



LAX/Community Noise Roundtable

Work Program Item C2 - Update on
Emerging Aircraft Technologies

July 10, 2019

Electric and Hybrid-Electric Engine Powered Aircraft Ready to Take Flight



The Paris Air Show took place from June 17-23, and was a showcase for industry leaders revealing concepts for new hybrid and all-electric engine powered aircraft for commercial use

- The number of electric aircraft design concepts in development increased by roughly 50% over the past year to 170 with potential to increase to 200 by the end of 2019
- The industry is currently focused on developing electric powered “urban flying taxis” with longer-range aircraft to follow
- Aircraft models in development range from electric vertical take-off and landing (eVTOL) delivery drones and flying taxis to regional carriers retrofitted with hybrid-electric engines

(CNN, *Electric planes herald new era for aviation at the Paris Air Show*, www.cnn.com, accessed June 26, 2019.)

(Guy Norris, *Rolls-Royce Takes First Step Toward Productionized Electric Propulsion*, *Aviation Week & Space Technology*, June 14, 2019.)



Fixed-Wing Aircraft - Electric Motors

Companies seeking to carve a place in the electric fixed-wing aircraft market range from new startups to industry mainstays

- U.S. based regional carrier Cape Air will be the first customer for the Eviation Aircraft-produced electric airplane, “Alice”, capable of flying 9 passengers 650 miles on a single charge
- French startup VoltAero has begun the phased development of a hybrid-electric aircraft called the “Corsair” that offers a range of propulsion options to optimize energy use depending on the mission profile
- Airbus is developing a hybrid-electric propulsion system with a turbogenerator to power electric motors and propellers



SOURCE: VoltAero

(CNN, Electric planes herald new era for aviation at the Paris Air Show, www.cnn.com, accessed June 26, 2019.)

(Guy Norris, *Rolls-Royce Takes First Step Toward Productionized Electric Propulsion*, Aviation Week & Space Technology, June 14, 2019.)

(Graham Warwick, *VoltAero Hybrid-Electric Regional Aircraft Development Testing Begins*, Aviation Week & Space Technology, May 28, 2019.)

Liquid-Hydrogen Fuel Cell Motors

Alaka'i Technologies, an air taxi startup, believes liquid-hydrogen fueled electric engines have potential to take electric aircraft to the next level

- Alaka'i has revealed a concept for a liquid-hydrogen powered electric aircraft called the “Skai” with seating for five passengers
- A pound of compressed hydrogen contains over 200 times more energy than a pound of battery, boosting run times for electric aircraft
- Alaka'i would initially market to emergency services, search and rescue missions, and cargo transport operations which have less stringent certification standards than passenger air transport
- \$200,000 per aircraft target price



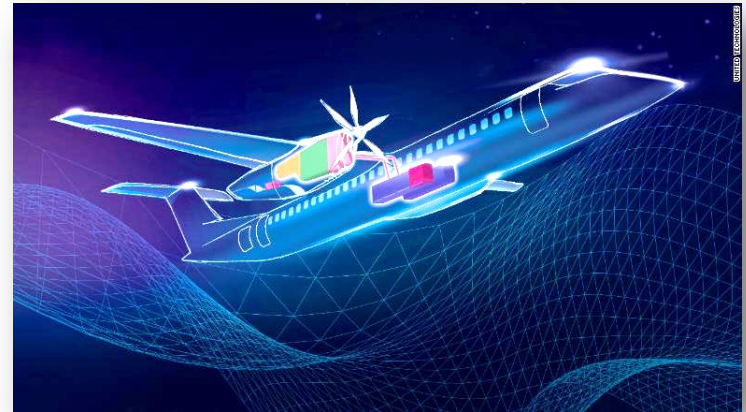
SOURCE: Alaka'i Technologies.

(Eric Adams, *Flying Car Startup Alaka'i Bets Hydrogen Can Outdo Batteries*, Wired, May 30, 2019.)

Fixed Wing Aircraft - Hybrid Electric Engines

Electric passenger aircraft are targeted to be operational within just a few years:

- United Technologies unveiled plans for a hybrid-electric engine with planes to be operational by 2022
- Airbus also plans to test its hybrid electric aircraft by 2022



SOURCE: United Technologies.



Rotary Aircraft and Drones - Electric Motors

Amazon and EmbraerX are developing aircraft concepts utilizing electric vertical take-off and landing (eVTOL) technology

- Amazon unveiled the latest design for a delivery drone, the Prime Air drone, on June 5, 2019
- The Prime Air drone design is shrouded and hexagonal in shape with six rotors. The shrouds serve as wings when the drone transitions from vertical take-off to airplane mode
- Drones are planned to have delivery capability to transport up to 5 pounds a distance of 7.5 miles



SOURCE: Amazon.



Rotary Aircraft and UAVs - Electric Motors

EmbraerX, a division of Embraer, unveiled a new flying vehicle concept with eVTOL capability during Uber Elevate Summit 2019

- The EmbraerX eVTOL development is an effort to provide urban aerial ridesharing and uses an eight-rotor system to enable span-wise lift and low noise output
- In order to operate in urban environs, EmbraerX acknowledges the aircraft needs to meet three essential requirements:
 - high reliability,
 - low operating costs, and
 - low noise footprint



SOURCE: EmbraerX.



Electric Propulsion and Aircraft Noise

Designers and manufacturers tout the potential for all-electric aircraft to reduce noise exposure levels, but research on electric aircraft noise output is still progressing.

- Preliminary noise modeling of electric aircraft operations indicates electric aircraft to be quieter than conventional turbofan aircraft on take-off while increasing noise exposure on approach.
- The benefits of lower noise emissions from aircraft engines may be somewhat offset by the slower rate of ascent on take-offs due to the weight of electric aircraft.
- What impact, if any, the difference between frequencies of electric aircraft noise emissions and conventional aircraft will have on perceived levels of annoyance is still undetermined.

Managing Urban Air Traffic of the Future



EmbraerX is taking the lead in developing standards for Urban Air Traffic Management (UATM)

- EmbraerX, in cooperation with Atech and Harris Corporation, published a white paper, *FlightPlan 2030*, proposing a procedures-based vision for UATM to support future “on-demand air transport”
- UATM would require coordination and integration with conventional Air Traffic Control agencies as well as unmanned traffic management systems used for drones, while also managing safe and efficient low altitude operations in dense urban environs
- UATM aims to ensure “equitable and safe” access to urban airspace for a range of aircraft types (delivery drones, aerial ridesharing services, etc.)

The Return of Supersonic Transports: New Supersonic Passenger Aircraft



Supersonic passenger travel is on the cusp of reemerging, this time with the potential for cross-country service

- Lockheed Martin has unveiled details of a quiet supersonic technology airliner (QSTA) concept capable of transpacific routes with up to 40 passengers
- The baseline design is believed to be capable of economically operating on routes up to transpacific in length, while simultaneously reducing the problems of sonic boom and airport noise that rendered the Concorde obsolete
- Enabling technologies include:
 - shaped-boom design
 - swept-wing supersonic natural laminar flow (NLF)
 - integrated low-noise propulsion
 - XVS high-definition camera and display system (compensating for obscured pilot vision due to the extended nose design)



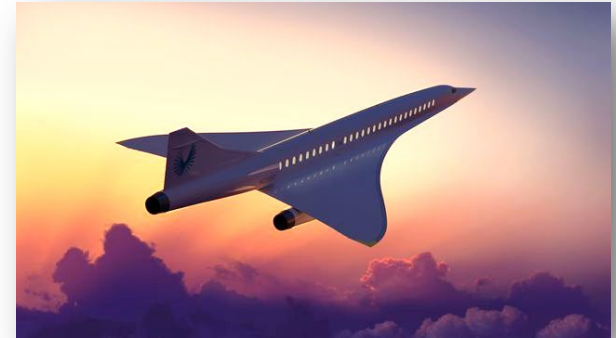
SOURCE: Lockheed Martin.

The Return of Supersonic Transports: New Supersonic Passenger Aircraft



Boom Supersonic, a Colorado-based firm, has been building its “Overture” supersonic airliner since 2014

- The Overture would have a 55-seat capacity and be the fastest civil aircraft ever built
- Five airlines have preordered Overture airliners, including the Virgin Group and Japan Airlines, for a total of 30 pre-ordered Overtures
- Boom claims the Overture’s Sonic Booms will be 30 times less severe than those produced by the Concorde
- Boom has been assembling a half-scale crewed prototype of a Mach 2.2 airliner



SOURCE: Boom Supersonic.

The Return of Supersonic Transports: New Supersonic Passenger Aircraft



Design breakthroughs have enabled the quieter supersonic technology driving the Lockheed Martin and Boom concepts

- Studies begun in 2009 under NASA's second generation, or *N+2*, quiet supersonic initiative “proved for the first time that low boom could realistically be combined with good supersonic-cruise lift-to-drag ratio”
- NASA's X-59 Quiet Supersonic Technology (QueSST) demonstrator aircraft is being built to help civil aviation regulators develop airworthiness noise standards to certify and regulate future supersonic transport designs
- The first flight of the X-59 is expected in 2021, and data from flight testing of the X-59 near U.S. cities from 2023-2025 will be used to help the agency establish an acceptable commercial supersonic noise standard

The Return of Supersonic Transports: New Supersonic Passenger Aircraft



Engine design characteristics as well as differences in the take-off and landing profile of supersonic aircraft can make them louder than subsonic aircraft even at subsonic speeds.

- Barring new regulations, the upcoming supersonic aircraft concepts would be required to meet Stage 5 standards for engine noise reduction
- Application of Stage 5 standards to supersonic aircraft could affect speed, fuel efficiency, and emissions
- Lockheed Martin's QSTA would include additional technology to reduce take-off and landing noise, including an engine designed to deaden sound in an effort to meet the new standard
- NASA's X-59 demonstrator aircraft is designed to reduce sonic booms to "sonic thumps"

The Return of Supersonic Transports: New Supersonic Passenger Aircraft



The FAA and the International Civil Aviation Organization (ICAO) are mulling adoption of new regulations and standards to address supersonic commercial aircraft operations

- Existing noise standards effectively prohibit civil flight at speeds greater than Mach 1 over land in most parts of the world
- The U.S. Congress has directed the FAA to assess regulatory options to make supersonic operations more feasible
- ICAO is beginning a similar exercise through its Committee on Aviation Environmental Protection (CAEP)
- The FAA may wait until ICAO develops its own standards before making a ruling, and ICAO is only in the early stages of such an effort with the hope CAEP working groups will be ready to vote on a standard by 2023 followed by full ICAO adoption by 2025

The Return of Supersonic Transports: New Supersonic Passenger Aircraft



More study will be necessary to develop noise thresholds for regulation of supersonic operations

- During previously conducted NASA studies the threshold requirement for sonic boom loudness was set at less than 80 PLdB (perceived level of noise), with less than 75 PLdB as the optimum target
- The 2023-2025 community acceptance tests with the X-59 should help determine if those thresholds are realistic
- The FAA is issuing a Notice of Proposed Rulemaking (NPRM) to simplify the approval process for flight testing of new supersonic aircraft

Update on Emerging Aircraft Technologies



Roundtable Member Questions?