Aircraft Electric VTOL Propulsion: Transforming Aviation

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AHS International — The Vertical Flight Technical Society
www.vtol.org

Uber graphic, April 2017
What is AHS International?

- The global Vertical Flight Technical Society
  - Founded in 1943 as the American Helicopter Society
  - Everything from VTOL MAVs/UAS to rotorcraft and eVTOL to STOVL
- Expands knowledge about vertical flight technology and promotes its application around the world
- Advances safety and acceptability
- Advocates for vertical flight R&D funding
- Helps educate and support today’s and tomorrow’s vertical flight engineers and leaders
Electric VTOL Air Mobility

- Transformative Vertical Flight Workshops
  - Building community & developing industry roadmap
  - https://nari.arc.nasa.gov/wghome

- Since 2014, annual series with AIAA, SAE, NASA, etc.
  2. Aug 2015, NASA Ames, California
  4. Jun 2017, Denver, Colorado
  5. Jan 2018, San Francisco, California

- Presentations, videos and links at
  - http://www.vtol.org/transformative

- Known electric VTOL companies:
  1. Airbus Group (CityAirbus)
  2. Airbus A³ (Vahana)
  3. Aurora Flight Sciences
  4. Bell Helicopter
  5. Carter Aviation/Mooney
  6. DeLorean Aerospace (DR-7)
  7. Detroit (AirspaceX)
  8. EHang (184)
  9. e-volo (Volocopter)
  10. Jetpack Aviation
  11. Joby Aviation (S4)
  12. Kitty Hawk (Flyer)
  13. Lilium Aviation (LiliumJet)
  14. Toyota (Cartivator SkyDrive)
  15. Uber Technologies
  16. XTI Aviation (Trifan 600)
  17. Zee Aero (ZP-1)
  18. Workhorse (SureFly)
The 20th Century proved that vertical flight was possible with combustion engines.

ASTOVL/JAST/JSF proved that the engine location could be decoupled from the center of gravity.

Mechanical complexity led to high failure rate and fatal accidents for a “Wheel of Misfortune.”
Electric Helicopters?

- Eliminate complex rotors!
  - Cyclic, collective, swashplate
  - Transmissions, gearboxes, shafting, hydraulics, etc.

- Environment
  - Noise, noise, noise!
  - “Tailpipe” emissions

- Get on a wing for efficiency
  - High speed
  - Long range

- Not this!
- Cars were not buggies with mechanical horses
Pre-Historic eVTOL


e-volo Volocopter VC1 Demonstrator (2010)
Multi-“Rotor” Configurations

NASA GL-10 Greased Lightning (2014 tethered, 2015 transition)

e-volo Volocopter VC200 (2013 tethered - 2016 manned)
e-volo 2x Multicopter
Now in pre-production
Aurora XV-24A LightningStrike

Graphics courtesy of Aurora
Lilium Aviation
A³ by Airbus: Vahana

Graphics courtesy of A³
Uber Elevate

- Unveiled at 4th Workshop in Sep 2016
- Summit in April 2017

Developing an “Ecosystem”
- Partnerships with cities, real estate companies, aircraft manufacturers, EV charger manufacturers and cities
- Connecting innovators, investors, regulators, technical experts, media

Smaller aircraft, but higher barriers
- Technical, regulatory, environmental, economic, infrastructural and cultural
Please don’t call it a ‘flying car’!
Unless it’s a flying car!

Terrafugia Transition

Aerombil
AHS, AIAA, SAE, NASA, ASTM, GAMA, etc. working together
– 4th Transformative Vertical Flight Workshop @ AVIATION Electric Flight Workshop
– Wednesday afternoon through Friday mid-day
– Developing a Transformative VTOL Roadmap — *get involved!*

Working on breaking the barriers
– Technological, regulatory, environmental, economic, infrastructural & cultural

Uber Elevate Network/ecosystem is being established
– Partnerships with real estate companies, aircraft manufacturers, electric vehicle charger manufacturers and cities
– Connecting “bits and atoms” with “dollars and sense”

Significant funds being invested in electric VTOL (>100M)
– The explosive interest in drones looks to be repeated
– >20? companies developing electric and hybrid/electric VTOL aircraft
eVTOL Resources

- eVTOL News: (vtol.org/eVTOL)
  - www.vtol.org/electricVTOL
  - www.facebook.com/electricVTOL
  - www.twitter.com/electricVTOL
  - www.eVTOL.news (in development)

- Uber Elevate white paper and Summit
  - www.uber.com/elevate/whitepaper or www.vtol.org/uber

- Transformative VTOL
  - www.vtol.org/transformative

- Roadmap — Four Working Groups
  - Private Intra-city (Short range ~ 5 – 50 miles)
  - Commercial Intra-city (Short range ~ 5 – 50 miles)
  - Commercial Inter-city (Longer range ~ 50 – 150 miles)
  - Public Services (Medical, fire, disaster, enforcement)
Questions?