- Founded as “The American Helicopter Society, Inc.” 75 years ago in Connecticut on Feb. 25, 1943
  - “For the purpose of collecting, compiling and disseminating information concerning the helicopter”
  - Sikorsky Aircraft received its order for the first American helicopters on January 5, 1943 (28 XR-4 helicopters)
- The first and longest-serving helicopter non-profit
  - Founding members Igor Sikorsky, Arthur Young, Frank Piasecki, Stanley Hiller, Reggie Brie, A.A. Griffiths, etc.
  - Included engineers, pilots, operators and presidents from industry, academia and government in Allied countries
- Now 6,000 individual and 95 corporate members
- Advancing vertical flight worldwide
AHS has a proud history of advocacy and support
- Helped in establishment of NASA-Army joint office, VLRCOEs, NRTC, RITA/VLC
- Worked with NASA and DOD to save the NFAC wind tunnel

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

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

Military Developments
Distributed Electric VTOL
Advanced Civil Technologies
Urban Air Taxis

Disruptive Technologies and Approaches ...
The Future of Vertical Flight

... Enable a Transformation in Vertical Flight
Bell V-280 Valor

Next Generation, Affordable Tiltrotor
A³ By Airbus Vahana

Autonomous tandem electric tiltwing
Joby Aviation S4

“The pilot managed a vertical takeoff, 15 minutes of flight in a 15-mile loop, and a safe landing. Powered by electric motors and sophisticated control software, the taxi performs like a cross between a drone and a small plane, able to zip straight up on takeoff and then fly at twice the speed of a helicopter while making about as much noise as a swarm of superbees.”

Joby S4
4-Seat all-electric
6-propeller tiltrotor
Ultra-quiet
200 mph

Robison R44
4-Seat piston
Single-main rotor
135 mph
Kitty Hawk Flyer Prototype

Electric Ultralight (250 lb)
Aviation Comes to the Consumer @ CES 2018
The global **Vertical Flight Technical Society**
- Everything from VTOL **MAVs/UAS to helicopters** and **eVTOL to STOVL** (everything vertical except rockets)

**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

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**Engineers, Scientists and Innovators**
**Working to Bring New Products to Market**

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**What is AHS International?**

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CFD of Joby S4, Aug 2015

VFF Scholarship Winners at AHS Forum 71, May 2015
- Annual Forum attracts 1,300 engineers, scientists and leaders from industry, academia and governments
- VTOL aircraft CEOs/VPs/engineers, military leaders, researchers, etc
- ~250 technical papers
- ~50 panelists
- ~70 exhibitors
- Grand Awards Banquet
- Short courses & industry tours
- Micro Air Vehicle Student Challenge

Forum 74 is May 14-17, 2018 @ Phoenix, AZ
AHS Electric VTOL Efforts

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

- Since 2014, annual series with NASA, etc.
  2. Aug 2015, NASA Ames, California
  4. Jun 2017, Denver, Colorado
  5. Jan 2018, San Francisco, California
  6. Jan 2019, Phoenix, Arizona
  7. Jan 2020, Mountain View, California

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

- Significant funding in electric VTOL (>500M?)
  - >50 companies developing electric and hybrid/electric VTOL aircraft

Uber Elevate
  - Unveiled at 4th Workshop in Sep 2016
  - White Paper in Oct 2016 / Summit in April 2017

Developing an “Ecosystem”
  - Partnerships with cities, real estate companies, aircraft OEMs, EV charger manufacturers & cities
  - Connecting innovators, investors, regulators, technical experts, standards organizations
San Francisco, Jan. 16-19, 2018
- www.vtol.org/TVF-2018

Watershed event with technologists from
- Traditional: NASA, Army, OEMs, suppliers, etc.
- eVTOL: Joby, Zee, Carter, Terrafugia, Aurora, etc.
- New tech: Uber, Amazon, Honda, Toyota, Intel, etc.
- Big OEMs: Embraer, Boeing, Airbus, etc.

Technical community has embraced the future of vertical flight
AHS provides the forum for understanding and collaboration

AHS Recognized as a Leader in Electric VTOL
Flight Global, Feb. 19, 2018
• “OPINION: Are air taxis on a ride to nowhere?”

Unmanned air taxis? (Poll Closed)

- All hail (207 votes) 15.36%
- Fleeting gimmick (439 votes) 32.57%
- Rank stupidity (702 votes) 52.07%

Total Votes: 1,348

84% say won’t happen

AHS TVF5 Participant Survey
• Did the Conference and/or Workshop change your mind?
• Will eVTOL be operational in 5-10 years?

% respondents

- 21.6% say no, no
- 37.3% say no, yes
- 1.9% say yes, no
- 21.6% say yes, yes
- 17.7% say other

59% say will happen in 5-10 years
Advancements in electric motors
+ Advancements in batteries
+ Advancements in computer modeling and simulation
+ Advancements in composites
+ Change in FAR Part 23
+ Tech innovations
+ Tech investments > $1B
= All enable new configurations and new innovations
Electric Helicopters?

- Eliminate complex rotors!
  - Cyclic, collective, swashplate
  - Transmissions, gearboxes, shafting, hydraulics, etc.
- Distributed Electric Propulsion
  - Replace single complex system with multiple simple thrusters
- Get on a wing for efficiency
  - Higher speed, longer range
- Environment
  - Noise, noise, noise!
  - “Tailpipe” emissions

- Not this!
- Cars were not buggies with mechanical horses
## Electric VTOL Air Mobility

### Tilt Thrust
1. **A³ by Airbus** Vahana
2. AirspaceX MOBi
3. **Aurora Flight Sciences** LightningStrike
4. Autonomous Flight Y6S
5. Bartini Flying Car
6. **Bell** (Air Taxi)
7. Carter Aviation CarterCopter
8. DeLorean Aerospace DR-7
9. Digi Robotics Droxi
10. Digi Robotics DroFire
11. **Embraer** unnamed
12. EVA X01
13. HopFlyt (unnamed)
14. JAXA Hornisse 2B
15. **Joby Aviation** S4
16. Lilium Jet
17. **Mooney** (unnamed)
18. Pipistrel (unnamed)
19. Terrafugia TF-X
20. VerdeGo Aero PAT200
21. Vimana (unnamed)
22. VRCO NeoXCraft
23. **XTI Aircraft** Trifan 600

### Lift + Cruise
1. **Aurora Flight Sciences** eVTOL
2. Flexcraft (unnamed)
3. HoverSurf Formula
4. Napoleon Aero VTOL
5. **Sikorsky** VERT
6. SKYLYS Aircraft AO
7. **Zee Aero** Z-P1

### Wingless
1. **Airbus Helicopters** CityAirbus
2. Avianovations Hepard
3. Cartivator SkyDrive
4. Dekatone (unnamed)
5. **EHang 184**
6. Jetpack Aviation (unnamed)
7. **Volocopter** VC200 / 2X
8. Workhorse SureFly
9. Passenger Drone
10. PAV-X PAVX
11. PAV-X PAV-UL Ultralight

### Hover Bikes/Hover Seats
1. Alauda Airspeeder
2. Davinci ZeroG (Prototype)
3. Flike
4. Flyt Aerospace FlytCycle
5. HoverSurf Drone Taxi R-1
6. HoverSurf Scorpion
7. Kalashnikov (unnamed)
8. Kitty Hawk Flyer
10. Malloy Hoverbike
11. Neva Aerospace AirQuadOne
Please don’t call it a ‘flying car’! Unless it’s a flying car!

Terafugia Transition

Aerombil
Stabilized Market Share
Total (Civ + Mil) % by value

2008-2017

- Russian Helicopters, 17.91%
- Airbus Helicopters, 13.15%
- Leonardo, 9.707%
- Bell/Boeing, 8.813%
- Boeing, 7.465%
- Bell Helicopter, 5.971%
- NH Industries, 5.261%
- Robinson Helicopter, 0.955%
- Eurocopter, 1.227%
- AVIC, 2.962%
- All Others, 3.363%
- KAI, 0.719%
- MHI, 0.864%
- HAL, 0.981%

Total: $215.4B

2018-2027

- Russian Helicopters, 18.348%
- Airbus Helicopters, 14.538%
- Leonardo, 10.657%
- Bell/Boeing, 8.813%
- Boeing, 6.844%
- Bell Helicopter, 7.308%
- NH Industries, 4.856%
- TAI, 1.186%
- HAL, 1.211%
- All Others, 1.618%
- Not Selected / Opportunity, 2.034%
- KAI, 2.44%
- AVIC, 3.972%
- Robinson Helicopter, 0.803%

Total: $202.2B

- Bell Boeing V-22 Decreases by $10B
Changes in Market Share
Civil % by value

- Airbus Up $5.5B
- Leonardo Up $3.5B
- Bell Doubles Sales Value
- Russian Helicopters Down 30%
- Sikorsky Down 50%
Industry Outlook: Overview

Civil & Military Production Units, 2008-2027

Civil & Military Production Value, 2008-2027

• Longterm Outlook for Industry is Stable
Industry Outlook: Breakdown

Civil Production Units, 2008-2027

Military Production Units, 2008-2027

Civil Production Value, 2008-2027

Military Production Value, 2008-2027

Long Term Outlook:
- Civil Upswing
- Military Decline

Doesn’t Include eVTOL!
Airbus H175 / AC352 (7.5 t)
Airbus H160 Medium Twin (6 t)
Leonardo’s AW Family

AW169

AW139

AW189
AW609 Civil Tiltrotor
Clean Sky 2: Airbus RACER
Initiated Support in Congress for Future Vertical Lift (FVL) / Joint Multi-Role (JMR) program: www.vtol.org/FVL
- Lobbied for 2009 FVL direction
- Initiated 2011 letter signed by all CEOs to SecDef on FVL Strategic Plan
- FY15 Congress added $14M for JMR/FVL
- FY16 Congress added $10M for JMR/FVL
- FY17 Congress added $11M for JMR/FVL
- FY18 Congress adding (?) $10M for JMR/FVL

NASA Advocacy
- Saved NASA funding in 2002; wind tunnels in 2003
- Successfully keeping NASA budget up

Working to repeat successes for FY19 budget
V-22 only new U.S. military rotorcraft design fielded in past 30 years

All other deployed designs are 30-50 years old

- UH-1 Huey first flight 1956; Chinook 1961; Black Hawk 1975; Apache 1976
- Many 1960s airframes are still flying!
- CH-53K only new design in acquisition process
US Military: VTOL Capability Gaps

- **Performance shortfalls**
  - Speed, range, payload, endurance, altitude

- **Unexploited autonomy/collaboration**
  - Significantly increased mission effectiveness remains untapped

- **Unacceptable survivability & situational awareness shortfalls**
  - Safety and threat losses, no common picture

- **Costly sustainment**
  - Supportability, maintainability, reliability and availability

17 years of conflict and DoD studies reveal significant VTOL mission capability gaps
Future Vertical Lift (FVL) Concepts for Capability Set 3

- Sikorsky-Boeing SB>1 Defiant
- Bell Helicopter V-280 Valor
- AVX Aircraft CCH
- Karem Aircraft KVL-3 Mustang

www.vtol.org/FVL
Compounds & Tiltrotors

Sikorsky-Boeing SB>1 Defiant™ (2018)

30,000 lb (13.6 t) class

Sikorsky S-97 Raider™ (2015)

11,000 lb (5 t)

Sikorsky X2 Technology™ Demonstrator (2008)

5,500 lb (2.5 t)

Bell Helicopter V-280 Valor (2017)

30,000 lb (13.6 t) class

Leonardo (with Bell) AW609 (2003)

16,800 lb (7.6 t)

Bell Boeing V-22 Osprey (1989)

52,600 lb (23.8 t)
Sikorsky-Boeing SB>1 Defiant
Sikorsky S-97 Raider
**eVTOL Online Resources**

- Electric VTOL News
  - www.eVTOL.news
  - www.facebook.com/electricVTOL
  - www.twitter.com/electricVTOL
  - www.youtube.com/HeloSociety

- Also
  - Email newsletter
  - eVTOL News videos
  - Analytical report (March 2018)
AHS is the global Vertical Flight Technical Society
- 74th Annual Forum is May 14-17 in Phoenix, Arizona

Significant civil and military rotorcraft developments underway
- State-of-the-art conventional helicopter developments and AW609 tiltrotor
- Clean Sky 2: advanced compound and tiltrotor
- FVL/JMR: advanced compound and tiltrotor — see www.vtol.org/FVL

Significant funds being invested in electric VTOL ($1B+)
- 50+ companies investing in electric and hybrid/electric VTOL aircraft
- The explosive expansion in drones may be repeated with manned eVTOL
- For more info, see www.eVTOL.news
Wednesday Press Conference: The Electric VTOL Revolution

Wednesday, Feb. 28 @ 11:00-11:45 am

- **Mike Hirschberg**, Executive Director, AHS International (moderator)
- **Michael Thacker**, EVP Technology & Innovation, Bell Helicopter
- **Mark Moore**, Director of Aviation Engineering, Uber Technologies
- **Greg Bowles**, VP for Global Innovation & Policy, General Aviation Manufacturers Association (GAMA)
- **Dr. Mike Romanowski**, FAA Aircraft Certification Service’s (AIR) Director of the Policy & Innovation Division (AIR-600)