Breakthrough ZA10 aircraft for delivery starting 2023

- Operating cost: 8¢/seat mile
- Passengers: 6 exec - 12 econ
- Max range: 700 miles
- Max cruise speed: 340 mph
- Take-off distance: 2,200 ft
Hybrid to all-electric air for high-speed regional transit
Extending from 700 miles in 2023 to 1,500 miles in 2035

Operating costs  60-80%
Door-to-door  2-4x faster
Emissions  80-100%
Noise  80%
Runway  50%

Series hybrid-to-electric powertrain
Airframe-integrated battery packs
Quiet electric propulsors
Optimization and control platforms

ZUNUM Aero
Fast, affordable, and everywhere!

<table>
<thead>
<tr>
<th>Disruptive economics</th>
<th>Fly to every community</th>
<th>Get there much faster</th>
<th>Zero emissions short-haul*</th>
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<tbody>
<tr>
<td>60 to 80% lower costs</td>
<td>40,000 airports</td>
<td>2 to 4x door-to-door</td>
<td>Quiet and green</td>
</tr>
</tbody>
</table>

*50% of aviation emissions on short-haul flights
Scaling to 80% of departure and 50% of emissions

2023: ZA10
700 miles
6-12 passengers

2027: ZA50
1,000 miles
50-60 passengers

2030+: ZA100
1,500 miles
100 passengers

Disruptive economics over short-haul
2017 was the year that electric aviation ‘tipped’ – and Zunum played a significant role

National research agenda should lower priority assigned to programs that are developing high-power batteries, fuel cells, and superconducting motors.
Addressing a vast transport gap over regional ranges

Driven by 70-year shift to large airliners serving fewer hubs

- 96% of air traffic in 1% of airports
- 96% of regional trips on ground

Air

Door-to-door times worse today than 50 years ago

1,000s of communities without high-speed links

Inflexible and capital-heavy alternatives, e.g., HSR
Regional has seen a shift to larger aircraft & longer ranges

Evolution of the U.S. regional fleet (seats)
Building on the 1970s U.S. short-haul air system

“We envision a short-haul system capable of operating from every runway and urban area V/STOL port in the United States and very comfortable in an environmental sense”

John Shaffer, FAA Administrator, 1970

- U.S. DOT 20-year strategy targeted short-haul air
- $800M investment in an innovative short-haul air system:

<table>
<thead>
<tr>
<th>US Government</th>
<th>Aerospace OEMs</th>
<th>Major airlines</th>
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<tr>
<td>US DOT</td>
<td>Boeing</td>
<td>PanAm</td>
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<tr>
<td>FAA</td>
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<td>US Army</td>
<td>Grumman</td>
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<tr>
<td>Universities</td>
<td>General Dynamics</td>
<td></td>
</tr>
</tbody>
</table>

- Halted due to 1973-74 oil crisis, poor economy
Reducing door-to-door times by factors of two to four

- 13,500 airports
- 40,000 world-wide

Zunum Aero

- High-speed rail
- Commercial air
- Autonomous car

Mode Options

- June 10: Work to Pasadena/Hilton
  - Dep: 9:00A, Arr: 7:30P
  - SQL-PAO-HWD to BUR-EMT: $75, 2:20
  - HSJC to HBUR: $190, 4:10
  - SJC-SFO-OAK to LAX, LAX to PAS: $150, 4:00
  - $175, 5:50

- June 12: Pasadena/Conf Ctr to Home
  - Dep: 4:30P, Arr: 6:30P
Extending to address all short-haul air by 2035

**Zunum Aero focus**

80% of departures  
50% of emissions

20% of departures  
50% of emissions

**Disruptive**

- 2020
- 2025
- 2030
- 2035
- 2040

**Range miles**

0  
500  
1,000  
1,500  
2,000  
2,500  
3,000  
3,500

**Strong hybrids to all-electrics**
- Scale and range independent
- Very low operating costs
- Very low to zero emissions

**Parallel hybrids to turboelectrics**
- Scale and range advantaged
- Lower operating costs
- Lower emissions
On track for first flight in 2019 and delivery in 2023


Ground testbed

Flying testbed

Conforming prototype

FAA/ASTM Electric aircraft group
FAA engagement
Certification basis closed
Type Certificate application

50-seat regional

Partners

ZUNUM AERO

Confidential
Rapid prototyping underway, leveraging rich ecosystems

Seattle

Chicagoland

Indianapolis

**Aircraft**
- Flight Sc
- Structures
- Systems
- Certification
- Thermals
- Controls

**Power**
- Electric motors
- Power system
- Power electronics
- Controls

**Propulsion**
- Aerodynamics
- Configuration
- Mechanical
- Test

**Avionics**
- Autopilot
- Yaw Damper
- Displays

**Landing Gear**
- Flaps
- Brake Control
- Nose Wheel
- Steering

**Stabilizer Control Unit (SCU)**
- ST1
- ST2
- ST3
- ST4

**Electronic Flight Control Unit (EFCU)**
- A1
- A2
- R1
- R2
- Y1
- A3
- A4
- R3
- R4
- Y2

**Electronic Circuit Breaker Unit (ECBU)**
- Primary Power (Essential Bus)
- Secondary Power (Main Bus)
- Battery Power

**ZUNUM Aero**

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All key technologies in prototype or test for flight in 2019

- Hybrid-to-electric controller: In test
- Optimization and control platforms
- Power system: In simulation and test
- Hybrid-to-electric powertrain
- Testbed aircraft: N8445C purchased
- Turbogenerator
- Quiet electric propulsors
- Quiet fan: Fabricated for test
- Propulsion thermal system: In test
- 500kW Power electronics: In test
- 500kW Electric motor: In fabrication
- Ardiden-3Z Partnership closed

ZUNUM Aero
World-class launch customer and turbogenerator partner

- Orders for up to 100 aircraft for charter (JetSuite) and scheduled (JetSuiteX)
- Scaling nationwide with financing from leading global airlines

- Ardiden-3Z turboshaft tailored for Zunum 500kW turbogenerator
- Long-term development-sales-service contract, offering disruptive economics
Legislative progress in the US and Europe

• 18-month engagement with Norway led to goal of all-electric short-haul by 2040
• Extending to all Scandinavia/Baltics

• Zunum zero emissions air to 1,000 miles in Senate; new Electrification incentives in draft
• Proposed LINK-Air act of Washington; the WA DOT-led Electric Aircraft Working Group

GA expansion; Green drive
UDAAN and make in India schemes
Can this plane reshape air travel?

Zunum Aero leads in betting on the power of hybrid-electric technology, nextgen.

These 9 Airplanes Transformed Flight Over the Last Century

On the anniversary of the Wright brothers’ flight, see how flying has evolved since—and the otherworldly models that may be in our future.

FUTURE

PROTOTYPES

Concepts are under development to increase efficiency and speed, and reduce emissions. In 2015, Airbus unveiled its reimagined E-Fan, a hybrid-electric plane. This year, Boeing’s new Dreamliner will gain new technologies and reduce fuel burn.

27%

Landing with increased efficiency

1,074

Testing flights conducted in 2015

700

Sustainable flight distance

Zunum Aero

Zunum Aero is developing a 42-seat hybrid-electric aircraft in a collaboration with the Massachusetts Institute of Technology and NASA. The company plans to build a prototype next year.