IT'S NOT EASY

FLYING GREEN

The airline industry is now facing another stiff challenge—this time from so-called environmentalists who are focused on reducing the amount of greenhouse gases (GHGs) emitted into the atmosphere by transport aircraft. Although the North American section of the industry has been largely spared so far, a wave of anti-aviation sentiment has already swept through Europe and is virtually assured of washing up on our own shores in the foreseeable future.

While the subject of global climate change has been a strong focus of interest in the United States for some time, it has been generally recognized that aviation contributes only about 3 percent of the total amount of carbon dioxide (CO_2) emissions from all sources and has been spared overt criticism. The same is not true in Europe—so-called environmentalists have tarred the airline industry with charges that its pollutions will ultimately result in a global catastrophe, in particular because of current and projected airline growth rates over the next two decades. "Plane Stupid" and other European environmental groups launched protests in the U.K. throughout August. The protests included action by one group to commandeer a barge delivering an A380 wing, on the basis that the large aircraft will encourage people to fly. Such environmentalists' stated goals are to see airport expansion plans scrapped, a tax levied on aviation fuel, and short-haul flights ended. Even Richard Chartres, Bishop of London and the Church of England's third most senior figure, said in an interview with U.K.-published *The Sunday Times*, "Making selfish choices such as flying on holiday or buying a large car are a symptom of sin."

Such radicalism has influenced the public discourse. These kinds of statements, and many more like them, have had a strong impact on public opinion and government policy regarding aviation's future in Europe. The European Union Emissions Trading Scheme (EU ETS), which began Jan. 1, 2005, instituted industry trading of CO_2 emissions allowances in commodity-like fashion and has since put the airline industry in its crosshairs.

The EU ETS is only one of a variety of international emissions trading schemes. In December 2006, the European Commission, the governing body of the EU, proposed legislation that would extend the EU ETS to civil aviation. Without the consent of their state governments, the draft legislation would mandate participation of non-EU airlines flying to and from the EU in 2012, one year after the measure would cover flights within the EU. Under the legislation, both EU and non-EU airlines would be mandated to cap the number of flights at a set value, then either reduce emissions or purchase the right to pollute more. The upshot is that U.S. and Canadian airline revenues could ultimately be sent, for example, to the coffers of a factory in a developing nation that switches from carbon-based fuels to solar power and thus has emissions allowances for sale on the ETS market.

Although even the scientific community does not unanimously embrace human activity as a primary cause of glo-

"WE HAVE A CHOICE. WE FLY LESS, OR FIND A WAY TO MITIGATE THE EFFECTS OF AVIATION ON THE ENVIRONMENT."
—ROBERT KOBEH GONZALEZ PRESIDENT OF THE COUNCIL OF ICAO, MAY 14, 2007

bal climate change, the political reality is that the airline industry must become less polluting, and be viewed as doing that, or risk having instituted draconian measures that will threaten future growth and better jobs for airline pilots. As evidence of this truth, numerous Fortune 500 companies now include an airline's effects on the environment as one selection criterion when purchasing air travel for their employees.

ALPA engages

"Pilots must have a seat at the table as emissions mitigations and future air traffic management plans are debated, developed, and implemented," said ALPA's president, Capt. John Prater, during ALPA's 2007 Air Safety and Security Forum. "We will not stand by and watch the North American airline industry be put at an economic disadvantage in the global market. ALPA wants to be certain that action to protect the environment is reasonable and rational, but only with the assurance that the economic health of the industry and its jobs are protected."

As a result of the developments in Europe and the need for pilots to be involved in any debate on environmental effects of aviation, Capt. Terry McVenes (US Airways), ALPA's Executive Air Safety Chairman, recently appointed the United MEC's central air safety chair, Capt. Mary McMillan, as the ALPA Safety Committee's director of Environment and Energy Programs. McMillan will be responsible for collecting information on the environment and alternative energy sources and share that knowledge with ALPA members and staff to help guide and inform the Association's decision-making.

McVenes says, "It will become very important for all of us, as an Association and as an industry, to put the debate about global warming into context and to provide the facts about aviation's role in the environment. The issue's technical aspects will affect the way we design our airplanes, the way we fly and train our pilots, the way we operate our airplanes on the ground and in the air, the way we interact with the ATC system, and the way we analyze incidents to prevent future accidents."

Among McMillan's first information-gathering initiatives, the 2007 Air Safety and Security Forum included a panel titled "Going Green: Aviation Safety Implications." The panel experts sketched out the science and policy context of global climate change as well as its potential implications for aviation safety.

McMillan summarized the role of CO_2 emissions in global climate change. "One of aviation's biggest contributions to atmospheric pollution is carbon dioxide, or CO_2, emissions," she said. "CO_2 is a function of the combustion of carbon-based fuel, the only fuel currently available for use by the air transport industry." McMillan went on to state that a direct relationship exists between the amount of fuel burned and CO_2 emissions: the more fuel burned, the more CO_2 is emitted. Through the combustion chemistry of carbon, each pound of fuel burned produces more than 3 pounds of CO_2. When deposited into the atmosphere, the CO_2 accumulates and becomes an anthropogenic, or human-caused, contributor to climate change. Conversely, by saving fuel, emissions are correspondingly reduced.

"ALPA is now focused on gathering information about the technological and alternative fuel solutions that could help," says McMillan. "We know the basic principles that must form a fundamental part of any plan to reduce emissions. A plan cannot compromise safety. It must consider that aviation is unique and that a one-size-fits-all solution that may work in other industries is not necessarily appropriate for the airlines. In addition, national airspace modernization must be at the core of any solution. And more research into the problem, and the new technologies that may help us address it, is essential."

Air traffic efficiencies

Procedures already exist to increase efficiency while at the same time decrease fuel burn, which helps to reduce emissions. These operations include required navigation performance/area navigation procedures, constant descent arrivals, use of Automatic Dependent Surveillance-Broadcast, tailored arrivals, and reduced vertical separation minimums. The FAA is committed to reducing carbon emissions through improvements in air traffic management, and the agency has signaled its intention to move ahead with mitiga-

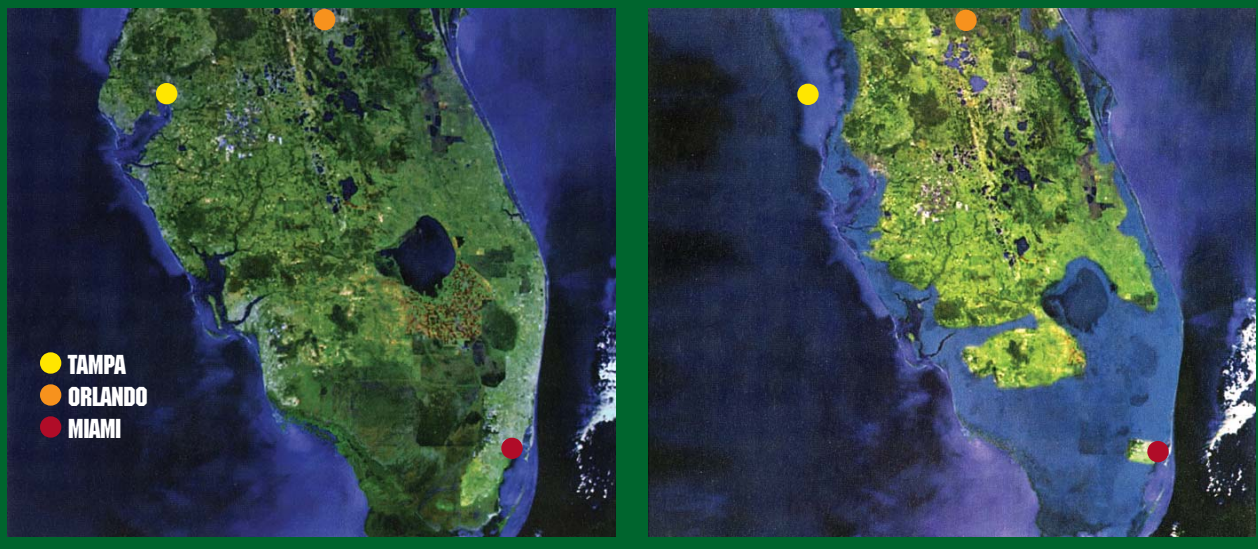
ALPA TO PUBLISH WHITE PAPER ON ENVIRONMENTAL AND ENERGY ISSUES

With one important exception—aircraft noise abatement—ALPA currently has no *policy* (i.e., a specific stand or response to an issue, approved by one of the Association's governing bodies) regarding environmental and energy issues. Nor has ALPA developed *positions* on specific environmental and energy issues.

The Association plans, however, to develop a "white paper" on these matters during the coming months. The white paper will be a milestone in crystallizing the Association's collective thinking on these important subjects.

ALPA already has begun to draw together resources from several departments—Economic and Financial Analysis, Engineering and Air Safety, Government Affairs, Legal, and Communications—to work on the many complex and interrelated aspects of these issues.—*Jan W. Steenblik, Technical Editor*

THIS IS WHAT COULD HAPPEN TO FLORIDA



Imagery from Al Gore's book, *An Inconvenient Truth,* depicts what could happen as a result of global warming. Sea levels worldwide could increase as much as 18 to 20 feet, leaving the Florida cities and airports of Miami and Tampa under water.

tion strategies that will result in more-efficient air traffic operations.

The Next Generation Air Transportation Management (NextGen) program in the United States and the Single European Sky air traffic management research (SESAR) program in Europe were conceived to help solve anticipated capacity shortfalls. Recently, however, environmental concerns are adding more impetus to the need to create more efficient air traffic management based on a fundamental relationship: the more efficiently air traffic is handled, the greater the reduction of aircraft emissions.

Influencing the outcome

"Climate change is difficult to debate dispassionately because the fundamental processes of civilization's success are at stake. It has the potential to create classes of winners and losers. ALPA is determined to assess facts and data and base policy decisions on accepted, proven science," says McMillan. "However, if we are to meet growth predictions, and the globally mandated CO_2 emission levels that we know are coming, the U.S. airline industry will need to radically work to limit emissions."

Action to limit emissions could include leveraging breakthrough engine and fuel improvements, curbing the current state of air traffic management inefficiency, and perhaps the most controversial remedy, seeking offsets in the carbon market.

In the near term, the amount of emissions that can be reduced by procedural modifications is significantly limited, given the current technology and fleet equipage. ALPA maintains that any changes to established procedures must pass safety risk assessments, regardless of the reason that they are undertaken. ALPA will also continue to monitor actions in Europe. There are multiple, interlocking environmental effects from noise, energy usage, and emissions, and all of them present significant challenges for the airline industry. The climate change issue is here to stay; and so is ALPA, in ensuring that the economic health of the U.S. airline industry, its jobs, and its safety will not be compromised.

ALPA AND ATA MEET ON ENVIRONMENTAL AND ENERGY ISSUES

On August 29, ALPA hosted a dialogue with environmental program staff from the Air Transport Association to share information and explore solutions to the environmental and energy challenges facing the U.S. airline industry. Below are ATA representatives, from left, Nancy Young, vice-president, environmental affairs; Betty Hawkins, managing director, international environmental affairs and assistant general counsel; and Tim Pohle, managing director, U.S. environmental affairs and assistant general counsel; plus Keith Hagy, director of ALPA's Engineering and Air Safety Department. Above, from top, are Capt. Chris Beebe, ALPA vice-president–finance/treasurer; Capt. Mary McMillan, ALPA director of environment and energy; and Jerry Wright, manager in ALPA's Engineering and Air Safety Department.

PHOTOS: WILLIAM A. FORD

Airline Growth—Incompatible with 'Going Green'?

By Capt. Paul Rice, First Vice-President, ALPA International; Deputy President, IFALPA

IN 2006, U.S. AIRLINES burned less fuel than they did in 2000—while carrying 12 percent more passengers and 22 percent more cargo. Today, aviation contributes less than 3 percent of the greenhouse gases generated worldwide.

While this degree of improvement in efficiency may be difficult to sustain year after year, many people are hard at work figuring out ways to decrease the fuel burn, emissions, and noise generated by the airplanes we fly to move all those people, boxes, and pallets from one place to another.

As an officer of both ALPA and IFALPA, I keep a keen eye on North American and global trends in the airline industry.

That industry, both at home and abroad, is enjoying a healthy revitalization: Travel demand is growing, particularly on international routes, and especially in such emerging markets as China and India. Across the globe, hub cities are growing larger. Airlines are adding capacity—again, especially on international routes. In North America, airlines have returned to profitability. Some have placed substantial orders for new airplanes.

But unrestrained growth of the airline industry, even assuming a healthy economy, is not a given. Airspace and airport capacity issues notwithstanding, Marion Blakey, then FAA Administrator, in March warned the airline community that "environmental issues may be the most serious, long-term constraints facing [the airline] industry."

We're talking about some huge economic issues here.

Right now, just in the United States, we're moving about 750 million passengers per year. Air transportation employs 9 million people in the United States alone, and contributes $640 billion per year to the national economy. The FAA predicts that, by 2015, we'll carry a billion passengers per year.

Worldwide, projections for passenger airlines are equally bullish: Capacity is expected to grow 5 percent per year in the near term. Legacy carriers are forecast to grow about 3 percent, while low-cost carriers (LCCs) will grow about 10 percent. (In 2006, LCCs flew about 18 percent of seats worldwide; by 2010, their market share is predicted to jump to 40 percent.) Regional airlines are expected to grow about 5 percent. Growth in international capacity is in the 5-percent range for 2007, with the biggest growth in the Asia/Pacific region.

Unit revenues are expected to increase 2-4 percent in 2007, and labor costs are predicted to increase, reversing the past several years of declines—good signs for airline pilots.

Air cargo will continue to be big business—internationally, air cargo is a $71 billion/year industry (including airlines, forwarders, and express companies). Approximately half of all air cargo worldwide travels in the bellies of passenger airliners; the other half travels in freighters.

AVIATION INDUSTRY LEADERS BELIEVE THAT, OVER THE NEXT COUPLE OF DECADES, THEY WILL BE ABLE TO ACHIEVE EVEN MORE EFFICIENCIES THAN THOSE ALREADY ACHIEVED FROM A VARIETY OF SOURCES, INCLUDING OPTIMAL USE OF ADVANCED MATERIALS, ADVANCED AIR TRAFFIC MANAGEMENT SYSTEMS, TWEAKING AIRFRAME AERODYNAMICS, AND INNOVATIVE ENGINE DESIGNS.

In the United States, air cargo nets more than $30 billion/year. Almost half of the world's air cargo traffic moves to, from, or within the United States. However, Asia is expected to become the dominant air cargo market by 2020.

Worldwide, air freight growth is predicted to stay between 4-6 percent in 2007, with the rate increasing slightly in 2008 to 5-7 percent.

Some alarmists have said recently that, if air traffic triples in the next 25–30 years, as forecast, aviation's

AIRBUS

BOEING

By combining aerodynamic refinement, simplified construction architecture and composite materials for weight savings, and advanced engine designs, airliners such as Airbus' A350, top, and Boeing's B-787 Dreamliner, above, will achieve significant fuel savings.

percentage contribution to greenhouse gases will triple as well.

Science tells a different story.

Aviation industry leaders believe that, over the next couple of decades, they will be able to achieve even more efficiencies than those already achieved during the first half-century of jet airline travel. The decreases in fuel burn they expect would come from a variety of sources:

- 5 percent from optimal use of advanced materials to build lighter airliners;
- 5–15 percent from NextGen and similarly advanced air traffic management systems in other countries, and associated procedures such as the continuous descent approach (CDA) concept;
- 10 percent from tweaking airframe aerodynamics; and
- as much as 25 percent from innovative engine designs.

Altogether, that adds up to reducing fuel burn by as much as 55 percent when compared to today's airline operations.

So while much work remains to be done, I see many reasons to be optimistic about the future of aviation technology.

Perhaps harder to predict—and to deal with—will be all the social, political, and economic aspects of the environmental issues confronting the airline industry, especially in Europe. The emissions discussion is one of the required components of Stage II of the current round of negotiations between the United States and the Europeans on air service agreements.

Questions already abound: Will Europe put restrictions on aviation carbon emissions? If so, how onerous will they be? Will they be the same for non-European airlines as for European carriers?

Will the airline industry be able to buy carbon emission "credits" from some other industry that will have an easier time reducing emissions? If airlines are forced to upgrade their fleets to meet environmental restrictions, will the new rules provide allowances for the unique circumstances and financial health of each airline?

Whatever the answers to these and other questions, one thing's certain—like it or not, the airline industry has entered a new era, and confronting the growing pressures to "go green" will be a mandatory checklist item for ALPA and IFALPA.

FLYING MORE, POLLUTING LESS

MITIGATING AVIATION'S NEW ENVIRONMENTAL DRIVERS.

By Carl Burleson and
Lourdes Maurice, Ph.D.,
FAA Office of Environment
and Energy

WE BELIEVE THAT THE U.S. NEXT GENERATION AIR TRANSPORTATION SYSTEM (NEXTGEN) INITIATIVE IS THE KEY TO ACHIEVE ENVIRONMENTAL PROTECTION THAT ALLOWS SUSTAINED AVIATION GROWTH. NEXTGEN IS UNDERTAKING VARIOUS ACTIVITIES FOCUSED ON ADDRESSING CLIMATE EFFECTS.

THE U.S. AIRLINE SECTOR has contributed less, not more, to growth in greenhouse gas emissions in recent years. U.S. airlines are consuming 5 percent less fuel through 2006 as compared to 2000. This translates into producing more than10 million fewer tons of carbon dioxide (CO_2) emissions. The U.S. airline industry achieved this even as it moved 12 percent more passengers and 22 percent more freight. This is substantially better performance than that of the overall U.S. economy. Nevertheless, as demand for passenger and cargo aviation continues to rise, the aviation industry has a responsibility to reduce aviation's carbon footprint even further.

The effects of aircraft emissions on the planet's current and future climate is a serious, long-term environmental issue facing the aviation industry. The last major international coordinated effort that focused solely on assessing the contribution of aviation to greenhouse gases was published by the Intergovernmental Panel on Climate Change (IPCC) in 1999. Aircraft were estimated to contribute about 3.5 percent of the total radiative forcing (a measure of change in climate) by all human activities; and this percentage, which excludes the effects of possible changes in cirrus clouds, was projected to grow.

The recently released Fourth Assessment Report by the IPCC notes that aviation CO_2 emissions account for about 2 percent of global totals. The report noted that mitigation of CO_2 emissions from the aviation sector can come from improved fuel efficiency, which can be achieved through a variety of means, including technology, operations, and air traffic management. However, such improvements are expected to only partially offset the growth of aviation emissions.

Today, scientists have a good understanding of the effect of aircraft-generated CO_2 on climate. However, large uncertainties remain in our present understanding of the magnitude of climate effects caused by other aviation emissions. Scientists still do not know the relative effect on climate of aviation oxides of nitrogen (NOx) emissions and contrails. Scientists also do not know the effect of particulates and their role in enhancing cirrus cloudiness. Better scientific knowledge is needed because there are often tradeoffs among emissions. For example, a more efficient engine that produces less CO_2 tends to produce more NOx.

We believe that the U.S. Next Generation Air Transportation System (NextGen) initiative is the key to

achieve environmental protection that allows sustained aviation growth. NextGen is undertaking various activities focused on addressing climate effects, including

- better scientific knowledge—understanding and quantifying the potential effects of aviation emissions to help policymakers address climate and other potential environmental effects associated with aviation;
- more efficient air traffic management—implementing operational changes and improvements to air traffic management to reduce fuel burn (hence emissions) of the aviation sector is crucial; and
- accelerated environmental technology development—the development and integration of promising improvements in engine and airframe technologies into the civil aviation fleets to quicken improvements in energy performance of the aviation sector is crucial to the NextGen concept of operations.

Energy availability is also a critical aviation issue, inextricably tied to environmental concerns. Efforts are under way to assess the potential for alternative fuels for airlines to enable energy diversity and reductions in aircraft emissions. The ultimate goal is to develop a viable, renewable "drop in" alternative fuel that does not require new engines or fueling infrastructure.

Ultimately, we need equitable and cost-effective measures that will ensure environmental protection as well energy diversity. The future is now, and for the sake of the future of the airline industry, as well as for the health and welfare and economic well-being of future generations, we must address environmental and energy issues. ▶▶▶

The Enviros Are Coming!

The Enviros Are Coming!

By Dr. Tim Bamber
British Air Line Pilots Association

WHILE I TODAY HAVE BEEN sitting writing this, the Conservative party in the U.K. has announced its policy on taxation ahead of a possible General Election in the autumn. I cut and paste the head note for you:

"Plans that would curb drastically the number of flights taken by British travellers are being considered by the Conservatives with new taxes on air travel and a halt to airport expansion.

"Short-haul flights would receive particular attention: VAT [value-added tax] would be levied on fuel for domestic flights for the first time and airlines would be forced to give over airport slots to long-haul trips. All flights would be subject to a separate per-flight tax based on the amount of CO_2 generated."

But, did you know:

- The most environmentally friendly form of transport over long distances is the airplane.
- The least environmentally friendly is the Urban Assault Vehicle.
- The aviation industry is responsible for only about 3 percent of carbon emissions.
- Aviation has been one of the principal driving forces of increased world prosperity.

Despite these facts, the aviation industry feels compelled to defend itself from a perception that has gained credibility: that aviation is the most damaging polluter, that we are complacent about the damage that we have done to the environment, and that unless aviation is curbed, civilization as we know it is doomed.

Whatever the actual reality, the perception is becoming fixed in the minds of the public. Sadly, no matter what the rights or wrongs of the arguments, it is a fact that he who lies first generally has his lies believed. Be it politics, cricket, or life, it is harder to play catch-up than to defend a lead.

DESPITE FACTS TO THE CONTRARY, THE AVIATION INDUSTRY FEELS COMPELLED TO DEFEND ITSELF FROM A PERCEPTION THAT HAS GAINED CREDIBILITY: THAT AVIATION IS THE MOST DAMAGING POLLUTER.

The activities and organization of our environmental lobby here in Europe with regard to climate change, and more specifically the anti-aircraft movement, are racing ahead. Check out YouTube and see the battle of Heathrow Airport recently waged by the Eco Warriors.

My purpose here is not to rehearse the arguments as to the damage that aviation is or is not doing to the environment. The British Airline Pilots Association (BALPA) has published some excellent and well-researched data on climate change, all referenced and peer reviewed. The website, www.balpa.org, is well worth a visit, both out of interest and as a site where the arguments for both sides are laid out clearly.

The website of The Enviro.aero, www.enviro.aero/FlyingChain.aspx, which is part of a global cross-industry

initiative that is supported and financed by commercial aviation, is excellent. Its purpose is to provide clear information on the many industry measures under way to limit the effects of aviation on the environment. It is a good interactive website that is excellent to direct people to when placed in a position where you and your industry are being vilified, usually by the dinner party participants in Greenwich Village or the like.

DID YOU KNOW: THE MOST ENVIRONMENTALLY FRIENDLY FORM OF TRANSPORT OVER LONG DISTANCES IS THE AIRPLANE? THE LEAST ENVIRONMENTALLY FRIENDLY IS THE URBAN ASSAULT VEHICLE.

Why is it important not to allow the Eco Warriors to get their message into the public arena first and unchallenged? Here I again draw upon the experience that we have had in Europe.

Once a relatively lightly taxed industry, aviation has become the cash cow of revenue-hungry governments. The UK government recently increased the taxation greatly on aviation, all in the name of being kind to the environment! Any dissention to this taxation was so muted that it failed to register, thus we can realistically expect another increase in taxation on our industry, all in the name of being kind to the environment.

The important lesson that we have learned from the UK when confronting this issue is to positively emphasise all the improvements that the industry is making to make us greener. At the euphemistic dinner party at the Hamptons when the inevitable occurs and aviation becomes the topic of conversation, make one point only, then leave the debate to others. That one point will be remembered—if the intention is to try to answer all our critics' points, then the arguments get lost in the fog of perceptions.

We have one great advantage going our way—even a Green Gatsby finds it preferable to let the airplane take the strain rather than cross the pond in an eco-friendly sailing boat. Being ready for the assault, and with careful handling, we can minimise the effect on our industry; if we fail, the consequences for aviation could be catastrophic. ▶▶▶

The New Buzz On Propfans

***AIR LINE PILOT,* MAY 1988,** carried an overly optimistic (but perhaps, in hindsight, prescient) two-page advertisement from McDonnell Douglas with the following text:

"NOTHING SHAVES FUEL COSTS LIKE OUR BLADES.

"That's because our revolutionary MD-91 and MD-92 will be the world's first commercial airliners powered by ultra-high-bypass engines.

"With twin GE Unducted Fan (UDF) power plants, nothing else will offer such remarkable fuel economy—up to 40% less fuel burn compared to today's most advanced twinjets.

"Nothing else its size will be as quiet for passengers and for airport communities. Or more comfortable for passengers.

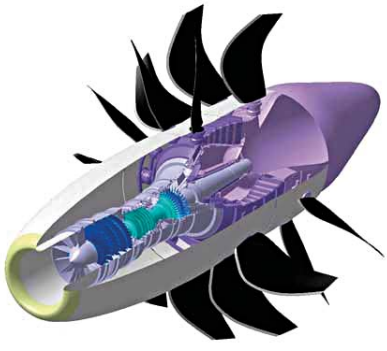
"Far more than a 'paper' airplane, our demonstrator aircraft has been in actual flight testing for nearly a year. This plane, an MD-80 with the GE engine mounted in place of one of its conventional jet engines, has logged more than 65 flights. Over 125 hours in the air. Executives of leading airlines around the world have already flown aboard the aircraft.

"As a result, we know exactly what this technology can do for airlines in terms of fuel savings and noise reduction.

"Now we're ready to talk.

"WE WERE THE FIRST. AND WE ARE THE FUTURE."

The next month, at the Farnborough Air Show, while the testbed MD-81 with the GE36 UDF buzzed overhead, Ron Welsch, then GE's general manager of commercial operations, said, referring to the presumptive commercial launch



ABOVE: GE's Unducted Fan (UDF) demonstrator in 1988. LEFT: Rolls-Royce open-rotor concept. ABOVE RIGHT: General Electric's GEnx, successor to the CF6, will power the B-787 and B-747-8. BELOW: CFM's LEAP 56 composite engine will have a fan diameter of 14 feet.

of the UDF, "It's not a case of *if*, it's a case of *when*."

But the "when" was not to be 1988. Though the GE36 UDF and the competing 578-DX "propfan" (a collaboration of Pratt & Whitney and Allison that later flew on the same MD-81 testbed) posted impressive fuel savings, they never made it to market: Too loud inside the airplane and out, said critics. Airline CEOs added, "Our passengers want to fly jets—not something that looks like a turboprop." And despite the fuel savings, jet fuel was still relatively cheap.

Today, Rolls-Royce, GE, and Snecma all have propfans (also called open-rotor concepts) on the drawing boards. Why?

Of all the technology solutions in the works to reduce airliners' fuel burn, noise, and emissions—including lighter airframes, improved aerodynamics, and modernized air traffic management—the greatest potential is still seen in jet engines themselves. And of all the engine concepts, the propfan concept offers the most dramatic improvements: 20–25 percent lower specific fuel consumption than high-bypass-ratio turbofans being built today.

But propfans aren't expected to enter airline service until 2020 or later. What, then, to fill the gap?

One of the most interesting of several evolutionary jet engine designs in the works is Pratt & Whitney's geared turbofan (GTF) proof-of-concept engine. The GTF's fan will turn at only one-third the speed of the rest of the low-pressure system, allowing the low-pressure compressor and the low-pressure turbine to spin as fast as 9,000 rpm. The slower fan speed also will permit building a larger-diameter fan, boosting efficiency and reducing noise.

P&W says the GTF will reduce fuel burn by 12 percent and maintenance costs by 40 percent while producing half the noise and emissions of current turbofans. That means coming in 15db below Stage IV noise limits, and lowering emissions as much as 70 percent below the CAEP/2 (European) limit.

The company believes the GTF's fuel efficiency, low emissions, and low noise will outweigh the complex airframe integration issues that face open-rotor engines. P&W plans to have the demonstrator engine (30,000 pounds thrust) running in the test cell by the end of this year, in flight tests in 2008, and ready for entry into service as early as 2012.

Pratt is looking at open-rotor concepts, too, in a long-term study. However, says Paul Adams, vice-president for engineering, the challenges of developing open-rotor engines include "making the installation practical," a nod to the propfan's necessarily large diameter, and "making sure the risk/performance benefits are there from a fuel-burn perspective. Right now, that technology just does not exist."

Much debate swirls already in the engine community about which environmental issue will take center stage—noise or emissions? The outcome will have large ramifications: Propfans are more efficient than conventional or geared turbofans, but hard to make quieter than current Stage 3-4 noise limits.—*Jan W. Steenblik, Technical Editor*