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AIRFINANCE JOURNAL

Catching up with the **recovery**

Shop visits will continue to increase this year as airlines get more confident about their capacity recovery plans.

The aviation market has dramatically changed since the start of 2022. Virtually all markets have reopened borders for travelling allowing airlines to plan further for long-term investments.

Original equipment manufacturer deliveries are still impacted by delays, and airlines have had to adapt their flying operations and find short-term solutions to fill the gap, sometimes with current-technology aircraft.

Engine issues on new-technology aircraft have also continued to make headlines. Air Baltic, an operator of 40 Airbus A220-300s, said in March that it contracted A319s and A320s along with Bombardier CRJ900s under wet-lease arrangements through the end of May as extended turnaround times servicing the engines were causing operational disruption.

"Such conditions have arisen as a result of the manufacturer's inability to fulfil the obligations of engine maintenance in a timely manner," says the carrier.

The shortage of materials and supply chain disruptions has weighed on the throughput of engine maintenance, repair and overhauls (MROs), with turnaround times on some engines rumoured to be about 180 days. This limits capacity and market size going forward.

However, the engine MRO is expected to exceed 2019 levels, according to Oliver Wyman's latest forecast. The consultancy firm confirms that this recovery comes a year earlier than previously forecast because of the rapid return of air travel demand and utilisation. Over the forecast period, engine MRO is expected to hit $63 billion by 2033, representing compound annual growth of 4%.

The narrowbody market has been leading the way as a factor of utilisation. The widebody market has picked up, albeit it still lags behind, but market differences between the two may mean more pressure on the widebody MRO shops now.

MROs struggled during Covid with minimum revenues as airlines preserved cash and consequently avoided shop visits. But with high demand for shop visits, MROs are now looking to maximise revenues according to their capacity. They need to recover from the Covid period, so there is also an equilibrium to achieve for them.

In this year's Engine Guide, *Airfinance Journal* has looked at engine leasing trends in the sector through interviews with SMBC Aero Engine Lease and elfc chief executive officers, Roger Welaratne and Tom Barrett, respectively.

The engine industry has gone through further changes over the past 12 months. The future of Rolls-Royce has been the main talking point. Under the leadership of its new chief executive officer, Tufan Erginbilgic, the UK engine manufacturer has embarked on a transformation plan, looking at improving the performance it needs to deliver on a sustainable and underlying basis.

Aircraft manufacturer Airbus announced in December plans to develop a hydrogen fuel cell-powered test engine as part of its goal to have zero-emission aircraft enter service by 2035. That announcement was significant because it marked the first time Airbus had branched out into engine technology development. Has a new engine manufacturer been announced? Probably not, because Airbus may seek partners in this project.

In *Airfinance Journal*'s engine poll, an emphasis was on widebody recovery because a strong year will benefit the widebody engine market. Still, shop visits, their timing and turnaround times, remain an issue.

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elfc names new CFO

Engine Lease Finance (elfc) has appointed Avril Comerford as executive vice-president and chief financial officer (CFO) with overall responsibility for the finance function, replacing Declan Sheedy, who is departing the company after 19 years to pursue other opportunities.

Comerford has more than 20 years' experience in the aviation industry.

Following her qualification in 1998, Comerford joined Ernst & Young as audit manager supporting various companies in the aviation industry.

In 2001, she moved to Shannon Engine Support and acted in the account manager, vice-president finance and CFO positions during her 12 years at the lessor.

Comerford joined elfc in June 2013 as a senior finance manager, and has held several positions of increasing responsibility within the finance department. She became vice-president of finance in 2016 and was senior vice-president of finance from January 2019.

Comerford graduated from University College Dublin in 1994 and holds a Bachelor of Commerce Degree, subsequently qualifying as a chartered accountant in 1998 with BDO Simpson Xavier. She also holds an aviation diploma from the Law Society of Ireland.


Avril Comerford

SAEL hires GECAS specialist

Niall Cronin joined SMBC Aero Engine Lease (SAEL) as senior vice-president trading in January.

Under the new role, Cronin is in charge of engine trading activities for SAEL, including sale and purchase of engines on lease and mature asset sales.


Niall Cronin

He has more than 20 years' aviation finance experience having worked on roles in risk, commercial and portfolio management.

Cronin was Aercap's senior vice-president and regional risk manager Asia for the past 15 months. He was based in Singapore and had responsibility for the Asia-Pacific region having held the equivalent position at GECAS prior to the acquisition in November 2021.

He started his aviation career in the marketing department at Shannon Engine Support in 2001.

In 2004, he was promoted to sales and marketing director, managing a portfolio of existing customers and generating new business for a given sales region. He gained sales experience and a track record in selling different leasing structures.

Cronin joined GECAS in 2006 as vice-president portfolio engine leasing. In 2010, he moved to the vice-president, marketing and asset management group position.

Cronin also worked with PK Airfinance on debt origination, underwriting deals for aircraft, spare engines and helicopters.

SES hires risk director

Engine lessor Shannon Engine Support has hired Heloise Di Menza as risk director for the Asia-Pacific region.

Di Menza was GECAS's vice-president risk, Asia-Pacific, between 2016 and 2021 and was based in Hong Kong SAR.

Before that, she was at General Electric's onshore wind turbines unit as a regional sales director France, Belgium, North Africa.

Di Menza worked as a director sales proposals for commercial aircraft engines and services for more than seven years and was at Safran for more than eight years in different positions.

She started her career at Le Credit Lyonnais in the syndication loan group in 1998.

Grant joins **Willis**

Phillip Grant has joined Willis Asset Management as a director of sales for the Europe, Middle East and Africa (EMEA) region, based in Cardiff, UK.

Grant was at Seraph Aviation Group since 2021, acting as senior vice-president of commercial EMEA and Asia-Pacific. Before that, he was a commercial aviation sales and leasing executive at Dragon Aero Leasing.

Between 2017 and 2020, Grant was at Aero Capital Solutions, responsible for the support of airline and lessor customers with engine trading, leasing, exchanges and other maintenance-avoidance products throughout the EMEA region, with an additional focus on the procurement of assets to support scheduled customer requirements and the acquisition of sale and leaseback aircraft.

He spent the previous six years at TES Aviation Group, the independent engine asset management services company, as senior vice-president of business development.

TES Holdings, the parent company of TES Aviation Group, was established in 1995, and DVB Bank purchased a majority shareholding in the company in 2007. The bank sold its stake to Japanese investors – Mitsubishi Corporation (35%) and the Development Bank of Japan (25%) – in 2012.

Grant started his aviation career in 1995 with the UK Ministry of Defence. He held maintenance roles at LTU Airlines, British Airways and Aeronavali MRO and worked at Airbus as a production engineer on the Airbus A380 programme.


Phillip Grant

IAE reaches 40th anniversary

The engine consortium is more successful than ever.

Pratt & Whitney has celebrated the 40th anniversary of the establishment of IAE International Aero Engines (IAE), a multinational consortium comprised of shareholders that also include Pratt & Whitney Aero Engines International, Japanese Aero Engines Corporation and MTU Aero Engines.

The launch of the successful joint venture in March 1983 leveraged diverse engineering expertise and advanced technology from across the party companies to develop the cleaner, quieter, more fuel-efficient V2500, an engine that would lead the single-aisle market into the new millennium and continues to power nearly 3,500 aircraft globally.

The continuous improvement of the versatile V2500 delivers "reliability, efficient power and performance" for about 150 commercial, cargo and military operators in 80 countries.

In total, more than 7,800 have been produced since entry into service, collectively powering more than 135 million flights and more than 255 million engine flight hours.

Approved for operation on 50% sustainable aviation fuel (SAF), the efficiency of V2500 will help the aviation industry meet its goal of net-zero CO2 emissions by 2050, says IAE.

"The V2500 is a workhorse of the aviation industry and has grown into one of the most successful commercial aerospace programmes of all time," says Earl Exum, president of IAE and vice-president, mature commercial engines, Pratt & Whitney.

"The V2500 wouldn't be the triumph it is without our IAE collaborators, customers and suppliers," he adds. "With the IAE collaboration agreement extension to 2045 and a substantial fleet of V2500s in service today, this joint venture has secured its standing as a global aviation leader for decades to come."

Only one year after IAE was formed, the V2500 won its position on the Airbus A320 family and entered into service with launch customer Adria Airlines in 1989.

The V2500 now powers 60% of the global in-service A321 fleet, with an average fleet age of only 12.8 years. The engine also powered 116 Boeing MD90 aircraft, entering service on that type with Delta Airlines in 1995.

"The V2500 has long powered Airbus aircraft," says Philippe Mhun, executive vice-president programmes and services, Airbus. "The engines reliably transport millions of passengers each year. We extend our congratulations to IAE and the party companies for 40 years of dedicated service to the V2500 and the aircraft that it powers."

In the spirit of rigorous continuous innovation and improvement, IAE released multiple engine enhancements between 1993 and 2011: the -A5, -D5, SelectOne, SelectTwo and E5 variants with each subsequent enhancement offering reliability, fuel, noise and other performance benefits.

The V2500 delivers a 3% fuel efficiency advantage over the competing engine and holds a dispatch reliability rate of 99.97%, says IAE.

More recently, the V2500 powered the first A321 and A320 passenger-to-freighter conversions, with more slated to enter service in the coming years. With custom service offerings tailored to the lower-cycle cargo market, and a fuel and payload-range advantage over the competing engine, the V2500-powered A320 family of converted cargo aircraft "offer a strong value proposition to cargo carriers around the world".

IAE says about 70% of V2500-powered aircraft are under 15 years old and about one-third of engines are still on first run.

The V2500 engine is backed by an established global network of 17 facilities for maintenance, repair and overhaul, including nine IAE partner facilities.

Pratt & Whitney and IAE have been enhancing services for the V2500 engine, including life limited parts solutions, new and serviceable material programmes, engine swaps and more, "which can be tailored and customised to support the unique requirements of our customers. With long-term agreements, fixed price services and transactional solutions, an increasing variety of workscopes and payment options are available to V2500 operators".

Rolls-Royce eyes investment grade rating

Manufacturer looks for a speedy return to a strong balance sheet.

Rolls-Royce is looking at an investment-grade rating as the company targets cash-flow generation and profitability.

This will involve operational efficiency as well as better earnings before interest and taxes margins and returns.

A stronger balance sheet will lead to a return to investment grade and will resume shareholder distributions, states the manufacturer.

"Our priorities at this point are cash generation with that investment grade. I am not going to give a timeframe but we would like to get there at pace because a strong balance sheet would allow us to resume shareholders' returns," said chief executive officer, Tufan Erginbilgic, during the 2022 full-year results.

Rolls-Royce is rated Ba3 by Moody's Investor Services, and BB- by Fitch Ratings and Standard & Poor's.

The company lowered its net debt by almost £2 billion ($2.4 billion) last year to £3.3 billion, as it completed its disposal programme.

"Our debt is still too high. Too much of our gross profit is simply covering our overheads and interest payments. A weak balance sheet and a sub-investment-grade credit rating limit our ability to invest in growth in the future," said Erginbilgic.

He adds that Rolls-Royce's margins are below the competition on a like-for-like adjusted basis.

"Our low operating margins and relatively high operating cost base leaves us financially exposed," he says.

> *"Our debt is still too high. Too much of our gross profit is simply covering our overheads and interest payments. A weak balance sheet and a sub-investment-grade credit rating limit our ability to invest in growth in the future."*
>
> **Tufan Erginbilgic**, chief executive officer, Rolls Royce

He notes that return on capital has been just 3.5% over the past five years.

"I believe we have the potential to be a much higher quality and more competitive company," says Erginbilgic.

As of 31 December 2022, it had £4.1 billion of drawn debt, of which £500 million matures in 2024, £800 million in 2025 and £2.8 billion between 2026 and 2028. It also had £1.8 billion of lease liabilities, £2.6 billion of cash and £5.5 billion of undrawn facilities.

Rolls-Royce reported a £652 million underlying operating profit driven by its civil aerospace and power systems segments.

This was £238 million higher than the previous year and represented a 5.1% operating margin, versus 3.8% in 2021. Total revenues stood at £13.7 billion for the period, up from £10.9 billion in 2021. The company posted a £206 million net profit, up from £36 million in 2021.

Growing spares business

Civil aerospace represented £5.68 billion in underlying revenues and £143 million of operating profit.

Revenues were up 25% on 2021. Original equipment revenue of £2 billion was up 23%, reflecting higher spare engine deliveries. Services revenue of £3.7 billion was up 26% on the previous year, reflecting more large engine shop visits, aftermarket revenue growth from business aviation, regional and the IAE V2500 engine programmes, as well as positive long-term service agreement (LTSA) catch-ups of £360 million.

The operating profit performance was partly offset by the non-repeat of a foreign exchange revaluation credit of £140 million in 2021.

Civil aerospace trading cash inflow totalled £226 million during the 12-month period, versus a £1.67 billion cash outflow in 2021, or a £1.9 billion improvement.

Rolls-Royce said the improvement was because of higher engine flying hour receipts reflecting the growth in LTSA flying hours, which grew at a materially faster rate than shop visits in 2022. Cash flows in 2022 benefitted from the recovery of overdue balances from airlines incurred during the pandemic of about £180 million.

The company notes that its civil aerospace business continues to recover from the impact of Covid-19.

Large engine flying hours were up 35% year on year at 65% of 2019 levels, with an improvement at the end of the year as travel restrictions in China eased.

Total shop visits were 1,044 versus 953 in 2021. There were 248 large engine major shop visits in 2022 versus 208 in 2021. In 2023, Rolls-Royce expects large engine flying hours at 80% to 90% of 2019 levels and between 1,200 and 1,300 total shop visits.

Panos Kakoullis, chief financial officer, Rolls Royce

Original equipment deliveries rose by 15% year-on-year, driven primarily by business aviation. Rolls-Royce delivered 190 large engines, five fewer than the previous year.

In 2022, it delivered 44 large spare engines (versus 36 large engines in 2021). This represented 23% of total large engine deliveries.

Chief financial officer, Panos Kakoullis, says this was higher than usual, at 10% to 15% of total engine deliveries, as Rolls-Royce grew the pool of spare engines to underpin fleet health and improve resilience as it builds up the spare engine market ahead of the anticipated increase in shop visits.

The manufacturer expects this elevated level of spare engine deliveries to continue in 2023 and 2024.

Erginbilgic believes the supply chain in civil aerospace will "only stabilise in 12 to 18 months' time from now".

He also notes differences between the supply chains in civil aerospace/defence and power systems.

He says that disappearing activity in civil aerospace during Covid affected the whole supply chain through reduced capacity and labour.

"Now they are trying to bring back capacity and it is challenging for the industry," says Erginbilgic.

"Power systems did not have that level of disruption during Covid. That supply chain will stabilise much earlier," he adds.

In February, Airbus said it saw growing demand in the widebody market as airlines continue to scale up international services.

"We are increasing our A330-family production rates to four aircraft a month in 2024 as well as nine aircraft a month for the A350 family at the end of 2025," said chief executive officer, Guillaume Faury.

The A330neo monthly production rate increased to about three at the end of 2022 and the A350 monthly rate is currently six aircraft.

Erginbilgic says Airbus targets are in line with Rolls-Royce targets. "We are totally aligned."

Guidance

Rolls-Royce's operating profit guidance is £800 million to £1 billion for 2023 and assumes £100 million to £200 million of targeted contract improvements.

The company anticipates free cash flow of £600 million to £800 million this year based on about £500 million to £700 million growth in the civil LTSA.

It also expects a year-on-year headwind of about £200 million associated with legacy Boeing original equipment concessions and about £100 million of adverse impact because of fires at two suppliers' premises in late 2022 and early 2023. "We expect this cash impact will reverse next year," it adds.

Rolls-Royce received new engine orders from Malaysia Aviation Group, Norse Atlantic Airways and Qantas Airways in 2022, and recently received an order from Air India for 68 Trent XWB-97 engines, plus options for 20 more, and 12 Trent XWB-84 engines.

Rolls-Royce recently received an order from Air India for 68 Trent XWB-97 engines, plus options for 20 more, and 12 Trent XWB-84.

Safran projects LEAP deliveries up 50%

CEO Olivier Andries cautions that industry-wide challenges to continue near-term.

French engine manufacturer Safran is targeting recurring operating profit of about €3 billion ($3.2 billion) on revenues of at least €23 billion in 2023, after posting a 33% increase in core profit in 2022.

Safran says it expects China's reopening to boost traffic further and help aftermarket sales. But its chief executive officer, Olivier Andries, cautions that he expects "industry-wide challenges to continue near-term".

He says: "We expect continuing positive trends in global air traffic with China reopening gradually, a good catalyst for our aftermarket businesses at a time when airlines are catching up on maintenance."

The aerospace group reported 2022 recurring operating income of €2.41 billion as revenues rose 25% to €19 billion, driven by services to support air travel recovery.

Safran posted a €1.21 billion adjusted net profit for 2022. This compared with an adjusted €784 million net profit in 2021 on revenues of €15.2 billion.

In 2022, revenues in aerospace propulsion reached €9.5 billion, up from €7 billion in 2021.

The aerospace propulsion segment returned a €1.56 billion net profit, up from €1 billion in 2021. Aerospace propulsion's free cash flow totalled €2.45 billion last year, up from €1.33 billion in 2021 as the commercial aircraft market improved in terms of available seat kilometres.

Safran says the conflict in Ukraine has impacted the group's activities. In compliance with the European, US and UK sanctions against Russia, it suspended all exports and services to Russia and halted the operations of its joint ventures in the country and with its Russian partners until further notice.

The company says the supply of engines, equipment and aftermarket services for the regional Sukhoi Superjet 100, the MC21 and the Kamov 62/226 helicopter programmes impacted business operations.

It also was affected over service activities for CFM engines powering about 500 Airbus A320 and Boeing 737 aircraft operated by Russian carriers.

"The suspension of all commercial exports (products and services) to Russia and the halt of all operations in the country represents a loss of business of approximately 2% of revenue," states the manufacturer.

The group booked a €105 million impairment charge for several programmes related to Russia. At 31 December 2022, consolidated cash and cash equivalents amounted to about €6.69 billion, up from €5.25 billion at the end of December 2021.

In 2022, the group continued to optimise its debt profile with key financing transactions.

Leveraging its liquidity position and business resilience, the group engaged in a financial rating process in 2021 and obtained its first long-term credit rating from Standard & Poor's, which assigned Safran a rating of BBB+ with a stable outlook.

In April 2022, Standard & Poor's revised the outlook on the company's BBB+ rating from stable to positive. Last December, the rating agency raised the rating to A- with a stable outlook.

Safran announced it would buy back up to 9.4 million of its own shares (about 2.2% of its share capital) last October with a view to eliminating the potential dilution risk related to its convertible bonds maturing in 2027. Under the programme, Safran bought back nearly 2.4 million shares in November and December 2022 for a total of €275 million.

In January, it entered into an agreement with an investment services provider for the implementation of a follow-on buyback tranche to meet its obligations arising from the convertible bonds maturing in 2027.

At 9 February, about four million shares were purchased, representing a cumulative €492 million cash-out. Under the terms of the agreement, Safran will buy back up to €650 million-worth of ordinary shares no later than 31 March 2023.

In March 2021, Safran signed a €500 million loan agreement with the European Investment Bank, which was drawn down in full on 21 February 2022 for 10 years (maturing in February 2032).

The loan is being used to finance some of the group's research into innovative propulsion systems for the next generation of single-aisle commercial aircraft, marking a major step forward in Safran's roadmap towards achieving carbon-free air transportation by 2050.

In addition, Safran set up a five-year €2 billion revolving credit facility in May 2022. At the end 2022, the new line was undrawn. The financial terms and conditions of the liquidity line are indexed to the achievement by the group of two sustainable development criteria: CO2 emissions (Scopes 1 and 2) and the proportion of women among senior executives.

The new line replaced the €2.52 billion facility set up in December 2015, which was terminated in advance last year.

Cash and cash equivalents totalled €6.69 billion at the end of 2022 (up €1.44 billion compared with 31 December 2021).

Earnings before interest, taxes, depreciation and amortisation reached €3.5 billion in 2022, up from €2.7 billion the previous year.

Free cash flow totalled €2.66 billion, up from €1.68 billion 12 months earlier. The company forecasts free cash flow of at least €2.5 billion subject to payment schedule of some advance payments.

Its revenue guidance is at least €23 billion for fiscal year 2023 with LEAP deliveries up 50%.

Andries says this translates into 1,700 engines in 2023.

Safran expects no further disruption to the world economy, and narrowbody available seat kilometres (ASKs) back to 2019 levels in the course of this year.

The company says worldwide CFM engine flight cycles were at 97% of 2019 levels at the beginning of February 2023, with North America, Middle East and South America above 2019 levels, and Europe at 85% of 2019 levels. China was at 93% of 2019 levels with a strong improvement with the lifting of travel restrictions since mid-December 2022. Safran says the Asia-Pacific region, excluding China, was at 84% of 2019 levels.

Safran delivered 1,196 CFM engines in 2022, including 1,136 LEAP engines (up 291 units compared with 2021). The company also delivered 60 CFM56 engines, down from 107 engines in 2021.

Safran's commercial engine backlog was at almost 10,000 LEAP engines at the end of last year. Its civil aftermarket revenues grew 29% last year in US dollar terms with strong growth of spare parts sales for CFM56 and high-thrust engines.

Andries says on civil aftermarket, volume is up but less than narrowbody ASKs. But he recalls that China has been volatile and the peak up in traffic was in December 2022.

"We also lost all shop visits related to the Russian traffic," he adds.

Andries expects shop visits to reach 2,000 in 2023. "That is a big step for this year."

Airbus moves into engine development

Airbus is developing a hydrogen fuel cell-powered test engine as part of its goal to have zero-emission aircraft enter service by 2035.

The propulsion system is being considered as one of the potential solutions based on hydrogen, says Airbus.

The announcement marks the first time the aircraft manufacturer has branched out into engine technology development, although Airbus may seek partners as the project progresses.

"It doesn't mean Airbus will do it on its own," said the Airbus vice-president zero-emission aircraft, Glenn Llewellyn, at the Airbus summit 2022 last December. "In a subsequent step, if we decide to commercialise that technology, we might decide that's the best approach, but we could equally partner."

The European original equipment manufacturer (OEM) plans to start ground and flight testing of the fuel cell engine architecture onboard its ZEROe demonstrator aircraft towards the middle of the decade.

Airbus will use an A380 test aircraft (MSN 1) for the tests. The aircraft is being modified to carry liquid hydrogen tanks and their associated distribution systems, says the OEM.

"Fuel cells are a potential solution to help us achieve our zero-emission ambition, and we are focused on developing and testing this technology to understand if it is feasible and viable for a 2035 entry-into-service of a zero-emission aircraft," explains Llewellyn.

"At scale, and if the technology targets were achieved, fuel cell engines may be able to power a 100-passenger aircraft with a range of approximately 1,000 nautical miles. By continuing to invest in this technology, we are giving ourselves additional options that will inform our decisions on the architecture of our future ZEROe aircraft, the development of which we intend to launch in the 2027-28 timeframe."

Airbus says it has identified hydrogen as one of the most promising alternatives to power a zero-emission aircraft, because it emits no carbon dioxide when generated from renewable energy, with water being its most significant by-product.

The manufacturer says that hydrogen can be used as a power source for aircraft propulsion, via hydrogen combustion in a gas turbine, or by using fuel cells to convert hydrogen into electricity in order to power a propeller engine.

Asked if net zero 2050 can be achieved through a combination of more efficient engines, hybridisation systems, 100% sustainable aviation fuel compliance, Airbus chief technical officer, Sabine Klauke, says all are necessary, adding: "The most powerful for us is hydrogen".

"Every one of our contracts stipulates that the operating entity pays for maintenance costs – the airline has to pay that difference and that is what they are upset about."

Steven Udvar-Hazy, executive chairman, Air Lease

Engine maintenance costs biting into fuel savings

While airlines are enjoying fuel-efficiency improvements in new engine technologies, this is not necessarily the case for maintenance costs because of engine time off-wing issues, according to Air Lease's executive chairman, Steve Udvar-Hazy.

During a JP Morgan conference in April, Udvar-Hazy said engine manufacturers were not delivering on promised maintenance cost savings compared with legacy engines.

"For the new-technology engines that power the [Boeing] 787, [Airbus] A330neo, 737 Max and A320/A321neo... the key motivations for the engine manufacturers were fuel consumption, reducing fuel burn by around 15%, and environmental concerns through lower greenhouse gas emissions and noise generation," said Udvar-Hazy.

"To achieve that, all the engine manufacturers – GE, Pratt & Whitney, Rolls-Royce and CFM – pushed technology to the outer end of the envelope in terms of alloys, engine heat and efficiencies gained to achieve those objectives.

"Consequently, what we have today are engines that do deliver 15% average fuel reduction, but the maintenance cost is also far higher than originally projected because the engines don't stay on the wing in operational status as long as their predecessor engines.

"They have to go to the shop, new upgrades have to be made as product improvements come out to extend the life of the engines. The airlines want those improvements but that means time on the ground lasts longer and there is not enough shop capacity to cover it all.

"While they have delivered on these fuel cost savings, they are not meeting the promised maintenance cost savings," said Udvar-Hazy.

Any potential shortfall in maintenance reserves versus shop visit payments that accrue over time, because of the higher maintenance costs of the new engine technology, is a difference that the airline contractually has to pay.

"Every one of our contracts stipulates that the operating entity pays for maintenance costs – the airline has to pay that difference and that is what they are upset about," added Udvar-Hazy.

Aercap praises strong engine leasing performance

Operating lessor Aercap says Shannon Engine Support (SES), the engine leasing joint venture company it inherited through the acquisition of GECAS in November 2021, performed higher than expectations in 2022.

"We've seen strong performances from our engine leasing, and helicopter leasing businesses. And we've had higher income from our joint venture, SES."

Peter Juhas, chief financial officer, Aercap

Speaking at the Aercap 2022 full-year earnings call in March, the chief financial officer, Peter Juhas, said the lessor generated a "strong performance" in 2022, driven by ongoing engine supply and demand factors in the marketplace.

In 2022, Aercap Engines recorded 173 transactions. Those included 98 leases to customers, 47 engines sales and 28 acquisitions.

During the year ended 31 December, Aercap recognised lease rental income from SES of $74 million. This was up from $12 million the previous year.

At the end of 2022, Aercap Engines owned and managed more than 900 engines with about 75 customers. Its orderbook included 47 engines. Its owned engine portfolio is comprised almost entirely of General Electric and CFM International engines.

Aercap manages the global spare engine pool for GE Aviation, while its joint venture, SES, manages the global spare engine pool for CFM International. Aercap's two largest customers of its engine leasing business are GE Aviation and SES, representing more than 50% of the net book value of its owned engine portfolio.

"We've also seen strong performances from our engine leasing, and helicopter leasing businesses. And we've had higher income from our joint venture, SES, which has performed well ahead of expectations," says Juhas.

Aercap sold just under $2.2 billion-worth of assets in 2022. This resulted in a gain on sale of $229 million and a 12% gain on sale margin for the full year.

GE Aerospace expects double-digit growth on services and travel recovery

General Electric's aerospace unit expects to benefit from the recovery in international travel with double-digit revenue growth forecast for 2023.

The company delivered the outlook as part of its 2022 earnings release.

GE Aerospace generated $4.8 billion in operating profit in 2022 because of "strong orders, revenue and operating profit growth... driven by continued commercial momentum, strength in services and improved execution from the team".

It also notes "key business wins", including entering an equipment and long-term support agreement with Cargolux Airlines for its GE-powered Boeing freighter fleet, and expansion of CFM's LEAP maintenance, repair and overhaul services to Air France Industries KLM Engineering and Maintenance as a LEAP engine service provider.

The company expects organic revenue to grow to "mid-to-high teens", with an operating profit of $5.3 billion to $5.7 billion.

GE's full-year outlook reflects a "higher services concentration" in the portfolio, as well as confidence in the strength of the aerospace unit as the worldwide commercial aviation industry continues its post-pandemic recovery.

It also expects military aerospace orders to deliver "significant profit growth" for the division this year, against the backdrop of increased defence spending because of the war in Ukraine.

Rolls-Royce's transformation plan

Improvements in the manufacturer's performance need to be delivered on a sustainable and underlying basis, says Rolls-Royce chief executive officer, Tufan Erginbilgic.

Although Rolls-Royce businesses continue to improve as markets recover, chief executive officer, Tufan Erginbilgic, says the engine manufacturer cannot rely on market recovery alone to deliver better performance in the future.

"I have much higher expectations from the business and improvements need to be delivered on a sustainable and underlying basis," he commented to analysts during the 2022 full-year results.

Erginbilgic says Rolls-Royce has been underperforming for an extended period.

"Our five-year TSR [total shareholder return] of negative 67% is evidence of this and shows this is not just a Covid-19 issue. Cash generation is unsatisfactory, and our debt is still too high. Too much of our gross profit is simply covering our overheads and interest payments. A weak balance sheet and sub-investment-grade credit rating limit our ability to invest in growth for the future.

"We have recently completed an extensive benchmarking study that confirmed our margins are below the competition on a like-for-like adjusted basis. Our low operating margins and relatively high fixed-cost base leaves us financially exposed when uncertainty impacts our markets. As a result, in the last five years, even excluding 2020 due to Covid, we have averaged a return on capital employed of just 3.5%. We have also not had sufficient strategic clarity to make investment choices. Instead, we have been trying to keep too many options open."

Rolls-Royce proposition

Erginbilgic believes Rolls-Royce has the potential to be a much higher quality and more competitive company, one that focuses on sustainable earnings growth and cash generation with a winning mindset and culture that drives and rewards outperformance.

"Underlying performance improvements will drive higher operating cash flows," he says. "This, coupled with disciplined capital allocation, will grow our sustainable free cash flow. A strong and flexible balance sheet will allow us to grow shareholder distributions and fund future growth. We will build a strong Rolls-Royce to deliver this proposition. We are already in action, and we are proceeding with a sense of urgency."

Priorities to deliver on potential

Rolls-Royce's proposition to stakeholders includes an improvement on earnings and cash potential of the business.

"Rolls-Royce also will create an efficient business with a competitive cost base and improved operating leverage. This will make us more robust to the external environment."

Tufan Erginbilgic, chief executive officer, Rolls Royce

The focus will be on quality growth in profits and cash rather than just revenue and market share expansion.

"Rolls-Royce also will create an efficient business with a competitive cost base and improved operating leverage. This will make us more robust to the external environment," says Erginbilgic.

The original equipment manufacturer (OEM) also will target sustainable cash generation and will deleverage its balance sheet at pace. Rolls-Royce says it remains committed to recovering its investment-grade credit rating and resuming shareholder returns.

Rolls-Royce is delivering and developing a clear and granular strategy to prioritise investment opportunities. It will allocate capital centrally to the attractive market opportunities and programmes.

In addition, the OEM believes it has an important role to play in the energy transition and remains committed to achieving net zero.

"We will develop a robust framework to make the right choices. We will focus our investment on the most attractive market spaces and programmes, evaluating all energy transition opportunities to ensure we are delivering the best value for Rolls-Royce and the shareholders. We must only invest in new technologies where we are differentiated, where the market opportunity is sufficiently large and where there is a viable business model and synergies with our existing activities.

"By adding complementary capabilities, we can build winning propositions and de-risk the group. Partnerships will be a purposeful part of our strategy. All this will be underpinned by our most important priority, to ensure that our people and products are safe. This is the right thing to do. We care about our people and the people that rely on our products."

Transformation programme: overview and governance

The company has launched a transformation programme to deliver a step change in performance systematically and at pace.

Erginbilgic chairs the weekly transformation planning group and the whole executive team will spend time together each month to focus on this project.

Work has already started on critical workstreams. To support this, Rolls-Royce has appointed a chief transformation officer reporting to Erginbilgic directly.

The manufacturer has seven workstreams, and has appointed senior leaders to the first four – efficiency and simplification, commercial optimisation, working capital and strategic review.

Rolls-Royce says: "The business improvement workstream is being led at the business unit level. We have set challenging targets based on rigorous peer benchmarking analysis. This identified the performance gaps, our relative position in key businesses and scale the potential for improvement.

"We are now working on the detailed plans to deliver that potential. The remaining two workstreams, changing the culture and performance management, are critical to lasting change. We will drive them by building the right mindset with our teams to be proactive and timely in our actions so that we can manage performance effectively."

Key building blocks: efficiency and simplification

"I'm going to share more details about some of the workstreams, starting with efficiency and simplification," says Erginbilgic. "This is about identifying and delivering sustainable improvements across the whole group focused on three

things: organisational review, footprint consolidation and optimisation, direct and indirect third-party cost efficiencies. This will improve our operating leverage so that we are competitive and robust to the external environment."

He adds: "Our costs are high compared to our gross profit, and we are a long way from best-in-class. Across the group, we have work underway to identify synergies across all our divisions and functions and to simplify our whole organisation. A significant part of the cost reductions during Covid were activity-related, and largely in our civil business.

"These costs have been going up again as activity levels come back. Our efficiency and simplification plans look to achieve sustainable cost efficiencies across the group that take the activity increase into account. We will also be looking to capture efficiencies, efficiency opportunities within each division and function. We are already in action on this. For example, in Power Systems, we are already removing duplication and optimising the organisational setup to accelerate decision-making."

Key building blocks: commercial optimisation and working capital

Erginbilgic says that commercial optimisation is about getting the right reward "for the risks we take and the value we create for our customers. It will focus on Civil Aerospace and Power Systems. A stronger Rolls-Royce will be a better partner for our customers, more able to deliver operationally and invest in product development.

"To support this, as part of our executive process, we established a group operating committee. I have already met with a number of our largest customers and they understand this. We have also changed our commercial discussions on new contracts and renewals. In Civil Aerospace, for example, we set up a task force to review all the large engine LTSA [long-term service agreement] contracts. We are also working to lower our product cost and drive up the margins in contracts to ensure we achieve the returns that are aligned with the risks that we take.

"It is early days," adds Erginbilgic, "but the results are already starting to come in. We improved several onerous contracts on the balance sheet at the end of last year, and we achieved double-digit price increases on spare parts. We will drive further improvements this year to the margins of both profitable and onerous contracts. And in Power Systems, we have already been able to renegotiate the prices with a benefit to profit and cash flows. These efforts continue as we speak. We are becoming a commercially minded and capable organisation.

At the end of 2022, we have £25 billion [$31 billion] gross working capital tied up in the business. "Our net working capital is £2 billion higher than our position before the pandemic despite revenues being lower." "We are confident that we can deliver a significant and sustainable reduction in working capital across the group by deep diving into the operational value chain and optimising each of the components of working capital. Our immediate focus is on improving inventory management and recovering overdue receivables."

Key building blocks: strategic review

The final workstream, says Erginbilgic, "is our strategic review. This is already underway. Let me start by making it clear that this is not just about what businesses should stay in the portfolio and what we should sell. My early take on the portfolio is that all of our established businesses have the potential to create significant future value. One of the outcomes of the strategic review will be to determine which areas we will invest in and which we will not. To support this new strategic rigour, we will centrally allocate capital to the most attractive market spaces or programmes."

He adds: "This is a change from the past when there was more autonomy within the individual businesses. This more disciplined approach will mean more effective resource allocation of limited available capital. We will continue to support critical safety programmes as well as investment to enable the business to execute on the opportunities presented by the market recovery, but we cannot continue to allocate capital to projects that have low returns.

"Beyond strategic clarity, a granular strategy will be an effective alignment and performance management tool as well as changing the culture. A clear strategy supported by the right performance management can be cascaded down and used as a powerful engagement tool to align the whole organisation. We will have a strategy implementation plan that makes it clear and meaningful to individuals how their business performance and individual objectives contribute to the strategy and mid-term goals. With the right engagement and processes, this not only aligns the organisation but also becomes a good performance management tool.

"We will have the new strategy and mid-term targets for you in the second half of this year, along with the metrics, we will be reporting against to track and measure our progress."

Who is Rolls-Royce new CEO?

Tufan Erginbilgic joined Rolls-Royce as chief executive officer in January 2023, replacing Warren East.

Erginbilgic describes his arrival at a time of significant commercial opportunity for the company. "As CEO, my goal is to work with customers, partners, and colleagues to leverage Rolls-Royce's proud heritage of engineering excellence to deliver its full potential as the market rapidly changes," he said.

Erginbilgic added that he wants to inspire "an urgent need to think differently, challenge the status quo, and change the ways we work to become more efficient, higher performing, and more competitive".

"We need to earn the right to invest in our future so we can play a big role in the world, decarbonising the industries we operate in today. We are going to do this together, as one team, because I fundamentally believe history is written by the people who show up to shape things and to make a difference."

"I will lead an open, frank, and transparent conversation about the business. I have always said: if you don't understand where you are today and don't have the intent to create a different future, you'll always remain in your current reality. My motivation is to get Rolls-Royce to a place where, in another 150 years, the company will still be doing great things for the world, as it has throughout its long history."

Erginbilgic was appointed chief executive officer and an executive director of Rolls-Royce Holdings in July 2022, succeeding East who, on 24 February 2022, announced his intention to step down at the end of last year year.

An oil industry veteran, Erginbilgic is a UK and Turkish national who spent more than 20 years at British Petroleum (BP). Starting in 1997, he rose up the ranks to become chief commercial officer and subsequently chief executive officer between 2014 and 2020 of BP's Downstream, which focused on fuels, lubricants and petrochemicals.

Over the past two years he was a partner at Global Infrastructure Partners, a private equity firm which focuses on large-scale investments in infrastructure businesses and manages $81bn for investors. He was also an independent director at multinational transport vehicle manufacturer Iveco Group.

Narrowbodies face **new-gen engine concerns**

Airfinance Journal talks to engine lessors and traders about their concerns in the industry.

With the almost full recovery of the short-haul and medium-haul markets anticipated this year, the narrowbody engine market will continue to improve.

Lease rates for popular aircraft have recovered well across the board.

The delays in new-technology aircraft have further developed an appetite for NG and A320-family aircraft engines. "They are right into the requirement for shop visits, consequently lease rates are back were they were pre-Covid. Considering where we have seen values and lease rates during Covid, it has recovered well in a relatively short time," observes one engine lessor.

However, in general, the leasing community has concerns about the new-generation engines on the narrowbody fleet for several reasons.

One leasing source says the unknown maintenance cost per flight hour is an issue when assessing the economic performance of a new-generation engine.

"Historically, we have been fairly sure what the maintenance cost and interval will be on engines within our fleet. With the new generation, we have a good idea of the cost but the interval is the main area of concern. It is very likely that we will not get to the published intervals for these engines," he tells *Airfinance Journal*.

He also points out the speed at which the new-generation engines are maturing is also a concern.

"The engine OEMs [original equipment manufacturers] are saying that the current new engines coming off production are mature and won't have issues going forward. We don't believe the engines are mature enough."

For him, this lack of maturity is playing out in the engine flight-hour agreement (FHA) discussions.

"The OEMs are trying to move airlines away from the OEM-backed FHAs. They say they are doing this to ensure there is a more open maintenance market. But the reality is that as the engines are not mature enough. Their cost exposure on maintaining these engines is much higher than they had budgeted for. One of the big issues this is causing is, airlines are refusing to take on additional new-generation aircraft, which come with unknown engine cost exposure. We have heard airlines have started taking Ceos [current engine option] and NGs over adding new aircraft as they know the engine maintenance cost. From an ESG [environmental, social and governance] and investment perspective, this is far from ideal," he says.

Dynamics

Another engine leasing source tells *Airfinance Journal* that short visit capacity was almost full in the narrowbody market in the first quarter of this year.

"The market is quite sensitive, and when operators start to increase their utilisation back to 2019 levels, then it can very quickly tilt from stable or slightly oversupplied to a market where operators need spare engine coverage for the next 12 months," he comments.

The source adds: "Engine shop visit turnaround times have also significantly extended, and trying to predict when you are going to get your engine in and out of the shop also impacts the scheduling of spare engines for operators."

Typicaly, an airline strategy is mainly driven by growth plans to capture traffic demand and utilising current-technology aircraft. As such, some carriers tend to go through the maximum of assets utilisation, including returning to service some previously parked aircraft.

"The market landscape is reshaping; some part-out candidates are still used by operators to use the gap with new-technology deliveries according to summer airline needs.

"But also contradictory, engine MROs [maintenance, repair and overhauls] are expecting a further continuation of the previous trend of supply materials. Every MRO now tends to source more used serviceable materials [USMs], which drives demand for more part-outs.

"The question is how much MROs are putting into their part-out plans for USMs and how can they efficiently address that temporary demand for additional USMs? Second and third tiers of ACMI and charter types of operations are bridging gaps for larger airlines, so demand is not long term," he says.

In the meantime, he points out a relatively high number of available engines versus the pre-Covid period.

"It [number of available engines] fluctuates because of the use of spare engines for different options other than shop visits. Demand remains strong and this will drive lease rates higher. How quickly depends on how some players are aggressive in placing engines, especially in an environment where cost of funding is creeping up," adds the source.

"Uncertainty is still around the on-going teething issues on some new-technology engines, and some are ready to invest further to extend their green time on an engine but not to the full restoration status."

All new engines go through some type of teething problem. In the meantime, the CFM56, which also had some concerns in its development phase, has set the reliability bar very high.

He recalls that the current-technology, now mature, engines that were introduced decades ago had problems in their development stage, but, at that time, capacity growth was not as acute.

"At the time, airlines were growing at a more moderate rate. The population of new engines is a challenge for the OEMs," he says.

Widebodies

The engine MRO sector for widebody aircraft is less developed than for narrowbody assets.

There are fewer MROs performing widebody shop visits and repair lead times have increased since Covid.

One trader highlights some points to consider in respect of widebodies.

"By factor of time in service, the industry is getting to the stage of compound shop visits on the likes of Rolls-Royce Trent 1000s and GEnx-2Bs, where there is a potential overlap between the early delivery engines having second shop visits, and later deliveries having first run shop visits."

As with narrowbody engines, the widebody market will have a backlog of Covid shop visit deferrals.

"Higher widebody utilisation and market certainty will mean operators want engines with more life remaining rather than green-time engines to match the expected future operation. I have seen this being a deal breaker in the [Boeing] 777-300ER market as six engines across three aircraft could not operate beyond 2.5 years," he says.

"Green-time engines are a big feature in widebody markets, particularly for the main passenger types," he adds. "If they are, in markets like the CF6-80C2/PW4000-94, we are seeing more shop visits because of green-time engine shortages."

Engine financings

A round up of engines transactions compiled by ***Airfinance Journal*'s Deal Tracker**.

French bank **Credit Agricole CIB** and PK Airfinance closed an engine financing facility for LATAM Airlines as part of the company's exit from Chapter 11 bankruptcy protection in November 2022.

The firms acted as joint arrangers of the $275 million facility with a five-year tenor.

This transaction provides LATAM with continued financing for its spare engine fleet through 2027.

Credit Agricole CIB is the facility agent and PK Airfinance, an Apollo company, is the security agent in the transaction.

Airfinance Journal's Deal Tracker shows that LATAM entered into a spare engine facility with Credit Agricole and KfW-IPEX bank in June 2018. The $275 million facility covered a total of 45 engines.

CCB Financial Leasing delivered a CFM LEAP-1B27 engine to Norwegian Air Shuttle in March.

CCB Leasing purchased the CFM engine from the manufacturer. A CCB Leasing special purpose vehicle (SPV) incorporated in the Tianjin Dongjiang Free Trade Zone (DFTP) served as the buyer.

The engine is on finance lease between CCB Leasing and Norwegian. The transaction was completed via the SPV in the DFTP.

The Norwegian deal is the first offshore engine lease transaction completed via the DFTP.

According to the free-trade port, the DFTP has finalised 164 engine lease transactions between lessors and Chinese domestic airlines, to date.

CCB Leasing will not be barred from expanding overseas businesses, and has approval to establish an overseas qualified subsidiary in Hong Kong SAR.

In January, the China Banking and Insurance Regulatory Commission approved CCB Leasing to establish an overseas qualified subsidiary in Hong Kong with an initial investment of $300 million.

In March, **Zhejiang Airport Financial Leasing** closed an engine lease transaction with Loong Air.

It is the first engine sale and leaseback transaction in Zhejiang province and covers CFM56-5B4/3 engines for Loong Air's Airbus A320 aircraft.

Zhejiang Airport Financial Leasing is incorporated in the Zhoushan free-trade zone. It was established in May 2018 with a registered capital of Rmb500 million ($72 million).

The leasing firm is a wholly owned subsidiary of Zhejiang Provincial airport, which was established in November 2017 with a registered capital of Rmb10 billion.

In the final quarter of 2022, **Castlelake Aviation** provided a $25 million senior secured loan to a European long-haul airline. The loan is secured by an engine supporting the carrier's fleet.

The loan was part of an overall $100 million in lending, which also featured a $75 million senior secured loan through a syndicated facility to an aviation services group. The loan will be used to finance cargo aircraft.

Evan Carruthers, managing partner and chief investment officer of Castlelake, said at the time that the aviation lending programme had "experienced great momentum" since the hiring of Armin Rothauser to launch and build the business.

"As airlines continue to look for bespoke financing in the current economic environment, we see a growing demand for our capital solutions," adds Carruthers.

Castlelake says the aviation lending programme provides various financing solutions to aircraft buyers, including senior secured, mezzanine and high loan-to-value financing.

Since March 2020, Castlelake says it has originated, purchased or committed about $5.4 billion and expects to continue this momentum as it works with aircraft operators as a capital provider.

It says the aviation lending programme builds on the firm's 17 years' experience of investing in the aviation sector.

Brazilian carrier Gol Linhas Aereas closed an $80 million engine financing deal with **Apollo PK Airfinance** last October.

Funds will be used to acquire one LEAP-1B25 and eight CFM56-7B27 spare engines directly from CFM International, to be equipped on the airline's Boeing 737 Max and 737NG fleets.

Gol says the financing further diversifies its capital expenditure financing at competitive costs and reduces cash outlays required to renew the fleet.

The financing covers the entire cost of acquiring the engines, net of pre-delivery payments already made by Gol.

Last year, the carrier completed a sale and leaseback transaction involving one new 737 Max 8 aircraft with certain funds managed by Apollo affiliates. The aircraft was acquired by the Apollo Funds on its delivery from Boeing in July 2022 and immediately placed under a long-term lease contract with the carrier.

SMBC Aero Engine Lease (SAEL) acquired four Pratt & Whitney PW1133GA-JM spare engines via a sale and leaseback with Philippine low-cost carrier Cebu Pacific Air.

SAEL has concluded a total of 12 engine sale and leaseback transactions with Cebu Pacific over the past two years, according to the engine lessor.

"We will continue to seek creative engine portfolio solutions to help Cebu Pacific and be a trusted engine partner," says Roger Welaratne, managing director and chief executive officer, SAEL.

"Cebu Pacific is likewise delighted to close another deal with SAEL. It is with the help and trust of our partners like SAEL that Cebu Pacific was able to hurdle the past two years of the pandemic and come out as one of the stronger carriers in the region," says Mark Cezar, chief financial officer, Cebu Pacific.

Cebu Pacific has 54 aircraft in its fleet, including nine Airbus A330s, 44 A320-family aircraft and one ATR72-600.

The carrier leases aircraft from a range of lessors, including SMBC Aviation Capital, Avolon and Jackson Square Aviation.

In September 2022, Air India signed a sale and leaseback agreement with **Willis Lease Finance** for 34 CFM56-5B engines for its Airbus A320-family fleet.

The engines will be supported under Willis Lease's ConstantThrust programme, designed to "deliver significant reliability and cost savings versus a traditional MRO [maintenance, repair and overhaul] shop visit programme".

This is the first ConstantThrust sale and leaseback agreement for aircraft engines by any Indian carrier.

Under the transaction, Willis Lease committed to purchase 34 engines powering 13 A321 aircraft and four A320s from Air India.

Through ConstantThrust, Willis provides replacement and standby spare engines, "allowing Air India to avoid potentially costly and unpredictable shop visits on engines powering a transitioning aircraft fleet".

Florida-based Willis will also have an in-country team to coordinate and manage the entire programme and all logistics and transportation involved.

Commenting on the agreement, the chief commercial officer of Air India, Nipun Aggarwal, says: "This is a very unique and landmark transaction which will enable Air India to eliminate the maintenance burden and fully de-risk itself from the maintenance cost uncertainty associated with the engines which were not covered under any power-by-the-hour programme with the OEMs [original equipment manufacturers]. This transaction will allow Air India to de-risk itself operationally, improve fleet reliability, reduce cost and optimise cash flows."

Market banks on **widebody recovery**

An anticipated strong recovery will benefit the widebody engine market this year. But asset owners will need to play carefully when they send engines for shop visits.

As the narrowbody market continues its recovery, all eyes will be on the widebody sector this year. The widebody aircraft utilisation, having been slow over the past two years, has been accelerating since autumn 2022 and the reopening of many countries to tourism and business.

International travel has dictated the widebody market recovery and obviously it was slower than the market for narrowbody.

"Some players have postponed shop visits because of the cost but, on the other side, availability is not in the numbers of the past," observes one source.

He adds that the returned demand for more widebody aircraft is pushing airlines to reconsider their fleet strategy, with some adding used capacity or extending their leases on engines as a result of original equipment manufacturer (OEM) delays on new deliveries.

"Last year, we saw some airlines extending their leases on the CF6 engines because of their reliability," he comments.

Another pollster says there is a lot of appetite for CF6-80C2 engines because there is a market for spares and tear down.

"The cargo conversion market is extending the CF6-80C2 market," he says, adding that issues with new-generation engines and the reliability vis-à-vis the mature engines as well as the longer turnaround times continues the demand trend for old-generation engines.

One pollster highlights the resurgence of the CF6 models because of cargo conversion in the widebody market especially on 767s and A330s. Another pollster agrees, saying: "It is due to the Amazon effect, high demand due to shortage of good engines and USM parts."

Still, the engine shop visit life and costs remain key.

"The market for 767 and 747 engines on passenger operations are in parity for the GE engines but the Pratt & Whitney on the 767 models is in least demand for freighter conversion," observes one source. "The CF6 engine is more reliable. In terms of values, they have been the same for a while. A good one is probably $5-6 million if a fresh engine," he adds.

Widebody engines

	Investor appeal (out of 7)	Remarketing potential (out of 7)	Residual value (out of 7)
CF6-80 (A330s, 747s, 767s)	3.60	4.20	3.50
GE90 (777s)	3.40	3.50	3.60
GEnX (787s, 747-8s)	5.38	5.25	5.25
JT9D (747s, 767s)	1.38	1.38	1.25
PW4000 (A330s, 747s, 767s, 777s)	3.50	3.60	3.30
RB211-524 (767s, 747s)	1.80	1.60	1.60
Trent 700 (A330s)	2.80	2.90	2.60
Trent 800 (777s)	2.00	2.20	2.00
Trent 1000 (787s)	4.75	4.75	4.50
Trent 7000 (A330neo)	4.25	4.13	4.00
Trent XWB (A350s)	5.25	5.13	5.00

NB: Rating of 1 means lowest rating, 7 highest. Source: *Airfinance Journal*, March 2023

> *"The CF6 engine is more reliable. In terms of values, they have been the same for a while. A good one is probably $5-6 million if a fresh engine."*

The PW4000 versions are equipping the A330 fleets at less rates. "The future of the passenger A330 remains uncertain. But the A300P2Fs are good successors to 767 freighters," says one pollster.

The Trent 700 advantage is the extra thrust provided versus other engine options which allows more flexibility for operations on cargo and payload. The market is OEM controlled, says one source, and it depends on demand outside of OEM power-by-the-hour programmes.

As with most investments, the value comes primarily from engines. They, however, need to have good green time remaining and impeccable records.

"Engines for -200ERs are all in short supply with very few spots open at MROs [maintenance, repair and overhauls] for shop visits. Air France, KLM, British Airways, American Airlines, United Airlines still have significant fleets, so demand for engines is still strong but it is not really a very deep market," says one source.

The -200ER market pricing totally depends on engine condition and can vary from $3 million to $6 million. Another source says a half-life Pratt & Whitney would trade around $6 million at the lower end, whereas a Rolls-Royce or General Electric equivalent's values will be more into the $7 million to $8 million range.

The -300ER market is different and has mirrored the widebody recovery. It is driven by two fundamentals: demand and engine values.

"Engine values for a half-life engine have risen from $11-13 million to $15-18 million, therefore aircraft values have also risen ($30-40 million now). Engine lease rates are $150-175,000 per month. Aircraft lease rates are now $350-450,000 monthly, conversion feedstock needs to be $20 million or less and rents after conversion in the $600-700,000 range," observes one source.

"There have been definitely some point movements on -300ERs, as the type has started to return to service with operators. Values have increased on the aircraft, and the engine values too," confirms a pollster.

"In the middle of last year, appraisers were around $7 million on half-life values and that has increased a bit. The GE90 engine is still expensive to send to the shop. At the bottom end, the broad values are in the $4-5 million range," he adds.

The PW4000 engine market has increased in rating since last year, and one pollster notes a tendency towards the 94-inch fan engine, being the first model in the PW4000 family of high-thrust engines. The 94-inch fan demand is driven by the continuing cargo conversion market, especially for serviceable engines.

Another pollster agrees, highlighting the 94-inch market being different from the 100-inch and 112-inch engine markets.

The GE90 continues to attract renewed interest and potentially a resurgence driven by cargo conversions as well as a return to passenger operations.

"International traffic returning and China reopening are main factors along with cargo conversion programmes with 777-300ERSF conversions by GECAS and Mammoth Freighter launch," says one pollster.

"There is a consensus that the market will experience a shortage of widebody aircraft, which I agree with. The 777-300ER will benefit from this," says another pollster.

GE90 lease rates were $110,000 a month a year ago, but can now command $140,000 to $150,000 a month, says one engine trader, who believes that the latter figure is where the market will peak.

The A350 engine market continues to strengthen with Airbus developing the -900 and -1000 customer base, albeit at a different pace. The A350 has been impacted in some bankruptcy restructurings too but new homes can be found easily.

Narrowbody engines

	Investor appeal (out of 7)	**Remarketing potential** (out of 7)	**Residual value** (out of 7)
CFM56-5A (A320 family)	2.00	1.91	1.91
CFM56-5B (A320 family)	4.55	4.64	4.64
CFM56-7B (737NG)	5.80	6.10	5.90
CFM LEAP-1A (A320neo family)	5.60	5.80	5.60
CFM LEAP-1B (737 Max family)	5.50	5.60	5.50
IAE V2500-A5 (A320 family)	4.18	4.27	4.27
PW1100G (A320neo family)	5.11	4.89	4.67
PW1500G (A220 family)	4.67	4.56	4.44
PW2000 (757s)	2.60	2.70	2.50
RB211-535 (757s)	2.90	3.40	2.60

NB: Rating of 1 means lowest rating, 7 highest. Source: *Airfinance Journal*, March 2023

The sale and leaseback market for the type is not much active but one engine trader says brand new engines or spare engines are priced at about $33 million.

The Trent 1000 and the GEnx family remain the top performers in the investor poll. Both have been impacted by pauses on the 787 deliveries but reflect investor confidence in the widebody market. "Demand generally remains solid," says one pollster.

The XWB is performing well in service, but the Trent 1000 has experienced mandated operational restrictions that forced airlines to ground part of their fleet. *Leeham News* recently reported that time between shop visits were as low as three to four years for the XWB against seven to eight years for the Trent 700.

It also flagged that some parts last only 2,000 to 3,000 cycles, with a number experiencing lower durability than anticipated. These include intermediary pressure compressor blades, high-pressure turbine blades and advanced materials in hot sections of the engine.

While the comments on 2,000 to 3,000 cycles for parts change appear concerning for the programme's aftermarket profitability, some industry observers believe this should only be an issue limited to a small fraction of the fleet.

The RB211-535 engine is interesting because it continues to have its day but it is difficult to get hold of some engines with reasonable green time, says one observer, who adds that shop visits are expensive.

Another pollster says the RB211 engine market is gradually eroding and shop visits are being avoided.

"When the value of exchange of engine is lower than the shop visit cost, players will avoid shop visits. But one may remember that a shop visit depends on what an asset investor wants to achieve in terms of restoring an engine condition. It can be half-life or full engine life condition or some minimum green-time extension to 12 months," says one engine lessor.

Narrowbody engines

Market sentiment in the narrowbody sector continues to favour new-technology engines but the delays from aircraft OEMs as well as teething problems in dry or humid applications has translated into a drop in their overall dominance.

"Low times on wings demand lots of spare," says one pollster. The engine OEMs have indeed sold more spare engines over the past year.

"It is a problem as if your engine is not going to be as reliable as previous engine generations, you will need more spare engines," says an engine lessor pointing out that, at some point in the past, V2500 spare engines reached 11% against 5% to 6% for the CFM56 family.

Another pollster highlights the technical issues but also mentions the Leap-1B, in particular, as dependent on China's reopening.

"The market for Neo and Max has not reached any level of maturity in the trading market, although there are some sale and leaseback transactions on new engines," he says.

The delays in new-technology aircraft have further developed an appetite for new-generation (NG) and A320-family aircraft engines. "They are right into the requirement for shop visits, consequently lease rates are back where they were pre-Covid. Considering where we have seen values and lease rates during Covid, it has recovered well in a relatively short time," observes one engine lessor.

Trading on current engines is more plentiful and there is a lot of -5B availability in the marketplace along with A320-family aircraft, especially A319s and A320s on offer, according to one engine source.

Old A319/A320 assets that are cargo eligible can trade in the $3 million range, says one leasing source, but the "non-convertible" assets would trade at a maximum of $1.5 million.

Demand for used serviceable materials (USMs) continued to dictate tear-down pricings. Old A319/A320 asset components have flooded the market since Covid, observes one lessor. He says the tear-down market is now more sophisticated than before with more inventory understanding.

One trader says the 5B5/6 engine market is still relevant, albeit not in great numbers.

"There has been some activity in the lower tiers type of airlines, which reflects the A319 low lease rentals," says the trader. "I don't think the A319 market has necessarily gone the way some would have thought. On the engine level, it is all common parts with the rest of the A320 family, and the operations command lower thrusts so the parts might actually be in better condition to serve shop and onward use."

One source says the V2500 engine market lacked Select engine materials. Demand for serviceable V2500-A5s is there but you have to be selective as a seller, argues one trader, who adds that there is all sort of demand for unserviceable V2500-A5 engines with the number of shops.

"On the 7B market, CFM has control of the market but you can place still with other shops. We have seen interest over the past two months for unserviceable engines in the part-out market," he comments.

During the first quarter, demand for engine leases remained subject to configuration and condition, but overall the -7B performed better than the -5B and A5 engines.

The market for the -7B is different because of the potential 737-800 conversion candidates that are in demand, and availability is in lower numbers.

Lease rates for the -5B are still in the $25,000 range, and the -7B is purely demand to shop demand and demand for spare engines. On the -5B4 engine, it is $35,000 to $45,000 a month, but the -7B commands a $10,000 premium. On the V2500 Select engine, lease rates are in the $55,000 to $65,000 a month range.

"It is purely supply and demand driven. But, historically, the V2500 versus the -5B is more unreliable, and consequently helps the V2500 market lease rates," says one trader.

Run-out -5B engines heading for tear down would trade at $1.5 million. A319 -5B5/6 engines sold for $1.1 million on average each, according to one trader.

"Historically, the V2500 versus the -5B is more unreliable, and consequently helps the V2500 market lease rates."

The -7B price can increase to $2.5 million for run-out engines. "A couple of -7B27s had decent LLPs but run-out engines sold at $2.8 million each," says an engine lessor.

A V2500 non-Select engine 27k thrust fresh and LLPs close to 20,000 cycles from shop visit was trading for $8.5 million. "It is a healthy number as the equivalent engine condition on a -5B would be in the $6.5-7 million range, where you would pitch a full-life engine for a -5B4/3 asset."

CFM-7B26 engines would achieve $7 million to $7.5 million, according to a source. "You will need to invest around $3.5 million per -7B to get them to a good level, which probably will not happen as some investors will only sell the life-limited parts."

An engine lessor comments: "When you see Ceos or NGs working through their airlines' penetrations with lower-tier carriers, as soon as operators spread, they require more engines to cover their operations. In developing regions, new operators of mid-life assets continue to provide a requirement for engines. In parallel, there is a high demand for shop visits still and the like of these part-out merchants will be stockpiling lower LLPs, say 5,000 cycles.

"Six years ago, those would not have been considered a built standard for a CFM56-5B/-7B or V2500. However, as now we are going towards the end of life or around 17-18 years of engine life, the operational timeframe reduces and you get an MRO network that caters for part-built shop visits at cheapest cost for another three years' operations until you retire the asset.

"Even if the engine is not for onwards use, it will be sold for parts for MRO companies to stockpile that trend like it did for 737 Classics where one operator can reduce costs."

Another pollster says: "Demand for -5B and -7B will continue to grow because of capacity requirements in that scenario. There is a congestion at MRO shops, and airlines are trying to find a quick solution and are not opting for full engine overall but modular changes on an engine that allows them to get a serviceable engine for a reasonable period, or three months."

He adds that airlines are looking at a different scenario, including change of engines, shorter shop visits with minimum spend to turnaround engines quickly by replacing modulars on a serviceable material to extend green-time.

Lease rates for the -5B/-7B engines have dramatically improved from the Covid-19 times and are moving towards where they used to be pre-pandemic.

According to one engine lessor, one of the big drivers is on investment by end-of-life players who acquired engine assets and are willing to generate revenues prior to part-out.

"Demand for used serviceable materials is high. This may drive some players, if they are already at break-even point in their investment, to moderately lease them at lower rates to burn the remaining life in the engine asset, and then part them out for USMs. How aggressively they will play in the current engine market and this will define the pace of the engine lease rates recovery."

Regionals

The PW127XT-M is the latest engine variant addition in the regional aircraft market having been introduced since autumn 2022 with ATR72-600 operators.

"So far there are only a handful of operators with four aircraft in service and 16 firm orders," observes one pollster. "Hybrid-electric or hydrogen-electric engines may obsolete the type by the end of decade."

The main engine market for the ATR72-600 is the PW127M with an estimated 400 aircraft in service and another 110 on order. Availability is very tight, according to one pollster.

The ATR72-600 lease rates environment is slightly improving versus the Covid period, especially as the Dash8-400 market continues to plummet. In the meantime, parts prices have gone up by as much as 11%, according to one leasing source.

Lease rates are definitely improving around two main factors: the interest rate environment and the cost of acquisition.

The pre-Covid lease rates, along with the power-by-the-hour contract for regional aircraft, are gone because there is enough competition and demand for products, observes one leasing source.

In the ATR72 market, lease rates have gone up by $10,000 a month over the past year depending on the age of the aircraft.

The trough of the ATR72-600 seems now at about $65,000 a month lease rentals for older assets, but the majority of them would lease in the $85,000 to $95,000 a month bracket. At the other end, new aircraft deliveries have been advertised at $180,000 a month in the past year.

Maintenance reserves have had to be adjusted to reflect overall OEM increased costs. The cost of parts has increased significantly in addition to labour cost.

An increased lease rate is not necessarily translating into an increased margin for lessors, but it is more aligning with interest rates and other costs associated.

"Regional airlines are increasingly forced to make a decision on their future fleet by taking new aircraft or they don't make a decision. The only way you are going to make a $170-180,000 lease rate is through brand new aircraft and if they don't have the alternative to get used aircraft, they will have to restructure their business plan," says a leasing source.

"I think you are going to get more operators that are not going to make a decision because the consumer market has not caught up with that level of increase. You can't increase fares by 40% to accommodate a 40% increase in lease rates. It won't work. This is why it is about the market stabilising and not the Covid recovery over the next 24 months."

Trading activity is subject to engine condition, with some transactions in the $7 million to $8 million range or at more than $10 million.

Overall, engines will be in the $1.5 million range and lease rates are in the $25,000 to $30,000 a month market for PW127F/M engines, says a source.

The ATR72 market availability has improved and engines are scarce. The PW127F engine variant still sees appetite with lower-tier operators but is increasingly driven by the ATR72-500 cargo conversion market.

"Demand for engines will improve with increased use from freighter operators," says the pollster.

The PW150A engine market is described as "very soft", while another pollster says it is heavily oversupplied. There is a high level of Q400 availability and trading is relatively limited in terms of sales.

"Pratt & Whitney Canada controls the market very tightly and the fact that the Q400 production has stopped has had a massive effect on this market," says one pollster. A potential restart of the Q400 production, possibly in the second part of the decade, leaves operators in limbo regarding their fleet strategy.

Regional engines

	Investor appeal (out of 7)	Remarketing potential (out of 7)	Residual value (out of 7)
CF34-8C (CRJs)	3.50	3.25	3.38
CF34-8E (E170/175)	4.00	3.71	3.71
CF34-10E (E190/195)	2.88	2.63	2.50
PW127M (ATR42-600)	4.17	4.33	4.33
PW127F (ATR72-500)	3.67	3.67	3.83
PW127M (ATR72-600)	4.86	4.86	4.86
PW127XT-M (ATR72-600)	4.50	4.17	4.67
PW150A (Q400)	2.67	2.67	2.67
PW1919 (E190/195-E2)	3.43	3.00	3.29

NB: Rating of 1 means lowest rating, 7 highest. Source: *Airfinance Journal*, March 2023

"It is a good aircraft for certain missions but, overall, it is a complicated aircraft to maintain and it needs a lot investment to put back into service," says one pollster.

As expected, there is appetite for green-time PW150A engines as investors may want to avoid high shop visit costs and lead times. The consensus is that lease rates are in the $15,000 to $20,000 a month bracket.

The Embraer 190/195 market has been the most active since the start of the pandemic. Many E190s left their operators and found new homes in countries such as the USA and South Africa. The E190 has benefitted from a liquid market and supply has been for the most part absorbed.

The 2022 activity included Alliance receiving nine E190s previously operated under the American Airline brand via Jetran. The Australian regional operator also recently agreed to purchase 30 E190s, currently operated in the USA, from Aercap.

There is a massive oversupply in this market, says one pollster, highlighting that the OEMs are undercutting residual via power-by-the-hour programmes and deeply discounting new life-limited parts.

The E195 is in high demand from LOT Polish Airlines, TAP Express, SAS and Breeze, says one source.

Main customer Azul Linhas Aereas started to rollover its fleet as it receives new E195-E2s. All of its E195s were expected to be phased out by the end of 2022 and were to be subleased at least until the end of the original operating lease term. Two years ago, LOT Polish Airlines signed letters of intent covering 18 units. Breeze is expected to add up to 28 E195s, while some aircraft were being earmarked to TAP Express.

One source says that operators have delayed and/or avoided shop visits by swapping engines because of pilot shortages in the regional jet market, especially in the USA, and a portion of the fleet have remained inactivated or the utilisation is not as high as it was pre-Covid.

This has caused some players to stop acquiring CF34-8 engines because quite a few are sitting in stock they thought they would release earlier.

"The E190 market transactions during Covid and since involved some spare engines and those operators were generally able to look after themselves," says a pollster, who adds that about 40 E190/195s have been scrapped and there have been 80 engines that have come to the market for part out or are candidates for lease, so there is reasonable supply for those operators that need to cover or delay a shop visit.

"In addition, there is a certain portion of those engines that are under the total care package which GE needs to provide spare engines for those going into the shop visit," he comments.

Generally, for the -8E engine, lease rates are in the $60,000 to $80,000 a month region plus reserves. The -10E is definitely lower than that range and is oversupplied.

One pollster points out that the OEM undercut residual via power-by-the-hour programmes and deeply discounting new life-limited parts. Another respondent agrees GE is lowering its prices to impact the secondary market and, in a way, that has depressed values.

"Half-life engines are somewhere in the region of $4 million but the cost of putting that engine through the shop is horrendous," he says, adding that transitions between operators can only make sense at low pricing.

SMBC Aero Engine Lease 10 years on

What comes next for the bank-owned engine lessor as it celebrates its 10th anniversary? **Olivier Bonnassies** talks to chief executive officer, Roger Welaratne, on the strategy around the new-technology models.

SMBC Aero Engine Lease specialises in engine sale and leaseback transactions directly with airlines typically on 10- to 12 -year leases.

Its primary focus is on new-generation narrowbody engines on Airbus and Boeing aircraft, so CFM International LEAP and Pratt & Whitney geared turbofan (GTF) engines.

SMBC Aero Engine Lease is also looking at expanding its portfolio with the Pratt & Whitney PW1524G engine covering the A220 family.

"We also participate in the widebody market with the General Electric GEnx engine and are looking at the Trent XWB-84 market," says Roger Welaratne, the lessor's chief executive officer.

"SMBC Aero Engine Lease will not venture into bigger engines. We have GE90-115 engines in our portfolio but our focus is on the narrowbody market with smaller size widebody engines. The LEAP and GTF is where our efforts are concentrated in right now."

In 2022, SMBC Aero Engine Lease closed 15 new-generation engine sale and leaseback transactions – all with LEAP and GTF engines.

There was more activity on the LEAP side than the GTF market.

When Welaratne joined the company in 2019, the SMBC Aero Engine Lease portfolio included only GTF engines when it came to the new-generation narrowbody segment. He explains that the lessor has since focused more on LEAP concentration and has gradually balanced the portfolio between the two engine types.

"At the time, the LEAP market was very competitive but, over the time, we have acquired approximately 20 LEAP engines and have 15 GTF engines," he says. "We aim for a two-third portfolio share with the LEAP engine because it covers two aircraft family types.

"In very simple terms," adds Welaratne, "if you have one [Boeing] 737 Max aircraft and two [Airbus] A320neo aircraft – one powered with a GTF and the other with a LEAP – you would align with the market.

"SMBC Aero Engine Lease will not venture into bigger engines. We have GE90-115 engines in our portfolio but our focus is on the narrowbody market with smaller size widebody engines. The LEAP and GTF is where our efforts are concentrated in right now."

Roger Welaratne, chief executive officer, SMBC Aero Engine Lease

Therefore, for one GTF engine you would like to have two LEAP engines – one LEAP-1A and one LEAP-1B – to get the balance aligned with the new-generation aircraft deliveries."

He recalls that the Max groundings delayed that strategy for the lessor but as deliveries of the Boeing models ramp up, he is confident that the equilibrium in the SMBC Aero Engine Lease portfolio will be reached.

Welaratne sees more appetite from aircraft lessors and financiers for the Max products since Boeing started re-delivering aircraft to customers.

"Last year, we did close more LEAP-1B transactions than ever before – closing transactions in Latin America, Middle East and India," he says.

SMBC Aero Engine Lease has doubled its portfolio over the past three years to almost 80 engines.

"When I joined, our target was 100 engines and we expect to exceed that in 2023," says Welaratne. "At the time, we estimated that 100 engines was the critical scale, but today our target is more like 150 engines.

"If we find the right deals, we could achieve the 150-engine portfolio target within three to five years. It will be also a function of sell downs as we need to keep trading, but from a portfolio growth perspective, it is a realistic target. Current demand supports our growth and, although we tend to be prudent in our approach, we can be competitive thanks to our competitive financing."

He adds: "Some of the deals that we did not close were more due to the maintenance security – where the airline was looking at unsecured leases or 'lease-end upsy'. This is the situation where the lease contract includes no maintenance reserves and, at the end of the lease period, if an aircraft is not in full-life condition, compensation is paid in cash.

"In this type of arrangement, we need the customer to be around at the end of the 10-year lease period and not to have filed for a Chapter 11-type restructuring process.

The risk is high and the Covid situation was a good reminder of that," he says.

"At the moment, on a LEAP lease for example, the monthly maintenance reserve payment and rent are roughly the same amount."

Welaratne adds: "Lessors can take letters of credit to secure their leases and, in some instances, when the engine is on power-by-the-hour maintenance agreement, we can negotiate the payment of the LLP [life-limited parts] only and take exposure on the repair side.

"The engine condition is a huge component of the lease transaction. For the customer, it also means a large cash flow at the end of the lease, but for weaker credits, it is risky."

Shop visits

The LEAP and GTF engines have yet to reach their expected shop visit intervals having been delivered relatively recently.

"We find that both engines are not mature, and a lot of early problems emerged on both engines but the GTF has bigger issues than the LEAP. CFM International says the fixes have been identified and will be implemented. It is important for engine lessors (and aircraft lessors) that problems are fixed.

"One of the issues is related to the operation in the Middle East, and there is an airworthiness directive related to LEAP engines that requires an inspection after a certain number of cycles because of the sand effect on the blades. The GTF, on the other hand, appears to be struggling in India and we now face a situation where the reliability of the engine is combined with the turnaround time at the shop, material and the labour shortage.

"All those issues translate into a clogged market," says Welaratne. "The shops are full and waiting for parts."

He says some players do not opt for a shop visit, instead using green-time leases waiting for a better timing to make a decision on the shop visit. But this is not possible with new-technology engines. As there are no green-time leases, all of the spare engines have been used.

> *"I like to compare the 777-300ER market to the 757's. The 757 was always 'dying' but it took 20 years to replace it with the A321 model."*
>
> **Roger Welaratne**, chief executive officer, SMBC Aero Engine Lease

"Demand has come back strong and, after a pause, the OEMs [original equipment manufacturers] have a challenge to address. Some factors affecting the engine situation existed pre-Covid, and Covid only masked the situation when approximately half the fleet were grounded. For the whole of last year [2021], the OEMs had time to prepare and be ready for full resumption of airline operations."

He adds: "New engines are now being removed prematurely, sent to the OEM/MRO [maintenance, repair and overhaul] but they need the same parts that go to the production line. The engine OEMs have to balance the supply of new engines to the aircraft manufacturers, the supply of spare engines to airlines and the supply of parts to the MROs. This is a very difficult situation."

He points out that the OEMs control the market on the new-generation engines.

"They are the only ones that can perform these shop visits. On the other hand, the market is open and there are independent shops for the current-generation engines. But there are turnaround time issues for all engines driven by supply chain and labour issues. There are enough CFM56-5B engines, but it is hard to find -7B engines," he says.

At the lower end of the market, the CF34 is challenging right now and, although SMBC Aero Engine Lease has only four units of this engine type, over time the lessor will look to exit that market and focus on the Pratt & Whitney PW1524G engine market in the regional sector.

The GEnx market is presenting more opportunities, says Welaratne, now the widebody market is progressively returning to normal levels.

"Widebody operators have been planning for this summer since the beginning of the year. That market is up but, although not to the level it was before, it is at a satisfactory level.

"I like to compare the 777-300ER market to the 757's. The 757 was always 'dying' but it took 20 years to replace it with the A321 model. My sense is, this is the same with major 777-300ER operators and this aircraft will be around for some time," he adds.

Investment strategy

SMBC Aero Engine Lease is exploring the XWB market albeit with the smaller engine model, the -84.

From a value perspective, the A320 and 737 families represent 75% of the market. The narrowbody segment has "everything": it has the market size, it is liquid with a wide operator base and, finally, those are good and reliable aircraft.

The narrowbody sector, for engine players, is the place to be. But it is very competitive.

"The widebody sector is different but we want to play a role in that market. SMBC Aero Engine Lease is comfortable with the small widebody segment (787/A350) but the larger the aircraft, the more difficult and riskier it gets for an engine play," says Welaratne.

A move into the XWB market would balance SMBC Aero Engine Lease's presence along with the GEnx exposure. "The Rolls-Royce Total Care consideration has to be factored into our investment, but we believe the right lease structure with the right customer makes us confident to invest into that market."

SMBC Aero Engine Lease has full shareholder support for its investment growth but can also fund its growth with third-party banks. "There is an appetite from banks. Most of our loans are based on our strong portfolio and marketing ability. We kept generating profit during the Covid-19 crisis period, and did not need to ask for any shareholder's capital support," he says.

A strong balance sheet has helped SMBC Aero Engine Lease in not providing a guarantee from the parent company. "We have enough track record to make sure that lenders can provide loans without the guarantee from our parent company," says Welaratne. "In some cases, we might look at some loans with full recourse to the asset where it may be the right funding structure."

Over time SMBC Aero Engine Lease will look to exit the CF34 market and focus on the Pratt & Whitney PW1524G engine market in the regional sector.

Who do we **blame**?

Reliability is still a problem for new-technology engines, but the original equipment manufacturers have delivered for the planet, and it remains a cyclical industry, writes **Tom Barrett**, chief executive officer, elfc.

Heading into the busy summer season in the northern hemisphere, it seems there is a definite sense of déjà vu, with many predicting problems to come for that busy period.

In 2022, the issue that did transpire was that the airports were not able to cope with the surge in demand for travel. In 2023, with another year of recovery, the problems that are being predicted have moved on to those regarding delayed delivery and reliability of new-technology equipment and delays in the maintenance and repair of existing technology equipment.

It seems to be the "go to" discussion topic at conferences and industry gatherings that the original equipment manufacturers (OEMs), regarding the new-technology equipment, and the maintenance, repair and overhauls (MROs) and their supply chain, regarding the current-technology equipment, are being targeted for blame by investors, including many lessors. Not so long ago, many of the same lessors were complaining about too many new aircraft being manufactured.

In particular, I have been reading with interest the criticisms levelled at the engine OEMs regarding the maintenance performance of the new-technology engines and how it is eating up the fuel savings. I think the people making this criticism are being shortsighted and forgetting that the absolute necessity with this new technology, which was to deliver fuel efficiency, has been achieved. To paraphrase a well-worn statement: "It's the planet stupid" and in this regard the engine OEMs have delivered for the planet.

That said, I do acknowledge that the reliability issues with the rollout of the new technology, which have placed a burden on the airlines, have yet to be overcome. However, it is the 15% saving in fuel consumption that will make the vital difference in the long run for us all.

It would be my contention that we all, particularly the equipment investors, including lessors, need to take a step back and realise that we have not been contending with the same level of issues faced by the OEMs and the MROs, which have come through a pandemic that affected them like none before. A little dose of humility for some lessors now complaining might be appropriate.

Tom Barrett, chief executive officer, elfc

It is the cycle stupid!

Instead of blaming others, the lessors and investors need to be reminded that the aviation industry always has been and still remains cyclical. Many of the experienced people now complaining know this and given that they have been around for a long time, they should know how to handle the cycle and just get on with it.

The problems encountered through the Covid-19 pandemic by each engine OEM and engine MRO were so great that they prompted a 26% collapse of the new-technology deliveries for new-technology engines (at a time they were to increase materially) and a 53% collapse for the shop visits of the existing-technology narrowbody engines.

Given that, overnight in March 2020, the world had to stop travelling, the airlines had to furlough their staff and park their aircraft, while the OEMs, in many cases, had to cut production and the MROs (when they were able to operate within the rules of their own country) did not have customers willing to order or pay for their services, I think it is true to say that we all have to allow some extra time for this recovery.

In previous cycles, it has been the experience of elfc that the utilisation and economic returns available in our sector have taken two or three years to recover. This cycle should have been expected to take longer and instead of complaining, it is the considerable experience within the leasing community that needs to be deployed to manage the cycle. It was not an immense challenge to spend the easily accessible money for reward in the top of the cycle, such as we were seeing prior to 2019, and the real challenge for lessors' management is to show they are "the smartest guys and girls in the room" and can continue to be so.

It is the planet stupid!

One fact that cannot be forgotten as we see the end of the pandemic in 2023 is that the OEMs have delivered on their promises regarding the environment. The anticipated 15% saving in fuel consumption has been achieved, and there is great credit due to the engine manufacturers – in particular, Pratt & Whitney and CFMI, concerning the narrowbody engines, but also Rolls-Royce and General Electric, for the widebody engines – that they have achieved this significant saving with the new technology.

Some airlines are saying they have exceeded these targets, and I think the entire travelling community and broader global community have to be grateful for this. The significance of this can only truly be understood when it is considered that the fuel consumption saved by their new developments will mean that a massive 300,000 less gallons of fuel a year will be consumed by the world's airlines per aircraft. This is without any further enhancements in the technology.

With fuel prices, which inflated greatly in 2022, now on the way down, there is not as much emphasis on the impact of this considerable fuel saving in the operations of the airlines.

However, I think there is always the reality that fuel price volatility will return and, when it does, the positive impact of these consumption percentages will be appreciated by all the airlines.

But even if you were to ignore the fuel price volatility, the real measure of success for the engine OEMs is the fact that the global aviation community as a direct result of their innovations and developments will consume 15% less fuel per flight.

It has to be remembered too that with every significant development of new technology, there have almost always been issues at the commencement of that technology's acceptance into the marketplace. It is interesting that CFMI

reports that both the LEAP 1A and LEAP 1B have, since the environmental impact statement, had a lower engine removal rate than their predecessors, the CFM56-5B and CFM56-7B.

Historically, it has taken a number of years for the reliability, which the industry has come to expect, to be experienced. I think many of the commentators forget, maybe reasonably because in the past few years they have been so reliable in terms of the current technologies, that these levels of reliability have not been the norm and, once again, I think some patience is required from the broader aviation community until that reliability is delivered.

Notwithstanding the 15% less fuel consumption, the entire industry knows that this is not enough for the long-term viability of the industry and I think we have to trust that the OEMs, in many cases with the support of their governments, will develop the technologies to see us continue to improve on the fossil fuel consumption within our industry.

It is not clear yet what technologies will succeed but it should be expected that many of the investors in the current- and new-technology equipment will be investing in something that operates quite a bit different in 25 years' time. The developments to come in this regard will be welcomed by all.

New-technology factors

Having acknowledged the tremendous steps made by the engine manufacturers regarding fuel consumption, there is little doubt that the current situation regarding reliability is not sustainable in the long run.

As well as the lack of reliability in both of the significant new narrowbody technologies, CFMI LEAP and Pratt & Whitney GTF, the situation is exacerbated greatly by the fact that, because of the pandemic, the repair shops where repairs to this equipment can be conducted are suffering significant issues around manpower and capacity as we exit the pandemic.

The perfect storm of these two issues has stretched the MRO industry in ways that it could not have anticipated, even in a normal market environment, which we will not see for a few more years.

However, the engine OEMs are taking considerable steps to improve things: they have manufactured additional spare engines to place into their pools to support their existing and new customers, and their teams of engineers are constantly developing improvements to enhance the reliability of the equipment.

The spares ratios on both LEAP and GTF engines are significantly higher than they would have been on previous engine types, and it will take quite some time for this spares ratio to normalise.

In terms of the reliability, the manufacturers and the statistics point out it is improving, and it would be my contention that some of the issues experienced by some carriers are to do with lack of viable businesses plans, as they exit the pandemic, rather than engine reliability.

From an elfc point of view, we are committed to working with our airline customers and the engine OEMs to support them in their efforts to overcome the immediate problems. The manner of this support has been to invest through the cycle in this new technology aggressively and provide the airline customers with extremely competitive lease rates while providing the OEMs with additional flexibility as they inevitably focus on the more important issues of building the reliability for the long-term success of their product. Instead of bashing the engine OEMs, elfc is determined to support them in any way it can.

The evidence of this support is that, outside of the OEM-owned (or affiliated) engine lessors, elfc is the largest independent owner of the new-technology narrowbody engines in 2023.

Older-technology factors

As the aviation industry embarks on a tremendous recovery, the MROs should rightly focus on their core purpose, which is to overhaul efficiently and reliably the engines that are inducted. It is our view that with their cost of capital and the core priorities of improving shop visit turnaround times, overcoming staff shortages and sourcing used serviceable material (USM), that the MROs can rely on the flexible options provided by engine lessors, such as elfc. In so doing, they can marry the requirements to provide spare engines to their airline customers, while the airline customers' engines are overhauled, and ensure that they are able to fill their shops to continue to generate the revenues that are so vital to their rebuilding.

Just like with the airlines, elfc will be competitive in the lease rentals offered and can be flexible to ensure that the engine MROs have the best options for their ultimate customers, the airlines.

With the engines, that have been so reliable for so long, it might appear peculiar that many airlines are now experiencing issues of returning their parked aircraft to service. I would contend that the issue here again is one of difficulty in managing an unprecedented cycle and, along with the MROs, we all have played a role in the current issue by parking up aircraft, thereby creating issues as a result of long-term storage, not repairing the product in accordance with their maintenance schedules and ultimately kicking everything down the road for much of the past three years.

The consequence of this behaviour by all of us, lessors, airlines and other asset owners has been that no industry, even a sophisticated MRO industry such as that which exists, could have been ready for the considerable surge in the stronger recovery which very few predicted.

The issue does not just stop at the door of the MRO but obviously is across all of its supply chain, and when it is considered that part repair shops for some of the pandemic would have received no new orders and, consequently, have no reason to maintain their workforce, it is to be expected that each single piece of that supply chain is being put under duress to go from less than 50% levels of business in 2020 to above 100% of historic levels in a very short period of time.

It will take quite some time for the repair shops to be able to deliver the USM in the quantities required for the engine overhauls and, pending the recovery of this space, the engine turnaround times that we hear about in 2023 will continue. It might be expected that in 2024 turnaround times will start to decrease but there is little doubt that even with such a sophisticated supply chain, small pockets of delays will continue and these will make it very difficult radically to improve on the engine turnaround times.

In terms of what elfc is trying to do to support this part of the business, following its acquisition in 2017 of engine lease finance company INAV, elfc is supporting INAV's strategy to develop long-term supply relationships with the engine MROs globally. The outcome of this is that INAV has been maintaining its sourcing, part out and repair of product through the pandemic and this means that INAV started 2023 with its most significant ever levels of USM.

This means also that the product is there, on the shelf and ready to go in supplying the engine MROs. In doing this, INAV is able to play its part in helping the engine MROs reduce that turnaround time, which leads to the very significant benefits for the aircraft operators, whereby they can build in the reliability required as they respond to the travelling public's demands.

Notwithstanding, the immense pressure in early 2023, brought about by the very strong surge in the recovery, will begin to pass later in 2023 and 2024. However, with more than 11,000 of the current-technology narrowbody engines yet to see their first visit, there is little doubt that the engine MROs will continue to experience capacity demand and they should be able to look forward to decent levels of business in this technology for at least 10 more years.

As one of the largest independent owners of current-technology narrowbody engines, elfc has a significant role to play in supporting the engine MROs and, combined with INAV, it is determined to

find new ways of supporting them in the years to come as they recover from the pandemic.

It is the airline customers stupid!

I do not want to slip into the trap of focusing this entire article where it does not belong – the engine OEMs and engine MROs. Therefore, now I want to focus on the key driver of our industry. Once the travelling public has determined the wish to travel, it is the airlines, and they are the key piece of this industry for all of us, which have to manage the issues presented in the most difficult circumstances imaginable.

They do not have to contend alone with the issues of equipment reliability, interest rates and other matters that consume the engine leasing community, they have to contend with all the issues of airport capacity, fuel costs, staff shortages and considerable geopolitical unrest across the globe. It is the airlines where I think we all have to focus our efforts on and remember that all of us industry participants owe our success and long-term viability to the expertise of the people involved in running these carriers.

Slightly conflicting with the previous statements regarding supporting the engine MROs, elfc is actively working in innovative ways through this cycle to lease engines directly to airlines which are maintaining a shop visit-avoidance strategy. By providing good quality used engines, often with superior reliability and technical records, elfc is able to give the airlines the certainty of supply in the medium term as the industry continues to recover.

The number of elfc engines in inventory, which would have peaked at just above 30% of our portfolio, had halved by the end of 2022 and is continuing to drop significantly in early 2023. Surprisingly, like previous downturns, we anticipate that, with the demand that we see today, our inventory numbers by year-end could be back to levels experienced at the peak of the previous cycle (ie, within three years).

In terms of providing these inventory engines at competitive pricing, elfc, through its long-term investment horizon, is not driven to pursue aggressive rentals, which exploit the current shortage, but is instead happy to offer lease rentals that reflect this long-term investment horizon. It is through the medium- and long-term lease product that elfc has built its business, and we are determined, and committed, to maintaining it by providing reasonable rentals that reflect our investment in the asset.

In terms of the new technology where airlines are anxious to generate some gains or access the most competitive possible lease rentals, elfc is committed to continuing to deploy its very competitive funding to ensure it can provide very competitive lease rentals for the benefit of its customers. As might be expected, with 33 years of unbroken profits, I think while we will not always be the cheapest, I am convinced that elfc can always be competitive. Any inability to be the cheapest can be overcome when the airline customers consider factors such as reliability of execution, professionalism, long-term relationship and certainty of supply.

The airlines can also draw comfort from the fact that it will always be elfc's intention to own, rather than flip or manage, the majority of its portfolio. It is for this reason that elfc was not a strong advocate of the GATS system which, in its view, served to commoditise the asset in which it invests much more than was merited. There was an inherent conflict in this commoditisation with the ability of the lessor to respond to its customers in the Covid pandemic.

What is the future?

As we exit the pandemic, I thought it would be worth mentioning where I see this industry being over the next five to 10 years. Notwithstanding the predictions of doom, for the medium- and long-term requirement for engine leasing, it is elfc's very strong opinion that long-term engine leasing, which combines very competitive rentals throughout the cycle with reliability of supply, will continue to exist.

As ever in a cyclical business, there are variations and these variations will mean that the management of the engine lessors will be called on to make swift, appropriate and occasionally aggressive decisions regarding how they manage their assets.

These aggressive decisions will not be to punish the airlines in their period of greatest need in the midst of a pandemic, and the quid pro quo for all this support will be that the airlines will have to prove their ability to pay for the services provided as the inevitable recovery comes.

That is not to say that the business is not more sophisticated and more competitive than ever because, in 2023, I can assure you it is just as competitive and at the most competitive in its history. This is good news for our customers and does continue to present many challenges for the management of elfc and this niche industry.

However, I can say for certain in 2023 that the engine leasing business is going to continue with large independents such as elfc seeking new ways to be competitive and to deliver for their airline customers.

elfc in 2023

Having branded itself from 1989 until 2022 (to build recognition of what it did at the infancy of this niche business) as Engine Lease Finance Corporation, our company saw fit to rebrand as elfc in 2022. Though the brand may be new, the fact is that this company is determined to remain at the centre of engine leasing in 2023 and into the long term.

elfc's core principle of delivering for its customers remains and it will continue to seek ways to enhance how it can deliver for those customers, be they airlines, MROs or OEMs.

As everything we do in this industry starts with the airlines, it will always be elfc's core objective to deliver flexible, competitive and sophisticated engine leasing products for the airlines.

In delivering for the airlines, elfc is one of the few engine lessors which is able to provide and discuss transactions of scale. With the list price of new-technology narrowbody engines of $20 million, it is important where multiple engine deals happen that the counterparty for the airline customer is able to absorb transactions of scale.

After 33 years of operations, I can say with confidence that elfc is one of the parties which can provide this in 2023.

As the airlines continuously seek to create sustainable options for their ultimate customers – ie, the public – it is vital they can gain quick access to the latest-technology engines which are so much more efficient than their predecessors. In terms of the funding arrangements in place with our lenders, elfc has always had access to the cheapest funding options in the market and will continue to convert these very competitive funding rates to the best possible lease rentals to satisfy our customers' requirements.

We might not always be the cheapest but, unlike many of our competitors which have come and gone, we consistently price our product to ensure we can sustainably deliver for the long term. It is the discipline around this pricing strategy that has seen us enjoy 33 unbroken years of profits and delivery for our customers, many of which have been our customers for the majority of those 33 years.

However, it is not just on the new-technology engines where elfc can distinguish itself from its competitors; elfc has an established current-technology portfolio of significant scale.

With its market-leading position in many of these engine types, it is well placed to provide flexible solutions to the airlines as they endeavour to maximise their fleets. With the delays in deliveries of new equipment, this has never been more important and, as the market embarks on a busy summer season in the northern hemisphere, it is crucial that well-maintained reliable engines are available from spare engine providers such as elfc. Our well-stocked and well-resourced parts supply company, INAV, will play its part too in delivering the USM to the industry.

Engine trends

(from an engine lessor outlook)

Graeme Crickett, chief technical officer of SMBC Aero Engine Lease (SAEL), discusses the market post-Covid.

As the aviation industry recovers from the Covid pandemic, the latest issues are the rapid cost of finance movements and the strength of the US dollar.

For countries or sectors where they have exposure to the US dollar and because their own revenues are largely in their own domestic market and currency, then the trend is not good.

South America and domestic India are ones that have been exposed previously.

Aviation for some markets has rebounded strongly (North America); others such as the Europe, Asia and South America have had a mixed bag with fluctuating returns.

Some airlines took the opportunity to enter into the US Chapter 11 process and renegotiated finance terms with banks and lessors which had little room to manoeuvre or resist.

This can tend to have a domino effect where direct competitors can be forced to follow suit just to stay on the same playing field.

For the narrowbody market, the latest engine configurations have reduced the fuel burn, extended the point-to-point range and have changed the market in a serious and permanent way.

The ability to get seven- to eight-hour sectors and even some 10-hour flights, which is right into the traditional widebody market without the aircraft cost nor the requirement for 400-plus passenger seating, is a game changer.

Not everything is smooth sailing, though, because while the fuel burn and extended range is exceptional, the reliability of the new engines is all over the place.

Where it would be a normal expectation of entry to service issues to come out and be addressed across the original equipment manufacturers (OEMs) over a period of time, we have not seen this yet despite over five years on Airbus Neo operations.

IBA's president, Phil Seymour, recently asked: "When does an EIS issue become a design issue?" This is a good question.

"Not everything is smooth sailing, though, because while the fuel burn and extended range is exceptional, the reliability of the new engines is all over the place."

Graeme Crickett, chief technical officer, SMBC Aero Engine Lease

Initially, the OEMs offered engine fleet-hour agreements to all and sundry in an attempt to lock in market share and keep OEMs' maintenance repair and overall (MRO) service workload consistent. This option has dried up for any new entrants to the industry as the agreements were loss making in total and, for one OEM, incredibly expensive.

OEMs promised the same cost of operations for the Neo engines as the current engine option (CEO) engines they were replacing, which was never going to happen.

Make no mistake, the CFM56 series engine and, more specifically, the CFM56-5B and -7B engines have been comprehensively brilliant in reliability and cost forecasting. The V2500-A5 eventually got there as well and, in the right environment, has evolved into a fine engine.

The industry has been spoilt by these great engines.

Less so for the Neo replacements where a hot and harsh environment is particularly hard on reliability.

Shop visit costs are trending around 35% higher than the CFM56 or -A5 but it is hard to lock down because early engine removals are still prevalent and when a shop visit event happens, there are a number of modifications and perhaps life-limited parts (LLPs) that are required to be installed, so the costs spiral.

Neo engines are running closer to the melt temperatures than ever before. Traditionally, the exhaust gas temperature upper limit for a CFM56-5B/-7B is about 950°C; the LEAP is much more with about 1020°C. Couple this with take-off core rotating speeds increasing by 25% to 35%. The engines are a lot heavier with different design strategies such a gearbox or significant low pressure turbine (LPT) stages making an impact.

The OEMs have not addressed the maintenance, repair and overhaul (MRO) market well, so when the engines do not approach the reliability levels originally planned, there is a log jam, long waiting

times, extended shop visit turn times, competition for new parts that are also needed in new engines with the aircraft OEMs clearly not wanting any delays in their delivery timescales.

New technology is expensive, which has resulted in new engine costs of up to 50% for the CEO engine replacement models. Coupled with interest rate movements, the market is seeing monthly rentals for LEAP and Pratt & Whitney PW1000 engines well into $150,000 range, which is into the GEnx and some GE90 ranges.

Shortly, the Indigo Airlines Pratt & Whitney PW1000G engines and aircraft will start to rotate out of lease and it will be a challenge to place them elsewhere because of market resistance to such operations unless the engines have been subject to a near full overhaul.

In addition, issues have been arising where the OEM flight-hour agreements will not allow second-tier leases into the original agreement because of heavily discounted rates under contract. But the airlines do not want to pay the effective actual rates of operations so there is push back. Some airlines seem happy to have grounded aircraft, engines in shops, available engines rejected and resulting in a finger-pointing standoff between the OEM and the operators.

Most engine leasing opportunities are either single or double or perhaps three engine sale and leaseback deals with the occasional large portfolio leading off into the dim future of perhaps six to seven years. Most engine leasing companies are fair minded and competitive but to take a seven-year option is a big punt, especially when taking the past few years into account.

Some engine lessors can offer pre-delivery payments, which are included in the request for proposals terms sheet for bidders – this is very risky and could be a complicated tripartite deal involving the OEM and various options such as refunds if the deal falls through. For marginal airlines including new start-ups, this is a valid option but high risk for the potential lessor.

One of the latest trends coming into the engine leasing market is the entry of the aircraft lessors. The returns are different and the exposure to specific engine leasing is not the same as in the aircraft leasing side of investment.

This is primarily because of the ability to hide impairments or back-end lease adjustments just don't exist with engines as they can do with aircraft.

Asset monitoring for engines as standalone investments is more critical than many believe and many engine lessors have pointed this out previously.

Engine leasing is a specialist knowledge base, not a generalist base.

Under aviation regulations, while an engine or aircraft is on lease, then the spec management and continuing airworthiness management operations is to the lessee. Once off lease, this passes to the owner, which is not an easy task to pick up for some investors.

The market is seeing monthly rentals for LEAP and Pratt & Whitney PW1000 engines well into $150,000 range.

One trend which is always subject to some intense discussion is the largely more recent trend in documentation and statements having a life and direction all of their own.

For some, it is an expectation that today's documentation can be trailed all the way back to birth for the engines and parts, which unfortunately is just not the case. Historical documentation simply does not conform to present requirements or expectations.

Many in the industry simply do not have the experience to establish quality documentation or statement coverage accurately and this is a problem when the early records do not seem to conform to expectations.

Over the years, the requirement to hold records has been reduced: for the Federal Aviation Administration, it is 24 months; for European Union Aviation Safety Agency, it is 36 months. The MRO is allowed to destroy older records if it wishes.

What is coming through is that MROs are very reluctant to make much effort in tracing or supplying previous records.

Parts manufacturer approval parts and designated engineering representative (DER) repairs do not seem to be as prevalent in the engine repair market at the moment.

It would be a consideration if someone could develop DER repairs for the GE90 market – the shop visit costs are still significant, especially for the second event where LLPs are much more likely to be replaced. The cost for this visit could easily exceed $16 million, which is where some engine trading values are sitting.

Anything like this would allow more tolerance in future life options.

Widebody

This market is still significantly stressed, with only the GEnx-series engines showing any solidification of interest but the recent delays in production of the Boeing 787 programme was a cause of concern for investors. With the phase 2 configuration being released on new engines, older engines that want to benefit of any reliability improvements are being left out of many shop visits because not only the cost of these upgrades but also the service bulletin categories are lowered to be excluded from any FHAs (functional hazard assessments) in contract. This makes these modifications optional and therefore exempt from the programmes.

The overall result is a split in global configurations with hot and harsh separated from non-hot and harsh operations.

The GE90-115B market is still depressed, rents are only recently recovering to some extent but nowhere even close to the pre-Covid period. Dead engines are being traded for less than the $5 million range, with LLPs either significantly discounted residual value or ignored completely. Normal spares ratios for this engine were about 13%, which was probably a little high but a good earner for GE sales (OEM current list prices being $40 million). Now, with operators putting a significant number of 777s into either long-term storage or actively exiting the fleet, few widebody aircraft come back from this positioning.

Delaying the 777X programme certainly helped reset the GE90 in some operators but with about 50% of the total fleet with Emirates Airline, they will likely be the dictator on rates and direction.

The A350 has an earned reputation of cost-effective and reliable operations – the Rolls-Royce XWB has two configurations, the 84k thrust model and the 97k thrust. Neither models share any commonality so investors should take this into account.

In the sale and leaseback market, a few lessors and financiers are keen and bidding is quite strong but the lease terms must be significant such as 10 to 12-plus years. All of these engines are on an OEM support programme, which should be taken into account when closing deals.

There are more interested and keen financiers for the 84k thrust variant but fewer for the larger 97k thrust model likely because of the smaller orderbook for the A350-1000.

Some financiers look to a production orderbook of at least 500 aircraft (1,000 engines if a twin) to be a successful investment option.

SAEL is not exposed to all engines, so some comments are based on conversations and feedback in the markets.

OEM	Engine	Fair Market Value ($m)	Base Value ($m)	Monthly Rental ($000)	QEC Value Range ($m)	LLP Cost (Est New) ($m)	Overhaul (ex. LLP) ($m)	MTBO	FH:FC
CFM	CFM56-3B1	$0.280m	$0.280m	$19,000	$0.025-$0.080	$4.300m	$1.470m	5,000	1.4
CFM	CFM56-3B2	$0.360m	$0.360m	$20,000	$0.025-$0.080	$4.300m	$1.470m	5,000	1.4
CFM	CFM56-3C1 - 23.5k	$0.530m	$0.540m	$42,000	$0.025-$0.080	$4.300m	$1.575m	7,000	1.4
CFM	CFM56-7B22	$3.100m	$3.000m	$48,000	$0.750-$1.250	$5.200m	$3.465m	21,000	1.8
CFM	CFM56-7B24	$3.600m	$3.600m	$52,000	$0.750-$1.250	$5.200m	$3.465m	21,000	1.8
CFM	CFM56-7B26	$4.100m	$4.100m	$55,000	$0.750-$1.250	$5.200m	$3.465m	19,050	1.8
CFM	CFM56-7B24E	$6.400m	$6.700m	$75,000	$0.750-$1.250	$5.200m	$3.780m	23,150	1.8
CFM	CFM56-7B26E	$7.200m	$7.600m	$80,000	$0.750-$1.250	$5.200m	$3.780m	20,600	1.8
CFM	CFM56-7B27E	$7.500m	$8.000m	$85,000	$0.750-$1.250	$5.200m	$3.780m	18,650	1.8
CFM	CFM56-5B5/P	$3.000m	$2.900m	$59,000	$0.800-$1.200	$5.400m	$3.465m	13,400	1.7
CFM	CFM56-5B4/P	$4.000m	$4.000m	$56,000	$0.800-$1.200	$5.400m	$3.465m	14,400	1.7
CFM	CFM56-5B4/3 PIP	$6.400m	$6.800m	$99,000	$0.800-$1.200	$5.400m	$3.780m	16,500	1.7
CFM	CFM56-5B3/P	$4.400m	$4.400m	$54,000	$0.800-$1.200	$5.400m	$3.465m	15,450	1.7
CFM	CFM56-5B3/3 PIP	$7.000m	$7.400m	$96,000	$0.800-$1.200	$5.400m	$3.780m	18,550	1.7
CFM	LEAP-1A26	$11.900m	$11.900m	$106,000	$1.500-$5.600	$5.900m	$4.725m	20,000	1.7
CFM	LEAP-1A32	$13.400m	$13.400m	$112,000	$1.500-$5.600	$5.900m	$4.725m	20,000	1.7
CFM	LEAP-1B27	$12.700m	$12.700m	$97,000	$1.600	$5.300m	$4.830m	21,000	1.8
CFM	LEAP-1B28B1	$15.000m	$15.000m	$99,000	$1.600	$5.300m	$4.830m	19,500	1.8
GE	CF34-3B1	$0.700m	$0.800m	$19,000	$0.380-$0.530	$2.100m	$1.155m	11,500	1.3
GE	CF34-8C5	$2.200m	$2.600m	$35,000	$0.550-$0.780	$3.700m	$1.575m	9,500	1.3
GE	CF34-8E5	$3.000m	$3.100m	$40,000	$0.550-$0.780	$3.700m	$1.575m	9,500	1.3
GE	CF34-10E6	$4.100m	$4.800m	$40,000	$1.400-$1.700	$3.100m	$2.730m	10,700	1.3
GE	CF6-80C2B6F	$2.600m	$1.900m	$120,000	$0.300-$0.800	$9.700m	$4.725m	21,500	6.0
GE	GEnx-1B74/75/P2	$21.200m	$21.000m	$180,000	$1.960-$3.600	$12.300m	$7.665m	19,500	6.0
GE	CF6-80E1A3	$4.000m	$8.300m	$80,000	$1.200-$1.824	$13.900m	$5.250m	19,000	6.0
GE	GE90-115BL	$11.300m	$14.000m	$150,000	$0.700-$2.100	$12.700m	$12.600m	30,000	7.5
GE	CF6-80C2B1F	$2.100m	$1.500m	$82,000	$0.300-$0.800	$9.700m	$4.725m	21,500	6.0
IAE	V2527-A5	$4.100m	$4.300m	$45,000	$0.700-$2.000	$5.300m	$4.410m	19,800	1.7
IAE	V2527-A5 Select	$5.500m	$5.500m	$65,000	$0.700-$2.000	$5.300m	$4.410m	23,900	1.7
IAE	V2533-A5	$5.000m	$5.100m	$55,000	$0.700-$2.000	$5.300m	$4.410m	14,500	1.7
IAE	V2533-A5 Select	$6.500m	$6.600m	$65,000	$0.700-$2.000	$5.300m	$4.410m	17,300	1.7
PW	PW4060	$2.600m	$1.700m	$60,000	$0.300-$1.800	$10.000m	$5.985m	18,200	6.0
PW	PW4168A	$3.200m	$3.200m	$50,000	$0.500-$1.200	$12.500m	$7.770m	18,200	6.0
PW	PW4090	$2.200m	$3.800m	$40,000	$1.000-$2.500	$20.700m	$14.700m	19,000	7.0
PW	PW1127G	$11.300m	$11.300m	$110,000	$1.800-$2.500	$5.600m	$3.885m	15,100	3.1
PW	PW1133G	$12.800m	$12.800m	$130,000	$1.800-$2.500	$5.600m	$3.885m	17,300	1.7
PW	PW1519G	$7.300m	$7.500m	$79,000	$1.800-$2.500	$3.800m	$3.570m	N/A	N/A
PW	PW1524G	$9.000m	$9.200m	$84,000	$1.800-$2.500	$3.800m	$3.570m	N/A	N/A
RR	RB211-535E4	$2.700m	$2.400m	$65,000	$0.225-$0.900	$5.200m	$5.460m	22,000	3.1
RR	Trent 1000-J2	$17.100m	$17.300m	$100,000	N/A	$9.800m	$8.505m	25,500	6.9
RR	Trent 772B-60EP	$4.900m	$7.700m	$70,000	$1.000-$2.000	$8.300m	$10.815m	26,200	4.4
RR	Trent 895	$2.300m	$4.500m	$57,000	NA	$10.000m	$10.815m	20,600	5.5
RR	Trent XWB-84	$23.900m	$23.900m	$220,000	N/A	$11.400m	$9.030m	21,000	6.9
RR	RB211-524H-T	$0.900m	$1.300m	$25,000	$0.125-$0.900	$6.600m	$7.350m	25,250	6.5
RR	Trent 970	$3.900m	$5.100m	$50,000	$0.600	$9.700m	$8.505m	25,200	8.8
RR	Trent 7000-68	$18.500m	$18.700m	$180,000	$0.650	$9.000m	$8.505m	25,200	4.7

Source: IBA, April 2023

Aircraft Model	Engine Options
1900C	PT6A-65B
1900D	PT6A-67D
340A	CT7-5A2
340B	CT7-9B
717-200	BR700-715A1-30
	BR700-715C1-30
737-300	CFM56-3B1
	CFM56-3B2
	CFM56-3C1
737-300QC	CFM56-3B1
	CFM56-3B2
	CFM56-3C1
737-300SF	CFM56-3B1
	CFM56-3B2
	CFM56-3C1
737-400	CFM56-3B1
	CFM56-3B2
	CFM56-3C1
737-400SF	CFM56-3B1
	CFM56-3B2
	CFM56-3C1
737-500	CFM56-3B1
	CFM56-3B2
	CFM56-3C1
737-600	CFM56-7B20
	CFM56-7B22
737-7	LEAP-1B25
	LEAP-1B27
737-700	CFM56-7B20
	CFM56-7B20/3
	CFM56-7B22
	CFM56-7B22/3
	CFM56-7B22E
	CFM56-7B22E3
	CFM56-7B24
	CFM56-7B24/3
	CFM56-7B24E
	CFM56-7B26
	CFM56-7B26/3
	CFM56-7B26E
	CFM56-7B27/3
737-700P2F	CFM56-7B22
737-8	LEAP-1B25
	LEAP-1B27
	LEAP-1B28
	LEAP-1B28B1
737-800	CFM56-7B24
	CFM56-7B24/3
	CFM56-7B24E
	CFM56-7B26
	CFM56-7B26/3
	CFM56-7B26/B1
	CFM56-7B26E
	CFM56-7B27
	CFM56-7B27/3
	CFM56-7B27/3B1
	CFM56-7B27/3B1F
	CFM56-7B27/B1
	CFM56-7B27E
737-800P2F	CFM56-7B24
	CFM56-7B24E
	CFM56-7B26
	CFM56-7B26/3
	CFM56-7B26E
	CFM56-7B27
	CFM56-7B27/3B1
	CFM56-7B27/B1
737-9	LEAP-1B27
	LEAP-1B28
	LEAP-1B28B1
737-900	CFM56-7B24
	CFM56-7B26
737-900ER	CFM56-7B26/3
	CFM56-7B26E
	CFM56-7B27
	CFM56-7B27/3
	CFM56-7B27/B1
	CFM56-7B27E
737-10	LEAP-1B28
737BBJ1	CFM56-7B26
	CFM56-7B27
	CFM56-7B27/3
	CFM56-7B27/3B1
	CFM56-7B27/B1
	CFM56-7B27E
737BBJ2	CFM56-7B27
	CFM56-7B27/3B1F
	CFM56-7B27E
737BBJ3	CFM56-7B27
	CFM56-7B27E
737MAXBBJ1	LEAP-1B28
737MAXBBJ2	LEAP-1B28
737MAXBBJ3	LEAP-1B28
747-200F	CF6-50E2
	JT9D-7R4G2
	RB211-524D4
747-400	CF6-80C2B1F
	CF6-80C2B5F
	PW4056
	RB211-524G
	RB211-524G/H2-T
	RB211-524G/H-T
	RB211-524G2-T
	RB211-524G3-T
	RB211-524H
	RB211-524H2
	RB211-524HT
747-400BCF	CF6-80C2B1F
	PW4056
	RB211-524H
	RB211-524H2
	RB211-524HT
747-400ER	CF6-80C2B5F
747-400ERF	CF6-80C2B1F
	CF6-80C2B5F

Aircraft Model	Engine Options
	PW4062
	PW4062-3
	PW4062A
747-400F	CF6-80C2B1F
	CF6-80C2B5F
	PW4056
	PW4062A
	RB211-524G/H-T
	RB211-524H2
	RB211-524H2T-19
	RB211-524HT
747-400ISF	CF6-80C2B1F
	PW4056
747-400LCF	PW4056
747-400M	CF6-80C2B1F
	PW4056
747-8	GENX-2B67
	GENX-2B67B
747-8F	GENX-2B67
757-200	PW2037
	PW2040
	RB211-535C
	RB211-535E4
	RB211-535E4-B
757-200ASF	RB211-535E4
757-200PCF	PW2037
	PW2040
	RB211-535E4
757-200PF	PW2040
	RB211-535E4
757-200SF	PW2037
	PW2037M
	PW2040
	RB211-535C
	RB211-535E4
	RB211-535E4-B
757-300	PW2040
	RB211-535E4-B
	RB211-535E4-C
767-200	CF6-80A
	CF6-80A2
	JT9D-7R4D
767-200ERF	CF6-80A2
	CF6-80C2B2
	CF6-80C2B4F
767-200F	CF6-80A
	CF6-80A2
	CF6-80C2B2F
	JT9D-7R4D
767-300	CF6-80A2
	CF6-80C2B2F
	CF6-80C2B4F
	JT9D-7R4D
	PW4056
	PW4060
767-300ER	CF6-80C2B2
	CF6-80C2B4
	CF6-80C2B6
	CF6-80C2B6F
	CF6-80C2B7F
	PW4052
	PW4056
	PW4060
	PW4060-1
	PW4060-1/3
	PW4060-1C
	PW4060-3
	PW4060C
	PW4062
	RB211-524H
	RB211-524HT
767-300ERF	CF6-80C2B6F
	CF6-80C2B7F
767-300ERP2F	CF6-80C2B2
	CF6-80C2B5F
	CF6-80C2B6
	CF6-80C2B6F
	CF6-80C2B7
	CF6-80C2B7F
	PW4060
	PW4060-3
	PW4062
767-400ER	CF6-80C2B8F
	CF6-80C2B8FG01
777-200	GE90-90B
	PW4077
	PW4084
	TRENT 875-17
	TRENT 877-17
	TRENT 884
777-200ER	GE90-85B
	GE90-90B
	GE90-92B
	GE90-94B
	PW4074D
	PW4084D
	PW4090
	TRENT 884
	TRENT 884-17
	TRENT 892-17
	TRENT 892B
	TRENT 892B-17
	TRENT 895
	TRENT 895-17
777-200LR	GE90-110B1
	GE90-115B
777-200LRF	GE90-110B1
	GE90-115B
777-300	PW4090
	TRENT 892
	TRENT 892-17
	TRENT 892B
	TRENT 892B-17
777-300ER	GE90-115B
	GE90-115BL2

Aircraft Model	Engine Options
777-300ERF	GE90-115B
777-8	GE9X
777-8F	GE9X-105B1A
777-9	GE9X-105B1A
787-8	GENX-1B64
	GENX-1B67
	GENX-1B70
	TRENT 1000-A
	TRENT 1000-AE3
	TRENT 1000-D
	TRENT 1000-D2
	TRENT 1000-D3
	TRENT 1000-G
	TRENT 1000-G2
	TRENT 1000-G3
	TRENT 1000-J3
787-9	GENX-1B70
	GENX-1B74
	GENX-1B76
	TRENT 1000-D3
	TRENT 1000-J
	TRENT 1000-J2
	TRENT 1000-J3
	TRENT 1000-K
	TRENT 1000-K2
	TRENT 1000-K3
787-10	GENX-1B76
	TRENT 1000-J3
A220-100	PW1519G
	PW1521GA
	PW1524G
A220-300	PW1521G-3
	PW1524G-3
A300-600	CF6-80C2A1
	CF6-80C2A3
	JT9D-7R4H1
	PW4158
A300-600F	PW4158
A300-600R	CF6-80C2A5
	CF6-80C2A5F
	PW4158
A300-600RF	CF6-80C2A5
	CF6-80C2A5F
	PW4158
A310-300F	CF6-80C2A2
	CF6-80C2A8
	PW4152
A318-100	CFM56-5B8/3
	CFM56-5B8/P
	CFM56-5B9/3
	PW6124A
A318CJ	CFM56-5B9/3
	CFM56-5B9/P
A319-100	CFM56-5A1/F
	CFM56-5A4
	CFM56-5A5
	CFM56-5A5/F
	CFM56-5B5/3
	CFM56-5B5/P
	CFM56-5B6/2P
	CFM56-5B6/3
	CFM56-5B6/P
	CFM56-5B7/3
	CFM56-5B7/P
	V2522-A5
	V2524-A5
	V2527-A5
	V2527M-A5
A319CJ	CFM56-5B5/P
	CFM56-5B7/3
	CFM56-5B7/P
	LEAP-1A26
	LEAP-1A26CJ
	N/A
	V2524-A5
	V2527M-A5
A319neo	LEAP-1A26
	N/A
	PW1124G-JM
A320-200	CFM56-5A1
	CFM56-5A1/F
	CFM56-5A3
	CFM56-5B3/3
	CFM56-5B4
	CFM56-5B4/2
	CFM56-5B4/2P
	CFM56-5B4/3
	CFM56-5B4/P
	CFM56-5B6/3
	CFM56-5B6/P
	N/A
	V2500-A1
	V2527-A5
	V2527E-A5
A320CJ	CFM56-5B4/3
	LEAP-1A26CJ
	N/A
	V2527-A5
A320neo	LEAP-1A24
	LEAP-1A26
	LEAP-1A26E1
	LEAP-1A29
	LEAP-1A32
	N/A
	PW1124G1-JM
	PW1127G1-JM
	PW1127GA-JM
	PW1127G-JM
	PW1129G-JM
	PW1133G-JM
A321-100	CFM56-5B1
	CFM56-5B1/P
	V2530-A5
A321-200	CFM56-5B1/3
	CFM56-5B1/P

Source: Avitas, April 2023

Aircraft Model	Engine Options
	CFM56-5B2/3
	CFM56-5B2/P
	CFM56-5B3/2P
	CFM56-5B3/3
	CFM56-5B3/3B1
	CFM56-5B3/3P
	CFM56-5B3/P
	N/A
	V2530-A5
	V2533-A5
A321-200P2F	CFM56-5B3/2P
	CFM56-5B3/3
	CFM56-5B3/P
	V2530-A5
	V2533-A5
A321CJ	CFM56-5B3/3
A321neo	LEAP-1A32
	LEAP-1A33
	PW1130G-JM
	PW1133GA-JM
	PW1133G-JM
A321neoACF	LEAP-1A30
	LEAP-1A32
	LEAP-1A33
	N/A
	PW1130G-JM
	PW1133GA-JM
	PW1133G-JM
A321XLR	LEAP-1A32
	LEAP-1A33
	N/A
	PW1133GA-JM
	PW1133G-JM
A330-200	CF6-80E1A3
	CF6-80E1A4
	CF6-80E1A4B
	N/A
	PW4168A
	PW4168A-1D
	PW4170
	TRENT 772B-60
	TRENT 772C-60
A330-200CJ	TRENT 772B-60
A330-200F	PW4168A
	TRENT 772B-60
A330-200P2F	TRENT 772B-60
	TRENT 772C-60
A330-300 HW	CF6-80E1A3
	CF6-80E1A4
	CF6-80E1A4B
	PW4168A
	PW4168A-1D
	PW4170
	TRENT 768-60
	TRENT 772-60
	TRENT 772B-60
	TRENT 772C-60
A330-300 LW	CF6-80E1A2
	PW4164
	PW4168
	TRENT 768-60
	TRENT 772-60
A330-300P2F	PW4168
	TRENT 772B-60
	TRENT 772C-60
A330-800	TRENT 7000-72
A330-900	TRENT 7000-72
A340-200	CFM56-5C2
	CFM56-5C3/F
	CFM56-5C3/G
	CFM56-5C4
A340-300	CFM56-5C2
	CFM56-5C2/F
	CFM56-5C3
	CFM56-5C3/F
	CFM56-5C3/G
	CFM56-5C4
	CFM56-5C4/P
A340-300CJ	CFM56-5C4
A340-500	TRENT 553-61
	TRENT 553A2-61
	TRENT 556-61
	TRENT 556A2-61
A340-600	TRENT 556-61
	TRENT 556A2-61
A340-600CJ	TRENT 556A2-61
A350-1000	TRENT XWB-84
	TRENT XWB-97
A350-900	TRENT XWB-75
	TRENT XWB-84
A350-900CJ	TRENT XWB-84
A350-900F	TRENT XWB-97
A380-800	GP7270
	GP7270E
	TRENT 970-84
	TRENT 972-84
	TRENT 972E-84
ARJ21-700	CF34-10A
ATP	PW126
	PW126A
	PW127D
ATP Freighter	PW126
	PW126A
ATR 42-200	PW120
ATR 42-300	PW120
ATR 42-300F	PW120
ATR 42-320	PW121
ATR 42-320F	PW121
ATR 42-400	PW121A
ATR 42-500	PW127E
	PW127M
ATR 42-600	PW127M
	PW127XT-M
ATR 72-200	PW124B
	PW127F

Aircraft Model	Engine Options
ATR 72-200F	PW124B
	PW127F
ATR 72-500	PW127F
	PW127M
ATR 72-500F	PW127F
	PW127M
ATR 72-600	PW127M
	PW127N
	PW127XT-M
ATR 72-600F	PW127M
AVRO RJ100	LF507-1F
	LF507-1H
AVRO RJ70	LF507-1F
	LF507-1H
AVRO RJ85	LF507-1F
	LF507-1H
BAE 146-100	ALF502R-3
	ALF502R-3A
	ALF502R-5
BAE 146-200	ALF502R-3
	ALF502R-5
	ALF502R-5-10
BAE 146-300	ALF502R-5
	ALF502R-5-10
C-212-100	TPE331-5-251C
C-212-200	TPE331-10-501C
	TPE331-10-511C
	TPE331-10-512C
	TPE331-10R-501C
	TPE331-10R-511C
	TPE331-10R-512C
	TPE331-10R-514C
C-212-300	TPE331-10R-511C
	TPE331-10R-513C
C-212-400	TPE331-12JR-701C
C919	LEAP-1C
C99	PT6A-36
CRJ-100ER	CF34-3A1
CRJ-100LR	CF34-3A1
CRJ-200ER	CF34-3B1
CRJ-200LR	CF34-3B1
CRJ-700	CF34-8C1
	CF34-8C5B1
CRJ-700ER	CF34-8C1
CRJ-900ER	CF34-8C5
	CF34-8C5A1
CRJ-900F	CF34-8C5
CRJ-900LR	CF34-8C5
	CF34-8C5B1
CRJ-1000ER	CF34-8C5A1
DHC-6-100	PT6A-20
	PT6A-27
DHC-6-200	PT6A-20
	PT6A-27
	PT6A-27A
	PT6A-34
DHC-6-300	PT6A-27
	PT6A-34
DHC-6-400	PT6A-34
DHC-7-100	PT6A-50
DHC-8-100	PW120A
	PW121
	PW121A
DHC-8-200	PW123C
	PW123D
DHC-8-300	PW123
	PW123B
	PW123E
DHC-8-400	PW150A
DO-228-100	TPE331-5-252D
DO-228-200	TPE331-10-252D
	TPE331-10GP-511D
	TPE331-10GT
	TPE331-10GT-511D
	TPE331-10P-511D
	TPE331-10T-511D
	TPE331-5-252D
	TPE331-5A-252D
DO-328 Jet	PW306B
DO-328-100	PW119B
	PW119C
E-170	CF34-8E5
	CF34-8E5A1G01
	CF34-8E5G01
E-170LR	CF34-8E5
	CF34-8E5A1G01
	CF34-8E5G01
E-175	CF34-8E5
	CF34-8E5A1G01
	CF34-8E5G01
E-175LR	CF34-8E5A1G01
	CF34-8E5G01
E-190	CF34-10E
	CF34-10E5A1G07
	CF34-10E5G07
	CF34-10E6G07
E-190AR	CF34-10E
	CF34-10E5A1G05
	CF34-10E5A1G07
	CF34-10E5G05
	CF34-10E5G07
	CF34-10E6A1G05
	CF34-10E6A1G07
	CF34-10E6G05
	CF34-10E6G07
	CF34-10E7B
	CF34-10E7G07
E-190E2	PW1919G
E-190LR	CF34-10E
	CF34-10E5A1G05
	CF34-10E5A1G07
	CF34-10E5G05
	CF34-10E5G07
	CF34-10E6A1G05
	CF34-10E6A1G07

Aircraft Model	Engine Options
	CF34-10E6G07
	CF34-10E7G07
E-195	CF34-10E
	CF34-10E5A1G07
E-195AR	CF34-10E
	CF34-10E5A1G07
	CF34-10E5G07
	CF34-10E6A1G07
	CF34-10E6G07
	CF34-10E7G05
	CF34-10E7G07
E-195E2	PW1921G
E-195LR	CF34-10E
	CF34-10E5A1G07
	CF34-10E5G07
	CF34-10E7G05
	CF34-10E7G07
EMB-110	PT6A-27
	PT6A-34
EMB-120	PW115
EMB-120ER	PW118
	PW118A
	PW118B
EMB-120FC	PW118
	PW118A
	PW118B
EMB-120RT	PW118
	PW118A
ERJ-135ER	AE 3007A1/3
	AE 3007A2
	AE 3007A3
ERJ-135LR	AE 3007A1/3
	AE 3007A1E
	AE 3007A3
ERJ-140LR	AE 3007A1/3
ERJ-145	AE 3007A2
ERJ-145ER	AE 3007A
	AE 3007A1
	AE 3007A1/1
	AE 3007A1P
	AE 3007A3
ERJ-145LR	AE 3007A
	AE 3007A1
	AE 3007A1/1
	AE 3007A1/2
	AE 3007A1E
	AE 3007A1P
ERJ-145XR	AE 3007A1E
F50	PW125B
	PW127A
	PW127B
F70	TAY MK. 620-15
F100	TAY MK. 650-15
J31	TPE331-10
J32	TPE331-10
	TPE331-12
J41	TPE331-14G
MA700	PW150C
MC-21-200	PD-14A
MC-21-300	PW1431G-JM
MD-10-10F	CF6-6D
	CF6-6D1A
	CF6-6K
MD-10-30F	CF6-50C2
	CF6-50C2B
MD-11	CF6-80C2D1F
	PW4462
MD-11CF	PW4460
	PW4462
MD-11F	CF6-80C2D1F
	PW4460
	PW4462
	PW4462-3
MD-81	JT8D-209
	JT8D-217
	JT8D-217A
	JT8D-217C
	JT8D-219
MD-82	JT8D-217
	JT8D-217A
	JT8D-217C
	JT8D-219
MD-83	JT8D-217
	JT8D-217C
	JT8D-219
MD-87	JT8D-217C
	JT8D-219
MD-88	JT8D-217C
	JT8D-219
MD-90-30	V2525-D5
	V2528-D5
MERLIN/METRO	TPE331-10
	TPE331-11
	TPE331-3
MERLINIVC	TPE331-11
METRO23	TPE331-12
METROII	TPE331-10
	TPE331-11
	TPE331-3UW
METROIIIA	TPE331-11U-511G
	TPE331-11U-601G
	TPE331-11U-611G
	TPE331-11U-612G
METROIIIB	TPE331-12UHR-701G
MRJ90	PW1217G
S2000	AE 2100A
SH330	PT6A-45
SH360-100	PT6A-65R
SH360-200	PT6A-65AR
	PT6A-67R
SH360-300	PT6A-65AR
	PT6A-67R
SJ100-95B	SAM146-1S17
	SAM146-1S18

Source: Avitas, April 2023

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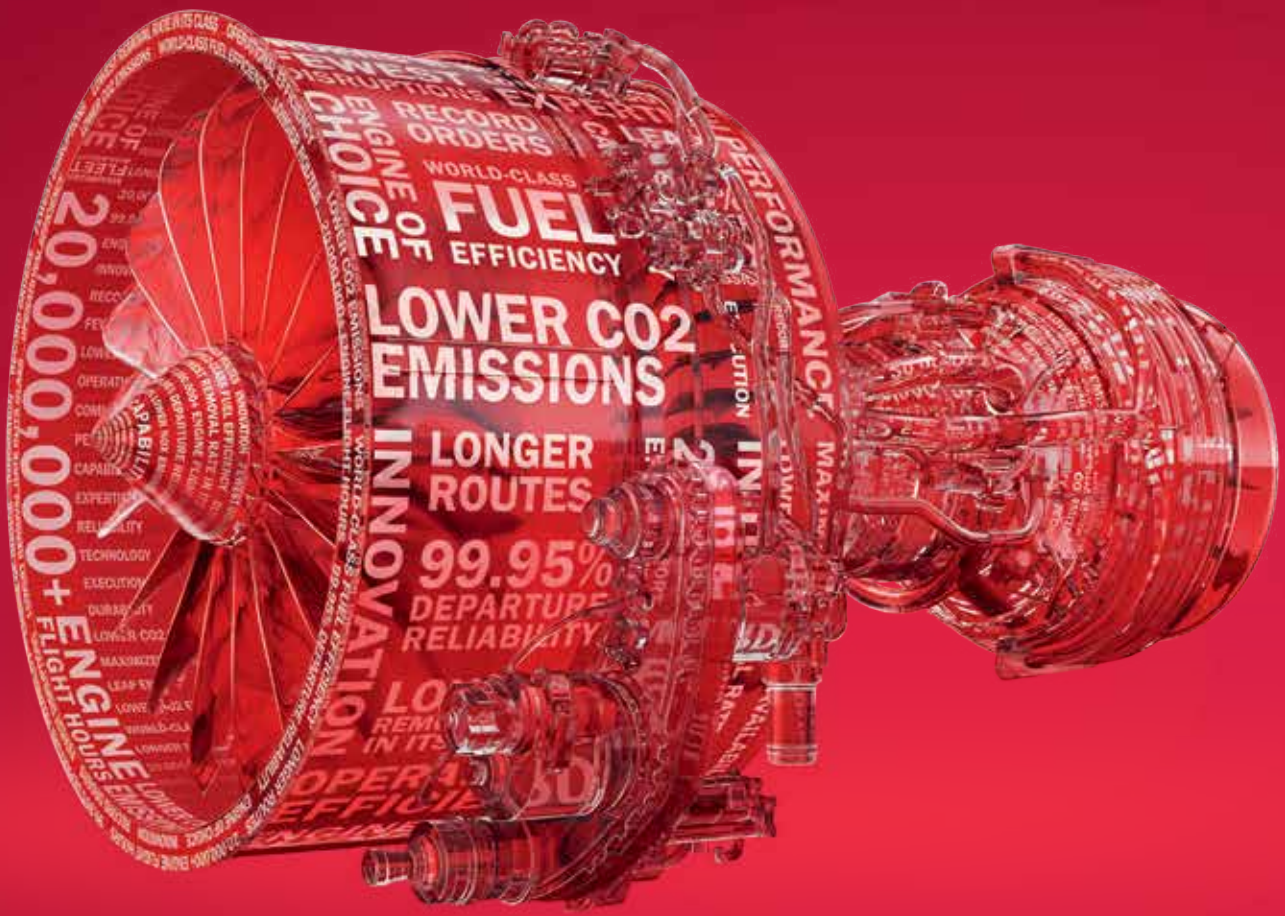

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