisition systems and computational design tools, GE now believes it has improved the design to reduce fuel consumption by 26 percent (compared with current turbofans) and address the problem of noise inherent with the open rotor. The program also has GE engineers and designers evaluating the open rotor for the Leap-X engine.

GE and CFM are calling Leap-X the “power of the future.” Test results are matching what GE said are “aggressive” targets set by CFM. Endurance testing on the full-scale Leap-X RTM demonstrator, a Snecma proprietary technology, began this summer and certification is expected in 2014.

The fan and casing will be built of composite materials. The fan’s larger, 3-D woven transfer molding blades will allow much greater efficiency than the CFM56, and the engine will weigh some 500 pounds less than a comparable powerplant with metal fans and casing. It will run on 15 percent less fuel and emit 16 percent less CO2 compared with today’s most fuel-efficient CFM56.

Meanwhile, testing continues on the GE Honda HF120 turbofan that powers the new HondaJet.

Features include advanced airfoils, materials and coatings; high-temperature, reverse-flow combustor configuration; single-stage air-blast fuel nozzles; titanium impeller in the compressor; two-stage, low-pressure turbine; and counter-rotating high-pressure and low-pressure shaft system.

Cost of ownership is key, according to Honda, which is aiming for 5,000 hours between major overhauls.

Honeywell Investing Heavily

Honeywell’s HTF7000 fleet recently surpassed 700,000 total hours, and the company continues to make improvements in the line. The HTF7750 that will power Embraer’s new Legacy 450 and Legacy 500 has completed design review and core testing. Engine tests began this summer and certification is expected next year.

And as Gulfstream ramps up for production of its G250, Honeywell is increasing deliveries of its new HTF725G to the Savannah, Ga.-based OEM. Honeywell will also incorporate technology from its Saber 1 engine improvement program into HTF7000 production engines, and those same improvements will appear in the new HTF7725G and HTF7750. Certification tests are under way for the updated HTF7000.

According to Honeywell v-p of propulsion systems Ron Rich, the Saber 1 technology will meet all ICAO standards, with a 25-percent reduction in NOx (nitrogen oxides) emissions.

The company has also launched Saber 2, which is expected to reduce NOx emissions by another 25 percent. The new Tech 7000 technology demonstrator makes use of a fleet of HTF725Gs to develop Saber 2 as well as make other improvements in a relevant environment.

Full component-level testing has already begun and combustion systems are running. “We’ll move toward engine testing near the end of 2010 or early 2011,” said Rich.

The improvements will include the fan, compressor and turbine. Among the goals for Saber 2 are better power-to-weight ratio, a smaller core to reduce engine weight, and a higher pressure ratio for improved fuel burn.

MTU Plans Green Lead with Geared Turbofan

German engine manufacturer MTU Aero Engines has been making much of a geared turboshaft, with its Claire (clean air engine) technology leading the way. The aim is to cut CO2 emissions by 20 percent by 2035, and at the Paris Air Show last year MTU was exhibiting a geared turbofan mockup.

The first steps are being taken under the umbrella of the European Commission’s Clean Sky joint technology initiative. MTU Continues on page 29
Engine makers’ green efforts

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is investing some $27 million in the project and industry partners such as Avio and Volvo Aero are adding another $40 million.

The Claire project will use an existing geared turboshaft, focusing on the high-pressure compressor and high-speed low-pressure turbine. Designers expect to reduce the length and weight of the turbine, while improving efficiency by way of the new low-pressure turbine, first-stage concept. The initial target is a 15-percent reduction in fuel burn. The second step is to combine a two-stage counter-rotating fan with the geared concept, targeting a fuel burn reduction of 20 percent by 2025. The third is implementation of an interconnected recuperative aero-engine concept in which exhaust nozzle heat is used to increase the temperature of the air entering the compressor.

MTU is also a partner in Pratt & Whitney’s PW1000G program. The engine from that program is expected to power the Mitsubishi regional jet and Bombardier’s C Series regional jet.

Pratt & Whitney ‘Changes Everything’

At the Farnborough airshow in July, Pratt & Whitney was promoting its PurePower engine core, saying, “This changes everything.” According to Bob Sala, v-p of the next-generation product family, “This advanced core contains many key technologies contributing to the lower engine operating cost of the PW1000G.” Current tests are confirming expectations.

The PurePower PW1000G features gearing that allows the fan to operate at lower speeds than the low-pressure compressor and turbine. The combination of the gear system and advanced core, reported P&W, “delivers double-digit improvements in fuel efficiency and emissions with a 50-percent reduction in noise over today’s engines.” Entry into service is scheduled for 2013.

P&W is in the midst of a five-year program during which it expects to spend approximately $1.5 billion in research and development.

The engine manufacturer claims to be the leader in developing low-emission technology, primarily through its Talon technology affordable low Nox combustion design. According to Pratt & Whitney Canada, it makes the PW307 “the greenest engine in its market.” With an emissions reduction of 33 percent relative to ICAO standards.

The Talon 2 combustor technology also meets Zurich 5 requirements for avoiding emissions surcharges. It also surpasses ICAO environmental standards by more than 35 percent for CO2 and by more than 50 percent for NOx emissions, unburned hydrocarbons and smoke.

Rolls-Royce E3E Core at the Center

Rolls-Royce announced in July that it has successfully run the latest E3E (efficiency, environment, economy) core engine as part of its two-shaft research. The program is intended to develop future powerplants for business jets and single-aisle airliners.

The latest core-build produced “excellent results” during 40 hours of run trials at Stuttgart University’s altitude test facility, exceeding the flight-envelope requirements, according to the company.

Rolls-Royce said E3E is developing “leading-edge technologies” that increase engine temperature, pressure ratio and component efficiencies, combined with a 25-percent increase in thrust-to-weight ratio.

Other goals include a 15-percent reduction in fuel burn as well as CO2 emissions, along with a 60-percent reduction in NOx emissions.

Specific technologies used on the E3E core include a two-stage shroudless high-pressure turbine; tip clearance control system with advanced ceramic abradable linings; lean-burn combustion; blisked high-pressure compressor air system for bearing-load management; and improved cooling using carbon oil seal and brush seal air sealing technologies.

The nine-stage blisked high-pressure compressor has thus far demonstrated a 22:1 pressure ratio. More cores are to be tested over the next two years and the program calls for 1,200 cycles of max-takeoff-power endurance testing.

Snecma Continues Silvercrest Development

Despite still lacking a launch customer, Snecma of France continues to develop its Silvercrest business jet engine.

The plan is to build the powerplant in versions developing between 6,500 and 12,000 pounds of thrust to power large-cabin business jets and single-aisle airliners such as the A319. In addition to better performance in climb and cruise, the Silvercette is expected to be “environmentally friendly, with low levels of both noise and [GHG] emissions.”

Snecma believes the direct-flow engine, 74 inches long, will yield lower emissions. In fact, the company expects emissions will be 50 percent lower than ICAO CAEP6 standards. In addition, fuel consumption is expected to be 15 percent better than other engines in that class.

Williams International Plays It Close

Williams International, which traditionally plays its research and development cards close to the vest, says it has been improving engine efficiency by about one percent per year on the FJ44 since the FJ44-1A went into production in 1998.

“Our engines have a good combination of low NOx and low CO2,” said v-p of business development Matt Huff. “And all our engines fall into the zero emissions surcharges category for the Zurich model.”

The FJ44-4 was certified in February for Cessna’s new C34, and the FJ44-3AP is in the certification process, earmarked for Hawker Beechcraft’s Premier II, the Nextant re-engined Diamond/Beechjet 400 and the PiperJet single.

Also going through certification is the FJ33-5, intended for the Cirrus Vision and Diamond D-jet.

While engine manufacturers are rapidly developing new technology in search of leaner, cleaner and quieter turbosfans, hardware is not the only focus in the quest to provide power that is more efficient for customers and more environmentally friendly for government agencies and public watchdog groups.

Alternative fuels are also under examination (see story on page 30), as are changes to the processes that control air traffic aloft and on the ground (see story on page 24).

Since none of these is the elusive silver bullet, the solution will
The alternative aviation fuel industry continues to conduct flight tests to validate the use of new jet-fuel blends. At the end of April, United Airlines became the first U.S. commercial carrier to fly using a certified synthetic-fuel blend that received ASTM approval last year. The 40/60 mix powered one of the engines on an Airbus A319 in an engineering validation flight that departed Denver International Airport and reached an altitude of 39,000 feet. The drop-in fuel, supplied by Los Angeles-based producer Rentech, was derived from natural gas and converted to liquid through the Fischer-Tropsch process.

“This flight confirms our assumptions about how this fuel performs on a commercial aircraft in a variety of situations and represents the next step in our effort to stimulate competition in the aviation fuel supply chain, promote energy security through economically viable alternatives that also demonstrate environmental benefits and contribute to the creation of green jobs,” said Joseph Kolshak, United Airlines senior vice president of operations.

That test flight followed one by the U.S. Navy, which for the first time operated one of its fighters on a biofuel blend. On Earth Day (April 22) an F/A-18 dubbed the Green Hornet took to the skies over the Navy’s flight-test center at Patuxent River, Md., powered by a 50/50 mix of camellia-derived biofuel supplied by Honeywell subsidiary UOP, which has developed the technology for the fuel under a contract from the U.S. Defense Advanced Research Projects Agency (Darpa) to help satisfy the service’s stated goal of meeting half energy needs with alternative fuels by 2020. UOP also supplied the fuel for the June test flight of a Royal Netherlands Air Force Boeing AH-64D Apache, the first use of sustainable aviation biofuels by a helicopter. In this case a blend derived from algae and used cooking oil powered one of the Apache’s engines, which required no modification for the demonstration.

Financing Options
While such flights provide a boost to the quest for alternative energy, this would-be industry faces deeper issues as it attempts to achieve relevancy in terms of the global jet-fuel supply. Companies such as UOP and Rentech have proved that alternative aviation fuels can be produced, and test flights have demonstrated their use, but exactly how to finance the construction of refineries and the growing of feedstock in quantities sufficient to meet the thirst of the aviation industry was one of the key topics at the recent Advanced Biofuels Leadership Conference.

“Who is going to pay for all this really is a question,” said conference organizer Jim Lane. Opinion varies widely on the question of exactly how much capital is needed to jump-start the industry. One biofuel executive estimated the need for a $20 billion investment in refineries, plus a similar amount to stimulate feedstock production, while another viewed that number as excessive. According to Lane, the current predicted capital cost for an alternative fuels refinery ranges from $2 to $12 per gallon of output. With plans calling for most refineries to be capable of producing 100 million gallons per year, the potential financing needed could be significant.

“Aviation biofuels is a 60-billion-gallon-per-year behemoth, so you could do the math,” said Lane. “You could get to $360 billion and I wouldn’t blink an eye.” Given those numbers, the availability of financing still represents a major hurdle for the industry. “To get project finance in this area you need to have a feedstock contract with a long-term fixed price from a credit-worthy supplier; you need to have an off-take contract [an agreement with a customer to purchase the producer’s entire output] with a long-term fixed price with a credit-worthy buyer; you need to have a proven, stable, safe, reliable technology. The biofuels industry doesn’t have any of that,” explained Lane.

At the end of last year, the government—through the Departments of Energy and Agriculture—handed out approximately $600 million in biorefinery funding, the biggest chunk of it earmarked for pilot and demonstration-scale projects to help accelerate the commercialization process. While the ASTM last fall approved the use of the Fischer-Tropsch process for synthetic jet fuel blends, and is expected to do the same for advanced biofuel blends this year, getting full-scale production of these fuels going will still take time. Refinery technology specialist UOP developed the green jet fuel process—which uses natural oils from non-food crops such as jatropha, camellia and algae to produce bio-derived synthetic paraffinic kerosene (bio-SPK)—and expects to announce the first licensees for its technology later this year.

“When from [biofuel producers] say they are going to license the technology it will take 24 to 30 months to get the unit up and running,” said Jennifer Holmgren, UOP’s former v-p and general manager of renewable energy and chemicals. “My expectation is that by the end of 2012, there will be biojet [fuel] production in place. I would say in the range of a couple of hundred million gallons and then working to a billion gallons in the 2015-2016 range.”

Once production starts it might still take some time before alternative aviation fuels make an impact on the market. “Building 10 billion gallons of [alternative aviation fuel] capacity can take a while,” said Lane. “The entire biofuels industry by comparison has around 30 billion gallons of capacity worldwide and that’s taken most of 25 years to build.”

Even when the alternative fuels arrive in quantity it might take some time before they find their way into the tanks of business aircraft. As production increases, the price for alternative fuels will presumably descend to the range of standard jet fuel, but until then, much of the supply will be used by the military and by commercial carriers.

At the end of last year, potential large-scale alternative fuel providers Rentech and AltaFuels announced they had signed non-binding agreements with numerous airlines to provide hundreds of millions of gallons of renewable jet fuels starting in 2012. In March the Air Transport Association (ATA) and the U.S. Department of Defense announced a strategic alliance. The joining of the world’s two largest consumers of jet fuel—the on the order of 1.5 million barrels a day—was aimed at spurring the growth of the alternative fuels market, as well as leveraging efforts and research between the two groups.

Based on its tremendous thirst for jet fuel, the alliance is expected to have a large impact. “If it weren’t for the airlines and the military saying that they are willing to buy fuel in advance of it actually being produced, then I don’t think there is any hope for these things to move forward right now,” said Holmgren.

Report continues on page 32

Alternative fuels still face hurdles
by Curt Epstein


Eurocopter and parent company EADS have teamed with Argentina-based Bio-Combustibles del Chubut (BC) to study the feasibility of building an aviation biofuel factory in Brazil. The three companies signed an agreement in June. The biofuel, made from algae, could be used in Eurocopter’s diesel engines for light helicopters, which are now in the research stage (see AIN, February, page 44). While Boeing has touted jatropha—a vegetable that grows in arid soils—as a potential source for biofuels, EADS is betting on algae. “It can grow in salted, not-so-clean water and needs only one-twentieth of the surface jatropha would need to produce the same amount of fuel. Moreover, algae culture is CO2 intensive. According to EADS chief technology officer Jean Botti, one pound of algae absorbs 1.7 pounds of CO2. In fact, it absorbs so much CO2 that a production facility would need to be located next to a plant that emits a lot of CO2 and located near an airport. The CO2 would be captured and fed to the algae. "EADS’s and Eurocopter’s goal is to de-reference a ‘drop-in’ biofuel solution that aircraft could burn with no modifications. EADS has been flight-testing a demonstrator—a Diamond Aircraft DA42 New Generation powerted by two Austro Engine AE300 diesel engines, fed with algae fuel. "The only modification we had to do was to turn down the injection nozzle a little, because biofuel is more efficient than conventional jet-A1 and otherwise the combustion chamber would overheat," an EADS spokesman told AIN. EADS and Eurocopter are not divulging a timetableView of developing algae-based biofuel and are focusing on technology for mass production, which they hope will reduce the cost. The biggest challenge is to set up a decentralized network of algae producers and refineries that can operate without subsidies," the spokesman explained.

While an algae-based biofuel is greener than conventional petroleum-based fuel because algae absorb CO2, it is not carbon neutral. In Germany, the Bavarian aerospace research and technology program is funding work—the “Bay68” project—to determine the CO2 emissions at every step of the process chain. “In particular, one needs to look at the harvesting and drying of the algae biomass, the oil extraction process [several methods], the refining of the oil into fuel [which needs hydrogen] and all logistics and transportation needs,” the spokesman said. Algae-based fuel also reduces other emissions compared with traditional jet A. According to EADS, tests indicate that exhaust gas contains eight times fewer unburned hydrocarbons, Nitrogen oxide (NOx) and sulfur oxide emissions will also be reduced, by as much as 40 percent and 98 percent, respectively, as a result of the biofuel’s low nitrogen and sulfur content.

Eurocopter and its partners in Europe’s Clean Sky research project are about to launch a call for proposal on diesel engines for helicopters. The first call for proposal, issued last year, failed. This time, the project will require a greater reduction in weight, and the budget accordingly will be larger. —T.D.
EPA begins ruling process to phase out leaded avgas

by Curt Epstein

With the deadline for the comment period on the Environmental Protection Agency’s advanced notice of proposed rulemaking (ANPRM) to phase out leaded avgas having just passed, many in the industry remain galvanized for possible effects of the proposed mandate.

The EPA published the ANPRM at the end of April, stating its intention to determine whether emissions from aircraft using leaded aviation gasoline (avgas) cause or contribute to air pollution, which can endanger public health. While the Industry Avgas Coalition, a group consisting of aviation associations such as NBAA, AOPA and NATA, along with petroleum industry representatives asked the agency to extend the deadline to the end of October, the EPA settled on August 27.

The 107-page ANPRM was issued in further response to a 2006 petition submitted by the environmental activist group Friends of the Earth titled “Petition for Rulemaking Seeking the Regulation of Lead Emissions from General Aviation Aircraft Under § 231 of the Clean Air Act.” Section 231 of the Clean Air Act establishes the EPA’s authority to regulate aircraft emissions of air pollution.

The most recent revision of the National Ambient Air Quality Standard, formulated in 2008, found that serious health effects could result from much lower levels of lead than previously believed. The standard did not identify a safe level of lead exposure. Under the Clean Air Act, if the EPA administrator determines lead emissions from the use of leaded avgas “cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare,” then the agency would be mandated to establish emissions standards for piston-engine aircraft in conjunction with the FAA. Establishment of such standards would include evaluating the technical feasibility of reducing or eliminating leaded aviation gasoline.

For future aircraft, this could mean a requirement that all newly manufactured general aviation piston engines run on unleaded aviation gasoline by some future date. For in-service aircraft, the EPA acknowledges greater technical and logistical hurdles. “In many cases, the implementation of this concept might depend upon efforts and actions of aircraft and engine manufacturers in identifying the necessary modifications and developing hardware as necessary,” the agency noted.


“Given the potentially large number of affected aircraft and the potential complexities involved, a program affecting in-use aircraft engines would need careful consideration by both the EPA and FAA, and the two agencies would need to work together in considering any potential program affecting the in-use fleet,” the EPA continues on page 35.

Committee studies eco-friendly production, dismantling

Operating an aircraft accounts for 80 percent of the machine’s lifetime environmental footprint, according to a newly released Dassault study. Manufacturing and dismantling account for the remaining 20 percent, and Europe’s Clean Sky research initiative includes an €80 million ($104 million) project called EcoDesign-Airframe, co-led by Dassault, aimed at greening aircraft cradles and graves.

In parallel with the research effort, Dassault has begun making its production process less polluting. It is using less hexavalent chromium, which is carcinogenic, mutagenic and reprotoxic. In addition, Dassault is also eliminating cadmium and lead from its production processes. Chemical machining is being replaced with mechanical machining.

“The environmental impact of carrying parts and subassemblies by road from one production site to another is not negligible,” noted Jerome Lery, project leader for EcoDesign-Airframe, so the EcoDesign-Airframe project aims to minimize road transport of components that are at intermediate manufacturing stages.

That they are lighter, but metal suppliers point out that aluminum is more widely recyclable than composites are. Although the company plans to use composites in more primary structures, aluminum will continue to play a role. New aluminum-lithium alloys are about 5 percent lighter than conventional ones.

To improve the metal buy-to-flying ratio (that is, to reduce scrap), Dassault favors adding material over removing it, or using welding or laser sintering rather than machining. When metal chips have to be produced, they can be compacted to reduce the number of trucks required to collect them. Dassault is already using this technique at its Seclin factory.

In the cabin, so-called bio-composites could make furniture closer to nature. Bio-fibers are already in use in the automotive industry. They come from hemp, flax or nettle.

Dassault research to improve dismantling at the end of the aircraft’s life is more embryonic since few Falcons have been withdrawn from service. Nevertheless, EcoDesign-Airframe’s mission centers on sorting materials.

In the works is a portable device to identify the various aluminum alloys. Dassault also has contracted Tarmac Aerosave, a company based in Tarbes, France, to dismantle the first Falcon 900 airframe with an eye toward greening such operations. Work started in June and the results were expected at the end of the summer.

EcoDesign-Airframe aims to have technologies ready for demonstration by 2015, for the possible launch of a program in 2018-2020 and deliveries in 2025, Lery said.

While the EPA issued an ANPRM for the gradual phase-out of 100LL, there is no drop-in replacement for it yet.

FAA Awards $125M in Green Contracts

Five aerospace companies have been awarded a total of $125 million in contracts as part of an environmental initiative to spur development of new aircraft technologies. Each company—Boeing, General Electric, Honeywell, Pratt & Whitney and Rolls-Royce North America—will receive $25 million and is required to match the contract in terms of resources. It is part of the FAA’s Clean (continuous lower energy, emissions and noise) program. According to FAA Administration Randy Babbitt, the goal is to support the use of new technologies on commercial aircraft as early as 2015 and get them into service as soon as possible.

The projects under development range from alternative aviation fuels, engine noise reduction, open rotor to geared turbine technology, and advances in air traffic and ground control.

Honeywell Launches New Emissions and Monitoring

Honeywell is offering a new emissions monitoring service for business jets operating in European airspace to assist in compliance with European Union emissions trading scheme (EU-ETS) requirements. Phoenix-based Honeywell will compile and store carbon emissions data based on flight plans, number of passengers and freight information for business jet operators. The service is part of Honeywell’s flight support service through its global data center at www.mygcd.com. “The new emissions monitoring service will help operators comply with regulations, save time and help take some of the mystery out of this new reporting requirement in the EU,” said Honeywell’s v-p of marketing and product management Carl Esposito.

Boeing Headquarters Earns EPA Energy Star

Boeing’s Chicago downtown headquarters has earned the U.S. Environmental Protection Agency’s Energy Star, indicating that the building performs in the top 25 percent of comparable facilities nationwide in terms of energy efficiency. Improvements to the building’s automation and lighting systems helped reduce energy consumption and costs. The EPA introduced the Energy Star program in 1992 as a voluntary, market-based partnership to reduce greenhouse gas emissions through energy efficiency.

Rockwell Collins Plays Key Role in Green Connection Evaluations

Rockwell Collins, as a member of a consortium of industry partners led by Swedish air navigation service provider Luftfartsverket (LFV), has been awarded an active role in the Atlantic interoperability initiative to reduce emissions (Aire) project, also known as Green Connections. The consortium includes partners LFV, Swedavia, SAS Scandinavian Airlines System, GE Aviation and Rockwell Collins. It represents a continuation of work done among the partners to develop initial concepts to be applied to the project. Rockwell Collins will provide connectivity services to allow exchange of flight management system-generated trajectory and time information between the participating aircraft movements and the ground-based metering functions. In addition, the Cedar Rapids, Iowa-based aerospace company will be responsible for analyzing the effects of winds aloft, air traffic constraints, revisions in the trajectory, cost index and other factors on movement trajectory and time.

–K.J.H.
Business Aviation & the environment

OEMs embrace more-electric aircraft systems

by Thierry Dubois

Business jet manufacturers are quietly progressing toward more-electric architectures, where electricity replaces hydraulic and pneumatic power in systems such as brakes, landing gear or even control-surface actuation. This avoids the use of environmentally unfriendly hydraulic fluids and ultimately should help reduce fuel burn.

The use of hydraulics has several disadvantages. First, hydraulic fluids sometimes leak, a negative for an industry looking to improve its perceived environmental impact. In addition, hydraulic fluids complicate maintenance and are difficult to recycle.

At the same time electric technology has improved rapidly in recent years. For example, motors have become smaller and can be integrated more easily.

As a result, this technology holds the promise of becoming competitive with traditional hydraulics in terms of power-to-weight ratio. An electric system is not necessarily going to be lighter than its hydraulic equivalent. However, once all the systems are integrated, it is likely that weight savings can be achieved at the aircraft level. This, in turn, will translate into lower fuel burn.

As a result of the interest in more-electric architectures Dassault is coordinating, with the Fraunhofer Institute, a €37 million ($48 million) European research project called EcoDesign-Systems as part of the Clean Sky program.

More-electric Systems

Which systems look easiest to electrify? “We are a system architect and we look at the big picture, not at how easy or difficult a system is to electrify,” Philippe Rostand, Dassault’s head of future Falcon programs, told AIN. He is hoping for greater energy efficiency at the aircraft level.

Electric systems are more flexible. This is especially true if there is a single source of power rather than a combination of electricity, hydraulics and so on. For example, with an electric system, pressurization can be interrupted to extend the landing gear. Such “smart shedding” means that generators do not have to be oversized, producing a more efficient architecture.

The power available today on electro-mechanical actuators is suitable for business aircraft, although it is not sufficient to move the control surfaces of a large airliner. Nevertheless, business aircraft may not become “all electric” in one shot. “We are doing a lot of iterations,” Rostand said. Dassault engineers are studying all-electric configurations. They are also evaluating the merits of combined electric-hydraulic configurations, with and without taking bleed air from the engines.

“Some of our actuators are electric already in secondary flight controls,” Rostand pointed out. Spoilers, for example, are already electric and primary flight-control surfaces (such as ailerons) will follow.

Gulfstream is already using electric backup hydraulic actuators (EBHAs) as the third source of power for the G650’s control system. An EBHA features a self-contained reservoir and an electric pump backup mode that allows it to operate even after a loss of aircraft-supplied hydraulic fluid.

The EBHAs have yielded a weight benefit for Gulfstream. Moreover, the parts count is reduced, since an EBHA combines hydraulic with electric power to move a single actuating piston. Dissimilar actuation (between the main and backup systems) also has safety benefits, and the G650 will use less hydraulic fluid than it would with hydraulics alone.

Incorporating the EBHAs is possible because motor pumps are smaller and batteries can now handle regenerative voltage from electric motors, a Gulfstream spokesman said.

Gulfstream has encountered several challenges with this project. The first has been attaching electric motors to wing spars. Another challenge has been performance at high rates and loads. Finally, system reliability has to be thoroughly proven due to the use of more electronics.

Other manufacturers have also demonstrated an interest in more-electric technologies. Bombardier tested electric brakes on the Global 5000 in 2008. The trials have not yielded a business jet application yet, but Bombardier will fit an electric braking system to its C Series jetliner.

Hawker Beechcraft uses electric actuators on the Hawker 4000 for pitch trim and speed brake control surfaces. The rudder power control unit is a dual electro-hydraulic unit, which is lighter than a fully hydraulic unit, according to the airframer.
ANPRM proposes 100LL phase-out

Continued from page 32

ANPRM stated. According to the document, the FAA would also be required to prescribe standards for the composition or chemical or physical properties of piston-engine fuel or fuel additives to control or eliminate aircraft lead emissions.

A ‘Persistent Pollutant’

“In the 20 years of working on this and testing of many hundreds of different variations of fuels, it has been determined that nothing does what tetraethyl lead does as well, as efficiently or as economically,” said Rob Hackman, AOPA’s vice president of regulatory affairs. “At this time there is no ‘silver bullet’ replacement for 100LL. There are some potential solutions out there that are being further researched, but to date we haven’t come up with something that we can just drop in seamlessly.” Of those solutions, two that show promise and have been flight demonstrated are offerings from General Aviation Modifications (GAMI) and Swift Enterprises. GAMI has tested its 100UL fuel in a Cirrus SR22, while Swift demonstrated its 100SF at Sun ‘n’ Fun by powering a Piper Seminole. “The general aviation avgas coalition looks forward to seeing data from GAMI, Swift and any others who may have a potential solution,” said Hackman. “With that data we can examine the production, distribution, performance, emissions and economic impacts associated with any given proposed alternative.”

The EPA classifies lead as a persistent pollutant; particles of the heavy metal that are dispersed through the air as emissions will eventually settle and contaminate soil or water. Piston-engine aircraft operating on leaded avgas represent the largest source of aerial dispersal, contributing about half of the National Emission Inventory in 2005, according to the agency. Of the approximately 27 million hours flown by general aviation aircraft in the U.S. annually, piston-engine aircraft account for approximately 66 percent. Across the country, leaded avgas can be found at nearly 20,000 airport facilities, and the EPA estimates that up to 16 million people reside near facilities servicing piston-engine aircraft that are operating on leaded avgas. Recent monitoring studies indicate that lead levels in ambient air at and near airports serving piston-engine aircraft are higher than lead levels in areas not directly influenced by a lead source.

When the EPA issued the ANPRM, it requested public input on its available data, which the industry avgas coalition members described as “a key opportunity for the general aviation community to provide comment regarding this possible new environmental standard and into the development of a plan for identifying, evaluating and ultimately transitioning to an unleaded fuel.” According to the avgas coalition, industry organizations have devoted more than 20 years of research and development to identifying a viable alternative to the 100 “low lead” avgas formulation currently used by most piston-powered aircraft. These organizations “look forward to continuing their work with the EPA and FAA on establishing a realistic standard to reduce lead emissions from GA aircraft along a transition timeline that balances environmental benefit with aviation safety, technical feasibility and economic impact,” according to the coalition.

In June, the coalition detailed its future avgas strategy and transition (Fast) plan, which it believes will help ensure the availability of 100LL until a replacement is created. The plan identifies several goals: establishing a process to develop a viable unleaded alternative to 100LL; creating incentives for the development of high-octane unleaded avgas; establishing a transition timeline that addresses aviation safety, technical feasibility and impact upon the GA and avgas industry; and minimizing potential impacts of EPA actions upon GA.

Sen. Mark Begich (D-Alaska), co-chair of the Senate GA caucus, also voiced his concerns about the proposed phase-out of 100LL before “a suitable, affordable replacement is found.” Noting his constituents had “six times more pilots and 16 times more airplanes than the rest of the country,” Begich said the premature regulation of leaded avgas would have a substantially negative impact in his state. “At this point the potential costs to Alaska associated with regulating avgas far outweigh the benefits and threaten to leave Alaska’s rural communities without a reliable means of transportation.”

In response to the growing criticism, at EAA AirVenture in Oshkosh in July, the EPA told the coalition that it will work with the GA industry and the FAA, as it seeks a safe and viable alternative to leaded avgas. In a letter, the EPA said it “has not established or proposed any date by which lead emissions from aircraft operating on leaded avgas would need to be reduced. In fact, the EPA does not have authority to control aviation fuels,” the letter stated, in a nod to the FAA’s jurisdiction.

As the matter has only just begun its legislative journey, it may be some time before operators can expect any regulatory action, according to Hackman. “I tell folks that this is a marathon, not a sprint. It’s a little early to speculate, but I think we are looking at a number of years for this all to play out.”

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