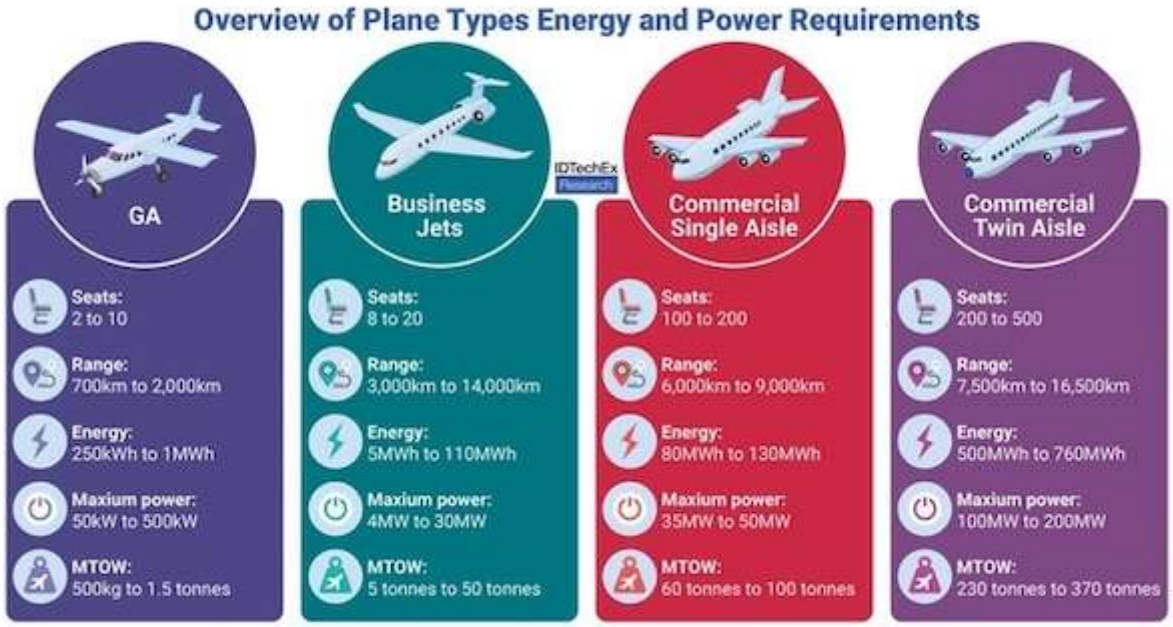
SUSTAINABLE FUTURE AVIATION 2025-2045: TRENDS, TECHNOLOGIES, FORECASTS

News / Manufacturer

It is no secret that the weight of batteries makes building electric planes an engineering challenge. It might be a surprise then that IDTechEx's report "Sustainable Future Aviation 2025-2045: Trends, Technologies, Forecasts" predicts that almost one-quarter of planes sold in 2045 will be battery-electric powered. The report also highlights the scale of the challenges faced by electric aviation, with weight, range, ownership costs, and even carbon footprint all needing consideration. Despite this, IDTechEx believes that current technical trends combined with achievable business use cases will generate significant electric plane uptake in the future.



The challenges

When building an electric airplane, the primary challenge is energy density. This is the amount of energy the battery contains per kilogram. Traditional fuels like AV Gas are exceptionally energy-dense at around 43MJ/kg or 12kWh/kg. By comparison, the best battery technologies today are around 0.3kWh/kg, meaning they are 40 times heavier for the same amount of energy. Thankfully, electric propulsion is much more efficient than internal combustion, which helps to offset this deficit, but not enough. Electric planes end up being heavier than their internal combustion rivals while also having significant range reductions, typically in the range of 80-90% less.

In addition to heavy batteries, the intense usage they will experience in an airplane application will likely shorten their usable life span. This creates a cost of ownership issue. While owners will save considerably on fuel, they will likely need to replace the battery more often than they service and replace engines. Not only is the replacement rate higher, but the cost is also likely to be higher while electric aircraft and certified batteries are produced in such small numbers.

Finally, owners will also have to consider the carbon impact of running an electric plane. The green credentials of an electric vehicle are highly dependent on the grid mix of the country in which it is operated, that is, the methods it uses to generate electricity. Operating an electric plane in a European country with a clean energy mix would reduce CO2 by more than 90%. However, in the US, where lots of fossil fuel is still used to produce electricity, the reduction is only 56%.

Despite the challenges, IDTechEx's research finds that there are pathways to improving the situation. New and emerging battery chemistries could more than double the energy density of batteries for aviation, while modifications to the airframe could allow greater battery weights. Larger batteries also mean less intense use, which, combined with further battery development, will deliver longer cycle lives and better OpEx and TCO benefits. Renewable energy production is growing across the globe, providing better access to low-carbon energy supply.

Even with the current technological limitations, "Sustainable Future Aviation 2025-2045: Trends, Technologies, Forecasts" finds that today's technologies can produce two-seat planes with a flight endurance of one hour. While this might sound extremely limited, the report also explains several

use cases where a one-hour flight can provide significant value.

Where electric planes can be useful

Small two- and four-seat planes, classed as general aviation, have a broad selection of uses, from passenger transport in island hopping to crop dusting. Within their pantheon of applications, there is a good selection of use cases where one hour of flight time is satisfactory, and the potential operational cost benefits of electrification are attractive.

Not only is the range a limitation, but since there is no widespread recharging infrastructure for electric aircraft, any use case should either return to the point of origin or be valuable on one predefined route.

One business case that meets these tight constraints is flight schools. Basic pilot training starts in two-seat, general aviation planes. Lessons are typically an hour long with a break in between. This can be handled with technologies today, and it is one of the first business cases that IDTechEx is expecting to take on electrification. From the flight schools' perspective, they stand to benefit from lower energy costs, simpler maintenance and upkeep, and even less prioritized but nice additions, like less noise around the airfield.

Flight schools aren't the only business that could make use of electric aircraft. Tourist flights, like aerial tours of the Grand Canyon and other attractions, could take on electrification. Or, perhaps hopping between islands and the mainland in remote regions.

IDTechEx's report doesn't stop at general aviation. It predicts that commercial airliners will also use battery electric power in the future. Again it is feasible to electrify larger planes today, and companies are working on it, see the report to find out which. But IDTechEx thinks that when ranges get up to the 500-1,000km range then there is a better argument for electrifying commercial airliners, particularly to serve high volume, short distance routes, like LAX to LAS.

What about hydrogen and SAF

Despite the promise that electrification has, it will not be the answer to all future air travel. Even with the most optimistic assumptions for future battery performance, it is unlikely an electric commercial airline would ever be able to cross continents or oceans.

For these larger journeys, the industry will have to turn to hydrogen and SAF (Sustainable Aviation Fuel) to decarbonize. Hydrogen offers fantastic energy density in terms of weight but occupies huge volumes creating challenges around storing enough of it on the plane. SAF, on the other hand, is a direct drop-in replacement for traditional fuels, but production is complicated and limited. It is already entering service in planes as a blended fuel with companies certifying for 100% SAF flight.

IDTechEx's report " Sustainable Future Aviation 2025-2045: Trends, Technologies, Forecasts" details all the technologies covered in this article. It explores business use cases from a feasibility, total cost of ownership, and carbon perspective, for electric and hydrogen planes. It also considers different plane types, including single-engine fixed-wing general aviation, multi-engines fixed-wing general aviation, business jets, narrow-body commercial airliner, wide-body commercial airliner, and more.

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