The Coming Narrow-Body Re-Engining Programs for the A320 and 737NG Families

The alternative to new aircraft programs

AirInsight

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Executive Summary

The headlines that will soon make news:

- China's COMAC selects the CFM International LEAP-X to power the C919, a new competitor to the A320 and 737NG
- Russia's Irkut selects the PW P1000G Geared Turbo Fan for the 150-200 seat MS-21
- Airbus and Boeing launch re-engine programs for their A320 and 737 families
- A320RE and 737RE will push out replacement airplanes until late in the 2020 decade
- Airlines are increasing pressure on Airbus and Boeing to make RE decisions sooner than YE2010

The implications of these headlines:

Airbus and Boeing are virtually certain to launch re-engining (RE) programs for the A320 and 737 families because customers are increasing pressure to provide dramatic Specific Fuel Consumption (SFC) improvements in the near term, preferably within the next five or six years. Airbus and Boeing now state that current generation single-aisle airplanes will be produced well into the 2020 decade. Cost overruns on the A380, A400M, 787 and 747-8 programs, with significant customer penalties, means neither Airbus nor Boeing can afford new airplane programs now.

Airbus is deep into the development of the A350 and Boeing is faced with how to best meet this competition. Two of the three A350 models are aimed squarely at the 777. With the 777-200 already reduced to a niche airplane in the -200LR and the -200LRF, Boeing must decide how to meet the challenge of the competing A350-900, with an EIS of 2013. The A350-1000, designed to compete with the 777-300ER, has a projected EIS of 2015. United Airlines, the launch 777 operator, selected the A350 in its recent order, underscoring the need for Boeing to replace the 777 to regain its historic competitive advantage in large twin engine aircraft. The 777 replacement decision facing Boeing, combined with the A350 R&D expenses at Airbus, further support the cheaper financial choice of launching A320 and 737 "RE" programs.

Airbus is on record saying it will make its decision by YE2010. Boeing is on record saying the business case for a 737RE is greater than first believed and that producing a derivative airplane is 20%-30% of the cost of developing an entirely new airplane. With continuing program challenges for the 787 and the decision to launch a second production line in the greenfield Charleston (SC) plant (construction begins in 2010, the first production airplane is scheduled in 2011 and full production of three per month in 2012), Boeing needs to take the more conservative route on a major upgrade to the 737.

Customer pressure is increasing on the OEMs to launch RE programs sooner than the end of 2010. With slow economic recovery and fuel hedging uncertainty, the only sure way to reduce fuel costs is with improved engine technology. New technology alternatives are arriving from Pratt & Whitney (P&W) and CFM. Rolls-Royce is also investing R&D in the RB285. The market is well aware of potential SFC gains that engine manufacturers could deliver by 2015.
With Airbus launching the A320 Sharklet program, a winglet that will improve SFC by about 3.5%, an A320RE will boost SFC savings to about 14% and leaves Boeing with little choice but to proceed with a 737RE.

The emerging Chinese aerospace company COMAC has selected the CFM International LEAP-X engine for its C-919 150-seat jet, according to our sources. COMAC desires to begin flight testing in 2014, with an EIS into revenue service in 2016. Russia’s Irkut selected the P&W P1000G for its 150-200 seat MS-21. Both these events put further pressure on Airbus and Boeing to re-engine their airplanes. While one can be skeptical about the market potential of the C919 and MS-21 outside the home countries—and we are—the sales within the home countries, likely dictated by the governments, will mean loss of significant sales to Airbus and Boeing.

Boeing’s 737 Classic and NG series are exclusively powered by the CFM-56 and the exclusive supplier contract is believed to have been extended to 2014. While it is assumed that CFM will become the supplier of a 737RE -- a 70% probability, in the view of one observer -- Boeing is known to be talking to Pratt & Whitney about the P1000G Pure Power, more commonly known as the GTF or Geared Turbo Fan. Although the P1000G has a larger fan diameter than the LEAP-X, Boeing has tentatively designed a solution that extends the engine pylon out and up to accommodate either the P&W or CFM solutions.

Although Rolls-Royce is developing the RB285, we believe it highly unlikely that Rolls will become a third provider for single-aisle engines. The company is developing the Trent 1000 for the Boeing 787 and the Trent XWB for the A350 as well as focusing on the prospect of an Open Rotor engine for an entirely new generation of A320/737 successors. We do not believe RR has the financial or engineering resources to become a third (or even a fourth) party with the RB285. We believe it more likely that technology from the RB285 might have application to marry with the P&W GTF to be offered through their joint venture, International Aero Engines (IAE).

Airbus is commonly believed to be leaning toward the P1000G. Airbus mounted this engine on the A340-600 testbed and conducted a wide variety of tests for P&W. The engine is scheduled to be available about a year before the LEAP-X. John Leahy, Airbus COO-Customers, stated that this engine would have to be offered through P&W partner IAE for Airbus to be interested, a prospect P&W has long considered. The likelihood is further supported by the fact that IAE partner Rolls-Royce is well behind P&W with its equivalent engine in this class. It is entirely possible Airbus will continue its relationship with CFM by offering the LEAP-X on the A320 family as well.

There are many issues Airbus and Boeing must consider before proceeding with RE programs, including these key factors:

- The cost and return on investment;
- How long must the customers operate these engines to achieve their ROI;
- What would RE aircraft do to the sales and residual values of the current generation of airplanes;
- How long to stick with an RE program before launching a replacement airplane;
- Prospects for customers to finance what will be immediately recognized as interim airplanes;
• Residual value impacts and assumptions;
• Lease rates lessors could assume in order to cover their capital costs; and
• The offsetting capital cost to the customer vis-a-vis the SFC savings, and savings to justify the capital cost.

**OEMs Face Major Challenges**

The two biggest aircraft OEMs face a difficult challenge. On the one hand they have robust order books for single aisle aircraft. This is especially compelling in the midst of the worst downturn the airline industry has ever faced. Fortunately for the OEMs the 2008 oil price shock ensured that airlines remained loyal to these orders - largely rescheduling A320 and 737 deliveries as cash flows shrank, but not canceling orders.

On the other hand, the OEMs are under pressure from airline customers to seek and introduce even lower SFC costs. For example, Airbus is being strongly encouraged by Qatar Airways to re-engine its A320 family. Air France is also pressuring Airbus to dramatically improve the operating expense of its single-aisle models.

For Airbus, the threat is that absent a re-engine program, Qatar says it will order Bombardier’s CSeries, which while at the smaller end of the A320 family (110-149 seats) nonetheless is a direct threat to the A319 (and 737-700) market segment. At Boeing, its largest 737 customer, Southwest Airlines, has been demanding a solution with 15% lower SFC. Southwest says it cannot wait 10-15 years for an entirely new airplane with the goal of 25% or more gains in SFC; efficiency is needed "now." The CSeries provides them such an option and this cannot be ignored by Boeing as it once would have been. Ryanair is about to walk away from a possible order for 200 737s, albeit for reasons other than fuel, but the ever-aggressive Ryanair CEO Michael O’Leary has also been agitating for a more efficient airplane.

The threat to the current generation A320/737 families may be further illustrated by an evaluation now underway by Republic Airways, the parent company to Midwest Airlines, Frontier Airlines and two regional carriers. Frontier is an exclusive operator of A319/A320s (having disposed of its A318s in bankruptcy reorganization). Leases on 48 of their airplanes expire between 2013-17. Republic has begun an evaluation of Bombardier’s CSeries, which with 110-149 seats may easily replace the A319. Powered by the P&W 1000G, the CSeries promises a 12%-15% improved operating cost over the A319/A320. Airbus must meet this in the future in order to protect A319 sales.

Additionally, United Airlines put off its narrow-body Request for Proposals to 2010 and expanded it from focusing on a replacement for the aging Boeing 757 to a full study of 100-200 seats. United already said Embraer will be invited to bid, presumably with its largest E-Jets. Bombardier will certainly bid its P1000G-powered CS-300 and probably its CS-100. We believe it likely Airbus will offer its A320 family with RE; we believe Boeing will have no choice but to bid a 737RE as well. It should be noted that Embraer has not yet announced its intention to stretch its E-190 but we understand this project is quietly being developed to compete with the CSeries. Consequently Airbus and Boeing are going to face rising pressure from competitors.
For both OEMs the 15% number is the watershed. If they can deliver cost savings of at least this level, the OEMs face the very difficult issues outlined above before they make their decisions.

Two years ago P&W told one of the authors of this report that a $1bn investment and four years are needed to upscale the P1000G designed for the Bombardier CSeries to a model large enough for the 737/A320 size aircraft. A P1000G-powered A320 could be ready for 2015 revenue EIS; the LEAP-X engine revenue EIS is estimated to be a year later.

With a re-engining program, Airbus and Boeing face uncertainties over the current robust order book. When Boeing created what later became known as the 737 Classic, sales of the 737-200A dried up and appraisers forecast sharp declines in residual values of this model, affecting financings by buyers of the airplane. This repeated itself when Boeing developed the 737NG to succeed the Classic. Airbus has yet to experience this phenomenon but obviously officials know their history and the executives and sales forces at both companies must take this into consideration not only for the prospective RE programs but also these factors for how long to rely on REs before launching the Replacement (RS) airplanes.

Clearly the rationale for REs exists. Airbus and Boeing have to consider more than airplane sales and residual values. Arguing in favor of an RE is that both OEMs have existing new programs that have seriously impacted cash and engineering resources. There are also several new programs in development from emerging competitors in Brazil, Canada, China, Japan and Russia that further pressure the demand for aerospace engineers. While the debate over the viability of these emerging programs remains heated, we believe that national goals means that several of the emerging competitors will produce viable products that will encroach into the market shares of Airbus and Boeing. Dramatic makeovers of the A320 and 737 families is, in our view, a must.

We believe that airline demands will force the OEMs to re-engine their narrow-body aircraft, with decisions coming as early as the third quarter in 2010.

P&W is in the lead, with its PurePower series about to complete its tests. Reports from the field indicate the engine has been getting better through its testing and beating initial expectations. The company has run the engine up to 40,000 pounds of thrust - double what the first commercial versions on the CSeries and MRJ have and what is required for the A320/737 class. Moreover, wear on the expected Achilles heel, its complex gearbox has apparently been solved through clever lubrication piping. This design is so clever that tests on the A340 testbed at radical angles of attack barely required the lube pumps to activate. Still, maintenance costs remain an issue, running about 2% above current generation engines.

General Electric has been doing tests on its next generation engine, the LEAP-X. This engine, although following a traditional turbofan path, has promised to deliver substantial improvements in fuel burn, noise and pollutants. The engine has not yet flown and tests continue. The Leap-X will utilize technology lessons from the GEnx engine developed for the Boeing 787 and 747-8.

Rolls-Royce has been exceptionally quiet about its plans. To date the only news has been limited information on the company's RB285, a three shaft advanced turbofan. Rolls-Royce
has long favored an unducted fan (Open Rotor) as the way ahead. But in deference to the fact that OEMs are looking at underwing solutions, the unducted fan becomes too large for consideration. The RB285 will, apparently offer 15-20% efficiency improvements, which would exceed the P1000G and LEAP-X if true, but timing and resource challenges may conspire to leave the RB285 grounded for a RE program. Interestingly, Rolls-Royce believes that in an advanced turbofan a three-shaft RB285 could deliver the better efficiency benefits as P&W’s PurePower engine, without a gearbox. Rolls-Royce’s marketing manager Simon Littlejohns has been quoted as saying the company aims to retain the flexibility to switch between a two- or three-shaft turbofan or open rotor solution for as long as possible.

**The Game of Leap Frog**

Commercial aviation is, to some degree, a game of leapfrog, and today the A320, introduced in 1988, risks falling slightly behind the better selling 737NG, which was introduced in 1998. Although the A320 and 737NG evenly split the market with some to-and-fro, Boeing has incrementally improved the 737NG through the years, with the next round to enter service in 2011. Airbus began a series of Enhancements in 2007, but Boeing—with a lighter airplane and older, if less complex technology (ie, no fly-by-wire)—is widely acknowledged to have a slight advantage on operating costs.

To provide additional economic gains for its customers, Airbus announced its "sharklet" style winglets with a 2012 EIS on the A320. The A321 will follow by six months and the A319 after that. (The A318 apparently won’t get the treatment.) Airbus still is talking with Aviation Partners about a customer-retrofit program for the A320 family.

Sharklets replace the short existing wing-tip fences to provide an additional 3.5% gain in fuel efficiency. But that alone will not be enough to satisfy airlines, already struggling with high fuel costs and a recession, who are seeking a 15% reduction in operating economics.

Customers tell us that the sharklets will give the A320 a slight SFC advantage over the 737W; Boeing believes this will only bring the A320 to parity.

If we assume that Boeing and Airbus re-engine their existing models for EIS in 2015-2016, and push back their next generation narrow-bodies closer to 2030 than to 2024, the competitive picture becomes much more interesting, especially with the introduction of new models from Bombardier, United Aircraft in Russia and Comac in China. With new engine technology and more modern systems, the CSeries, MS-21 and C-919 are promised to be 12-17% more fuel efficient than the existing A320 or 737NG models. While we are skeptical about the upper-end of these figures, carriers such as Southwest are asking for 10%-12%; 12%-15% exceed these numbers. Without an RE, Airbus and Boeing would, for the first time, not have the most efficient models in the marketplace.
The following chart illustrates the production lives of narrow-body commercial aircraft since 1980, and projects new models through 2030. We have assumed a re-engining of the A320 and 737NG series as an interim model until all new aircraft can be developed for EIS between 2025-2030.
Airlines Want Improvements Yesterday

The 2008 fuel crisis was unprecedented: the cost at one point was over $100bbl. As oil prices hit record highs, desperate airlines began hedging at $60+ per bbl, only to yet again be on the “wrong” side when prices unexpectedly collapsed and fell below their new hedges. Even Southwest Airlines, whose legendary hedging at $24bbl-$40bbl enabled it to post profits when other airlines were losing billions, wound up on the wrong side of hedges as its low ones expired and it hedged in the $50-$60 range. These factors further argue for a reliable solution (lower SFC with an RE program) as oil once again edges toward $100bbl.

A re-engining program could deliver the 15% improvements needed within five years.

New programs from Canada’s Bombardier, Brazil’s Embraer, China’s COMAC and Russia’s UAC threaten to leap-frog existing narrowbodies and represent a viable threat to Boeing or Airbus. The Bombardier CSeries CS-300 is exactly the size aircraft Southwest utilizes for its all Boeing 737 fleet, and promises 15% better economics using the P&W1000G. The COMAC C-919 has selected the GE LEAP-X engine technology for its program, which promises to take a strong share of the Chinese market and provide better economics than either the A320 or 737NG. Similarly, the MS-21 from United Aircraft in Russia is utilizing the skills of the merged Russian design bureaus to also offer a modern technology trunkliner with next generation engines.

Making Economic Sense and an ROI

Why are airlines so interested in a re-engined model? Because it makes sense economically. Economic models that assume a 14% improvement in fuel burn under scenarios of $2, $3, and $4 per gallon fuel prices result in a NPV at 10% of $8 million, $11 million and $14 million, respectively. If P&W can achieve the fuel savings they believe possible with the GTF, the NPV increases to $11 million, $15 million and $20 million respectively. The bottom line is that, all things equal, a re-engining program is compelling for airlines, assuming the same price for a new aircraft with the new technology engines.

It is worth noting that Lufthansa Airlines elected to order the CSeries after running an NPV analysis (among other things), concluding that 12% in 2013 is far better than waiting for 24% in what was then forecast to be 2020.

The case for the manufacturers is similarly compelling. For 25% of the cost of a new development program, a large fleet of existing models will become economically obsolete and in need of replacement with a sufficiently compelling ROI. Given that most of the costs of the narrow-body programs have already been amortized, the risks of a re-engined model are minimal, the economics are compelling for airlines, and the new models can fend off emerging competitors until investment and technology are available for a yet another leap-frog solution a decade later.

By 2016, airlines could have three viable alternatives to Boeing and Airbus with new technology airliners that would erode market share from the A320 and 737 families. Combined with strong demand from customers to upgrade their existing products, Airbus and Boeing have little choice but to move forward, or potentially lose large orders. An RE program is also the only viable alternative to both satisfy the customer base while fending
off new competition through new technology engines and waiting for the promise of dramatically new technology to become reality.

Even if emerging competitors have slightly better economics, the benefits of fleet commonality and known customer support records would likely sway the majority of existing customers to stick with Boeing or Airbus, as bringing in a new aircraft type requires a significant expense and some uncertainty, particularly with a new entrant manufacturer. With re-engined aircraft, Airbus and Boeing could retain their market share in the intermediate term, put pressure on emerging competitors, and capitalize on their research and development efforts into the next generation of aircraft to leap-frog the emerging competitors and re-assert their market leadership.

Airbus will Take the First Step

Airbus needs to upgrade its existing A320 family to keep its cash cow competitive, not only with the 737NG, which has taken the narrow-body market share lead because of slightly better economics, but also against the emerging competition from Brazil, Canada, Russia and China. We anticipate Airbus will announce a re-engining program for the A320 family in 2010, with entry into service in 2014-2015. As a replacement program is not scheduled until 2024 at the earliest, this provides Airbus a 10 year window to recoup engineering costs while providing an aircraft with the improved economics its customers desire.

We anticipate that a re-engined A320 will likely result in a 14% improvement over existing models, including sharklets. As most of this reduction is in fuel costs, airlines will likely jump at the opportunity to obtain more fuel efficient aircraft as rapidly as possible.

Boeing will be Forced to Follow

Boeing has three choices in a competitive response to Airbus. It could launch an all-new technology narrow body program to attempt to leap-frog Airbus, launch a competitive re-engining to match Airbus, or do nothing and let the existing product line stand, recognizing a likely shift in market share would occur. As Boeing cannot afford the former, given its cost overruns on the 787 and 747-8, and cannot realistically accept the latter, as that would erode the market for a significant cash generator, it is likely that Boeing will be forced to respond in kind and re-engine the 737NG. It should be noted that Boeing is likely to face more difficulties in tweaking the 737 than Airbus on the A320 due to engine ground clearance. However, recent reports that the engine pylons can be moved forward and upward to accommodate new engine technology indicates that Boeing has solved this issue.

We believe Boeing will focus on a replacement for the 777 program to compete effectively with the A350XWB, and protect its market leadership in the large twin engine wide-body category. The cost of developing a 777 replacement will be substantial, and virtually prohibit an all-new narrow-body in the short-term.

The Candidate Engines

There are currently three potential candidate engines to re-engine the existing narrow-body fleet, the P&W PurePower or GTF, the CFM International LEAP-X (CFM a joint venture of GE and SNECMA), and the Rolls-Royce RB285.
Pratt & Whitney PurePower

The P&W PurePower differs from conventional engines in that it has a gearbox, similar to gearboxes found on turboprop engines (which tend to be more fuel efficient than turbofans). The gearbox benefits are increased efficiency and lower fuel burn, but come with the risk of added complexity and potential maintenance headaches associated with an additional mechanical component. The P&W1000GTF, in a smaller thrust range, has already been selected for the Bombardier CSeries and Mitsubishi RJ programs, and is on target for introduction in 2013.

The P&W GTF has tested a 40,000 lb. thrust variant at Airbus using their A340 testbed aircraft, with successful results. The tests of the gearbox, which incorporates a unique lubrication system to avoid wear, even in unusual attitudes, worked well during those tests. The P&W GTF, given early availability, is a potential candidate for Airbus, and would likely be offered through International Aero Engines, the joint venture of P&W and Rolls-Royce which already supplies the V2500 for the A320 family.

The P&W1000G has a bypass ratio of 12. Moreover, P&W believes that with an even higher bypass ratio plus an increase in other pressure ratios, they can improve fuel burn by 22% over the next 10-15 years compared with the current CFM-56 benchmark and be nearly competitive with the open rotor’s promised 26% SFC improvement but without the noise, weight and blade failure issues. The initial variant, to be used on the Bombardier CSeries, has about a 14% improvement over existing engines, but P&W expects to continue to improve performance to the projected 22% level by 2016 as the engine evolves. A 22% improvement would provide very significant economic improvements, and dramatically increase the ROI from a re-engining program.
**CFM Leap-X**

The LEAP-X engine from CFM is a replacement for their existing CFM-56 series of engines currently exclusively used on the Boeing 737NG (CFM-56-7) and also offered on the A320 family (CFM-56-5).

According the GE, the LEAP-X has a 16% better fuel burn than the current CFM-56 engine. This has been accomplished using a novel “twin annular premixing swirler” – essentially a technique that increases the amount of oxygen in the combustion chamber. This same technology is being used in the GEnx engines on the 787 and 747-8. GE has benefitted from extensive carbon fiber development on large engines. This makes it possible to use 18 blades on the LEAP-X engine rather than 24 as on the CFM-56. In terms of bypass ratios, the LEAP-X will be at 10 compared to 6 on the CFM-56. (Note a big disparity with the P&W1000G, which starts at 12.)

**Rolls-Royce RB285**

The RB285 from Rolls-Royce is a new engine program in the lower thrust class, aimed at replacing the V2500. The RB285 utilizes a three-shaft concept to provide a 15-20% improvement in efficiency over today’s benchmarks, and will be presented to airframe manufacturers as a part of its "Option 15-20" program, along with an open rotor concept as "Option 30", which would provide a 30% improvement in fuel efficiency over today’s engines. While the three-stage RB285 will be more expensive and complex than the two stage RB282 that will be introduced on the new Dassault super-mid-sized business jet, it will provide better economics than two-shaft versions. The key question is whether such an engine would be too expensive for the 150 seat marketplace.

**Summary**

At maturity, we expect the P&W PurePower to be slightly more efficient than the LEAP-X and RB285, with a 22% improvement versus 16%-18% improvements for the non-gearered turbofans over the existing CFM-56 models as a benchmark. Any of these engines, with these performance increases, on an economic basis, justifies a re-engining program.
Open Rotor Engines

Open rotor concepts have been under study by P&W, GE and Rolls-Royce for the last 20 years, and efforts continue as open rotor concepts are inherently more efficient than shrouded fans. The latest estimates project a 26-30% improvement over the existing CFM-56 benchmark. However, because open rotors would not fit under wing, these engines are not candidates for re-engining programs.

Moreover, any re-engine program has to work with under wing engine placements, this negates any open rotor design. The OEMs have shown images or concepts that include rear engine layouts that lend themselves to open rotor engines. However, as these designs continue to have major technical challenges and may not be forthcoming until the 2030 time frame. Consequently current designs have a viable period to recoup investment required to re-engine the 737 and A320.

Finally, the last Open Rotor phase was cancelled when fuel prices dropped so much that ROI for these engines became too distant. Today, fuel prices are unlikely to fall by as much (to $2/gallon), but “eco-awareness” to factors such as noise are challenges yet to be overcome by the designs.

Implications For New Programs

The implications for the A320 and 737NG replacement aircraft are significant: these programs will be pushed further into the future, likely in the 2025-2030 period, and we believe closer to 2030 than to 2025. This will provide an adequate time to earn a return on investment for the re-engining programs, enable the engine manufacturers to develop another generation of engines with even better fuel efficiency, and enable the airframe manufacturers to develop all-new designs that capitalize on the experience with new technology materials, systems and aerodynamic efficiencies that will be introduced on the Boeing 787 and Airbus A350XWB.

By 2025, the feasibility and economics of open-rotor designs should be better understood, enabling the manufacturers to evaluate more radical aircraft designs to incorporate the larger engines that could not fit under-wing today. The additional timing will enable the airframe manufacturers to evaluate "quantum leap" technologies to further differentiate their offerings from the C-919 and MS-21, which are scheduled for introduction in the 2016 period if their programs remain on schedule. It should be noted that the C-919 and MS-21 both follow traditional under-wing engine layouts. Therefore the engine choices these two programs have are limited to the P&W PurePower and GE LEAP-X.

Implications For Aircraft Values

Aircraft values are fundamentally related to the ability to earn a profit using that asset. As a result, more fuel efficient aircraft tend to have higher values than less efficient aircraft. In the near term, after introduction, there is no question that the re-engined aircraft would have higher values than the existing models, as they will have lower operating costs. Similarly, when a replacement design is introduced between 2025 and 2030, these aircraft will also have a higher value than the predecessor models with inferior operating economics.
The A320RE should have a 14-15% improvement over existing models, with a 12-13% improvement for a 737NG. These differences in operating costs are significant enough to diminish values for existing A320 and 737NG models. With significant commonality, the re-engined aircraft will easily integrate into existing operator fleets, and thus provide an opportunity to gain additional efficiencies at reasonable costs.

The concern that results from a re-engining program is a relatively short economic life for the aircraft: from introduction in 2015 until the replacement aircraft arrive between 2025 and 2030. Rather than a more typical 30-year projected economic life, these aircraft could become economically obsolete within a shorter period of time, and therefore have less time during which an airline could amortize its acquisition cost before replacing them with a more efficient type.¹

Of course, this syndrome is experienced with almost every introduction of a new aircraft model. The last production models of the predecessor versions tend to have short economic lives, and lose value more quickly than aircraft built early in the program. These aircraft will share the characteristics of aircraft purchased on the "back half" of the life cycle of an aircraft program -- the potential for economic obsolescence and replacement with newer aircraft. Absent a re-engining program, any existing 737NG or A320 purchased in 2016 would be in an even worse position in 2024 or beyond vis-à-vis a new-design replacement aircraft with respect to economic obsolescence than a re-engined version.

Without a major spike in fuel prices, we would not expect a collapse in narrow-body aircraft values, and the improvement in fuel economy will enable an operator to continue to operate the aircraft for a longer period of time than existing models, for which a strong backlog still exists. We expect, as do industry people we polled, that a re-engined A320 or 737NG might not hold value well until the replacement program aircraft are well defined, at which point values should fall in relation to the economic differential between the types and the supply-demand balance for narrow-body aircraft in the marketplace. As it is likely for replacement aircraft to grow in size, the 737-700 and A319 re-engined versions may not be directly replaced, and residual values for the smaller models may outpace those of larger models, which is unusual given that larger models typically have better seat-mile economics than smaller models.

Will leasing companies purchase this aircraft, knowing that they may have only 15 years of prime economic life? The answer is yes, as airlines will demand the newer models and demand for existing models will fall. They are purchasing the existing models today, and absent re-engined models, would likely continue to purchase them. Will leasing companies abandon the narrow-body market simply because they believe the re-engined models will be replaced within two decades? They can't afford to.

Of course, lease rates are based on residual value assumptions, and the residual value curve for these aircraft will perhaps be more aligned to the experience of the MD-80 rather than the 737 or A320. As a result, we would expect leasing companies to mitigate their risk through lease rates and the potential early disposition of aircraft through securitization.

¹ It is worth noting that the 737 Classic was first delivered in 1984 and the last in 1999, a period of 15 years. The 737NG was introduced in 1994 and, assuming a 737RE EIS of 2016, has a 22-year run or more.
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arrangement, market conditions permitting, just as they would do with the last production models of the existing models absent a re-engining program.

**Implications For Aftermarket**

A key question is whether Airbus or Boeing would also offer the re-engining program as a modification program for existing models. An aftermarket retrofit program could be a boon to both airlines and engine manufacturers looking for additional savings and revenues, respectively. With a healthy backlog for new narrow-body aircraft to accommodate growth and replacement of older types still in use, both manufacturers could potentially benefit from a program that enabled them to defer new programs.

An aftermarket re-engining option for the A320 could potentially generate significant maintenance contracts for sister EADS company SOGERMA, as well as provide customers with a mechanism to refresh the value of their A320s, maintain competitiveness without the need to invest in a new fleet, which providing Airbus the opportunity to deliver new aircraft to accommodate growth.

But do the economics make sense? At 3,500 hours utilization per year, an A320 burns about 2.3 million gallons of fuel per year. A savings of 14% in fuel burn generates $955,000 annually at $3 per gallon. A savings of 22%, which P&W projects for the GTF engine at maturity, would save a little over $1.5 million annually, not counting reductions in emission-based landing fees and warranty coverage for the new engines. A retrofit program that could be accomplished for under $12 million would likely be quite successful in the marketplace.

With an easier and less costly retrofit likely for Airbus than Boeing, given ground clearance issues and little need for pylon re-design, Airbus could potentially offer a re-engining retrofit program at lower cost than Boeing. While aftermarket re-engining programs have not been discussed, there is a window of opportunity for competitive advantage that Airbus could exploit.

**Conclusion**

We project that Airbus will re-engine the A320, and make that announcement and engine selection early in 2010. We expect both LEAP-X and the P&W GTF, the latter offered through IAE, will be selected as the candidate engines.

Boeing will be forced to match, and re-engine the 737NG, as it cannot afford to develop an all-new aircraft in this class and cannot afford to be non-competitive with Airbus for an interim offering. Even with a re-engining, we believe that the A320RE, with sharklets, will have a slight economic advantage over a 737NG-RE due to the additional ground clearance and improved efficiency since engines for the Airbus will not require cropped fans. Although Boeing is talking with P&W about the GTF, we believe in the end the company will continue to “dance with the one that brung them”: CFM’s LEAP-X.

Competitively, these re-engined versions of the A320 and 737NG will enable Boeing and Airbus to fend off the CS-300, C-919 and MS-21 through competitive economics, as existing customers will be able to continue to take advantage of fleet commonality and avoid the expense of introducing a new aircraft type.

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Mr. Hamilton joined the airline management ranks in 1979. In 1989, he and a partner formed Linkraven in Britain. During the 10 years Mr. Hamilton and his partner owned and operated Linkraven, Commercial Aviation Report, Value Report and the Events became internationally recognized for their breaking news reporting and high-quality conferences. The influential publications regularly beat larger and more established magazines and newspapers with news about the airline industry. Mr. Hamilton is frequently called by broadcast and print media to offer expert analysis about the issues of the day. He is a regular contributing writer for Commercial Aviation Online (the successor to Commercial Aviation Report, which is now part of the Flight International family of publications) and Armed Forces Journal, a defense magazine. Leeham Co. partners with Ernest Arvai of the Arvai Group and Addison Schonland of Innovation Analysis Group to undertake projects and special reports. For more information see www.leeham.net.

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