What is The Vertical Flight Society?

- The international **professional society for those working to advance vertical flight**
  - Founded in 1943 as the **American Helicopter Society (AHS)**
  - Everything from VTOL MAVs/UAS to helicopters, eVTOL, etc.
- **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
- **Brings together the community** — industry, academia and government agencies — to tackle the toughest challenges

Join us today: www.vtol.org
VTOL Innovators – Then and Now

1st AHS Banquet
1944

1st eVTOL Workshop
2014
Electric VTOL News
- www.eVTOL.news
- www.facebook.com/electricVTOL
- www.twitter.com/electricVTOL
- www.youtube.com/VTOLsociety
- www.instagram.com/VTOLsociety
- www.vimeo.com/VTOLsociety

Also
- Electric VTOL eNewsletter
- eVTOL News videos
- eVTOL video proceedings (100+ hours)
- eVTOL short course videos (20 hours)
A 75+ Year Legacy

- VFS has a long history of advocacy and leadership
  - Helped establish NASA-Army Joint Office, Nat’l Rotorcraft Technology Center (NRTC), Centers of Excellence, RITA/VLC
  - Worked with NASA and DoD to save the NFAC wind tunnel

- Provided major support to transformative initiatives
  - V-22 Osprey tiltrotor
  - Joint Strike Fighter/F-35B STOVL

- Providing major foundational support to new transformative initiatives
  - Future Vertical Lift (FVL)/Joint Multi-Role (JMR)
  - Electric and hybrid-electric VTOL (eVTOL)

VFS Works to Advance Vertical Flight!
The Electric VTOL Revolution

- Electric & hybrid electric propulsion enable new possibilities for:
  - Regional/Rural Air Mobility (RAM)
  - Urban Air Mobility (UAM)/Air Taxis
  - Urban Cargo Delivery/Disaster Relief
  - Personal Air Vehicles
  - Ultralights
  - Personal Flying Devices
  - Urban Package Delivery
Uber Elevate & VFS
- Unveiled at eVTOL Workshop in Sep 2016
- Summits April 2017, May 2018, June 2019

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

Small aircraft, but high barriers
- Technical, regulatory, environmental, economic, infrastructural and cultural

Uber plans test flights in 2020 and operational service in 2023!
Advancements in electric motors
+ Advancements in batteries
+ Advancements in computer modeling and simulation
+ Advancements in composites
+ Low cost manufacturing
+ Movement to performance regs
+ Tech innovations
+ Tech investments > $2B

= Enabling new configurations and new innovations
"The Hype Cycle"

- Peak of Inflated Expectations
- Trough of Disillusionment
- Slope of Enlightenment
- Plateau of Productivity

"The Hype Cycle"

Attn VTOL Experts:

The eVTOL Revolution Needs YOU!

“To invent an aircraft is nothing. To build one is something. To fly is everything.”

Otto Lilienthal
“To invent an aircraft is nothing. To build one is something. To fly is everything.”
Otto Lilienthal

“It’s easy to design an aircraft if you don’t know how.”
Mike Hirschberg
“To invent an aircraft is nothing. To build one is something. To fly is everything.”
Otto Lilienthal

“It’s easy to design an aircraft if you don’t know how.”
Mike Hirschberg

“If you want to end up with a small fortune in aerospace …
“To invent an aircraft is nothing. To build one is something. To fly is *everything*.”
Otto Lilienthal

“It’s easy to design an aircraft if you don’t know how.”
Mike Hirschberg

“If you want to end up with a small fortune in aerospace, you need to start out with a large one!”
Anonymous
Will the eVTOL Revolution Succeed?

- eVTOL must have low direct operating costs and seat mile costs to be successful
- Batteries will continue to improve
  - Drones: As of January, 1.5M drones registered in US and 162,000+ registered drone operators.
  - EVs: Tesla Model S started in 2012, now all car companies have electric cars. Much lower operating costs vs. fuel-consuming cars.
    - Look at your laptop or cell phone today compared to 10 & 20 years ago
- Cost: eVTOL aircraft will be much cheaper/easier to manufacture, for much higher production rates/reduced costs vs. helicopters (but cars?)
- Noise: much lower, allowing more operations in higher density locations
- Potential for step-change in utilization by improved cost, noise & speed
5 Key Challenges for eVTOL for UAM

1. **Technology**: batteries, hybrid, motors, etc. for larger sizes, e.g. pilot + 4 pax
2. **Infrastructure**: physical and ATM/UTM
3. **Flying**: Pilot shortage vs. autonomy
4. **Standards & Regulations**: in development
5. **Public acceptance**: safety, **noise**, NIMBY

+ a rush for first mover advantage!
# Where We Are Now

<table>
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<th>First hover</th>
<th>First public demos</th>
<th>Capable product</th>
<th>Advanced product</th>
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<td>1907 Cornu (Lisieux, France)</td>
<td>1938 Fw 61 Deutschlandhalle (Bremen)</td>
<td>1967 Bo 105 first flight (Ottobrun)</td>
<td>2015 H160 (Marignane)</td>
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**First hover**

- 2011 e-Volo VC1 (Karlsruhe, Germany)

**First public demos**

- 2019 Volocopter 2X Mercedes-Benz Museum (Stuttgart)

**Capable product**

- 2019 Concept Volocopter VoloCity

**Advanced product**

- TBD
The Electric VTOL News
www.eVTOL.news

- World eVTOL Aircraft Directory
  - Everything from the silly to the serious
- 250+ aircraft (as of January 2020)
  - 96 Vectored Thrust
  - 37 Lift + Cruise
  - 54 Wingless (multicopters)
  - 46 Hover Bikes/Flying Devices
  - 19 eHelos & eGyros
- 200+ VFS articles on eVTOL
- Timeline, maps, company directory, educational videos, etc.

XTI TriFan 600 scale demonstrator (Placerville, California)

Lilium Jet flight test (Munich, Germany)
Upcoming Major VFS eVTOL Events

- **2nd Workshop on Electric VTOL Infrastructure near Atlantic City, NJ, March 17-18, 2020**
  - Supporting FAA Tech Center in Atlantic City
  - City planners, architectural firms, utilities, etc.

- **VFS – SAE Workshop on Battery Technology @ SAE WCX, Detroit, MI, April 23, 2020**

- **VFS @ AUVSI XPONENTIAL 2020, Boston, MA, May 5-7, 2020**

- **VFS Forum 76 @ Montreal, QC, Canada, May. 19-21, 2020**
  - Special Sessions EVTOL

- **CAFE – VFS Electric Aircraft Symposium @ EAA Airventure, Oshkosh, WI, USA**
Annual Forum attracts 1,400 engineers, scientists and leaders from industry, academia and governments

VTOL aircraft CEOs/VPs/engineers, military leaders, researchers, etc

~250 technical papers

~75 panelists

~75 exhibitors

Grand Awards Banquet

eVTOL short course & Bell Canada tour

Forum 76 is May 19-21, 2020 @ Montreal
Concluding Remarks

- VFS is the global Vertical Flight Society (the only one!)
  - Get involved — help shape the future of vertical flight!
  - 2nd eVTOL Infrastructure Workshop (200+ people): March 17-18, 2020
- Electric VTOL and Urban Air Mobility (UAM)
  - Significant funds being invested in electric VTOL, UAM (> $2.5B)
  - 250+ concepts — significant work in hybrid/electric VTOL aircraft
  - The explosive interest in drones is being repeated with manned eVTOL
  - Technology is there to fly off a prototype, but not yet for profitable mass mobility service (techno and socio-economical challenges)
  - Without stakeholders working together next 3-5 yrs, UAM will take longer
  - The eVTOL community needs to collaborate — industry/academia/government
  - Software alone will not make your plane fly safely => you need VTOL expertise!