

Global Forces in Vertical Flight Technology



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Oct 21, 2015

AHS International
The Vertical Flight Technical Society

www.vtol.org

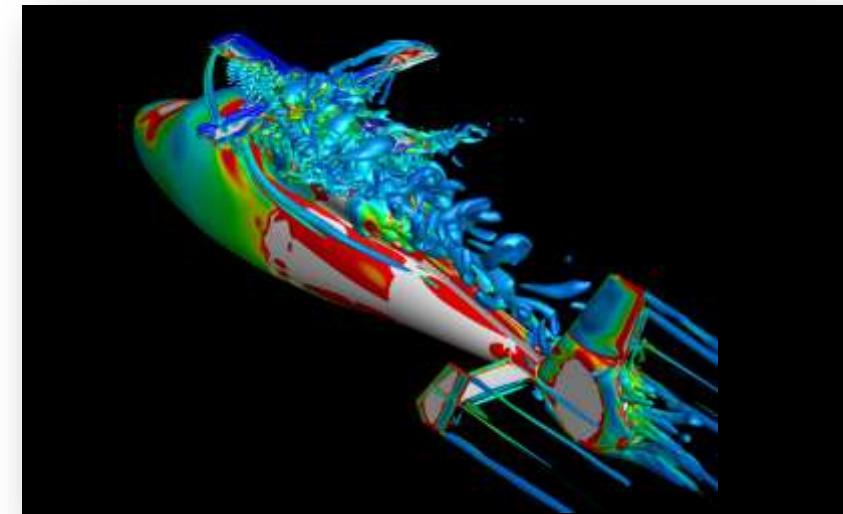
Overview

- Economic Outlook for Rotorcraft
- Global Competition
- Technologies for Vertical Flight
- Vision and Leadership



What is AHS International?

- Founded in 1943 as the American Helicopter Society
 - Now the global vertical flight technical society
- **Expands knowledge** about vertical flight technology and **promotes its application** around the world
- Advances rotorcraft **safety and acceptability**
- Advocates for vertical flight **R&D funding**
- Helps **train the next generation** of vertical flight leaders



CFD simulation of Eurocopter Dauphin in forward flight
Courtesy of ONERA



VFF Scholarship Winners at AHS Forum 71, May 2015

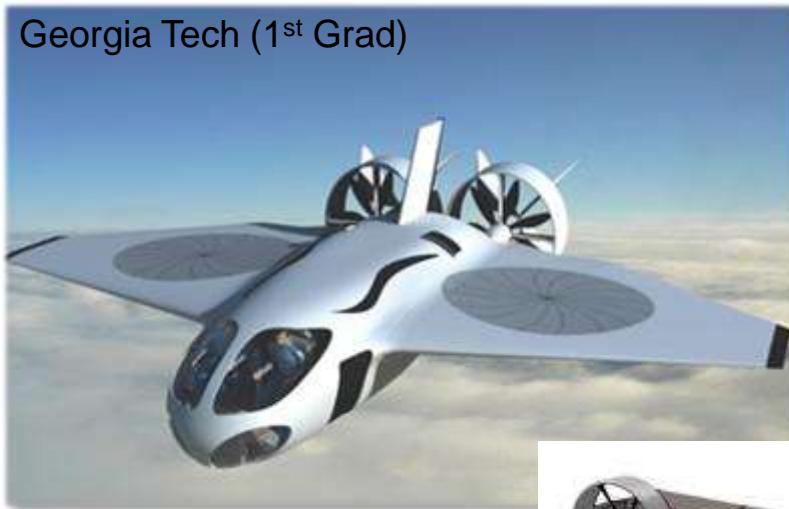
Transformative VTOL

- Many exciting VTOL concepts now being explored



2014 Student Design Competition: X-VTOL based on DARPA VTOL X-Plane

Georgia Tech (1st Grad)



Politecnico di Milano (2nd Grad)



St. Louis Univ. (1st Undergrad)



Georgia Tech (2nd Undergrad)

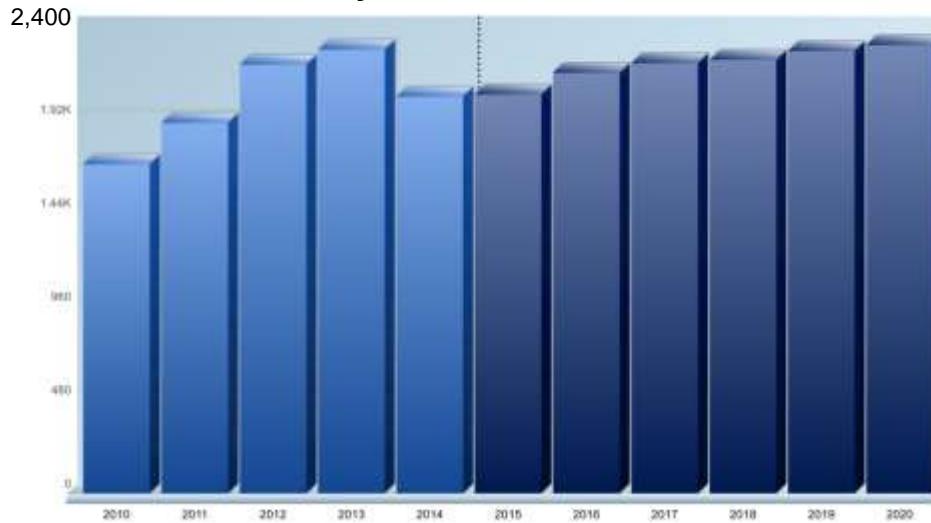


Rensselaer Polytechnic Institute (3rd Grad)

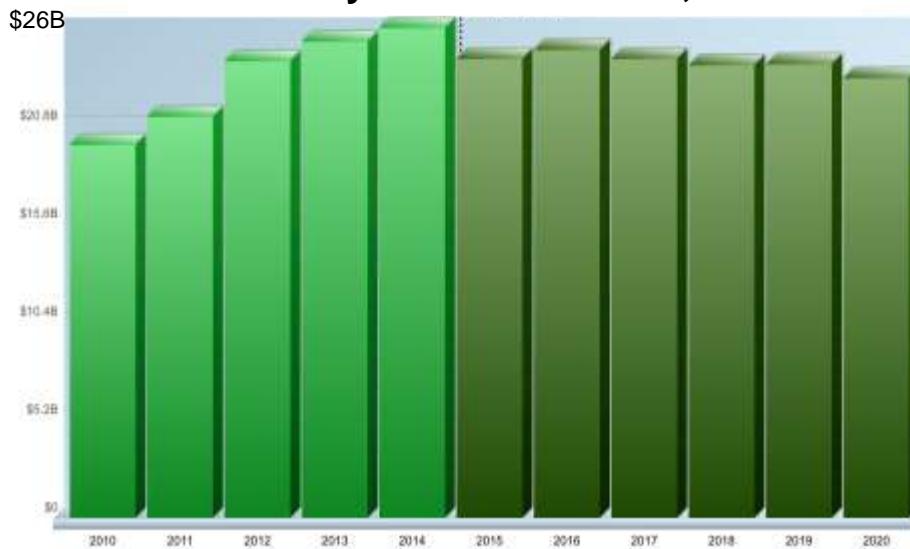


Industry Outlook: Overview

Civil & Military Production Units, 2010-2020



Civil & Military Production Value, 2010-2020



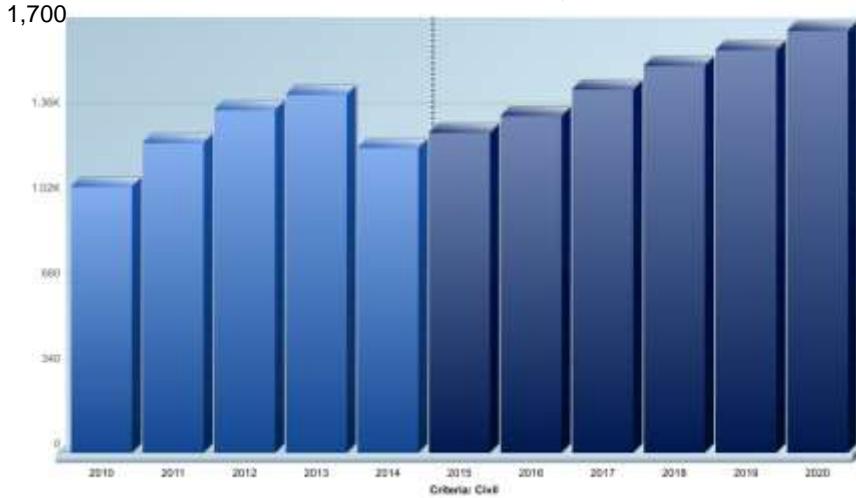
Robinson Helicopters at the factory



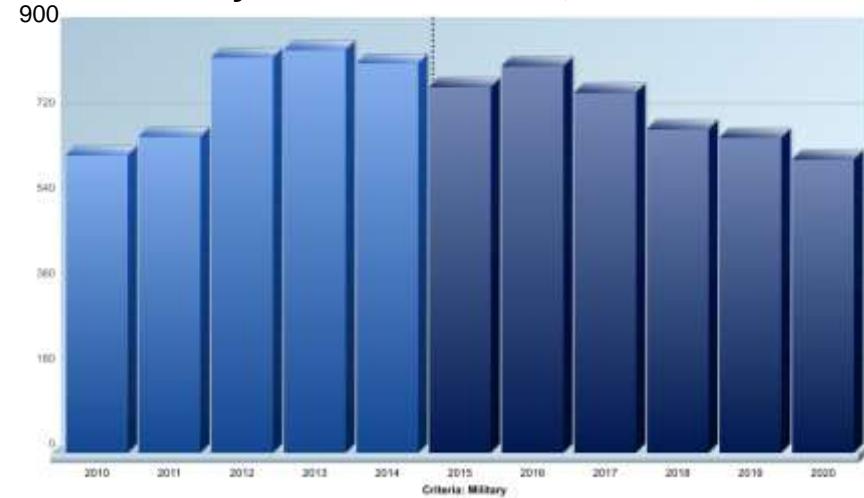
USMC MV-22 Osprey deployed on USS Wasp

Industry Outlook: Breakdown

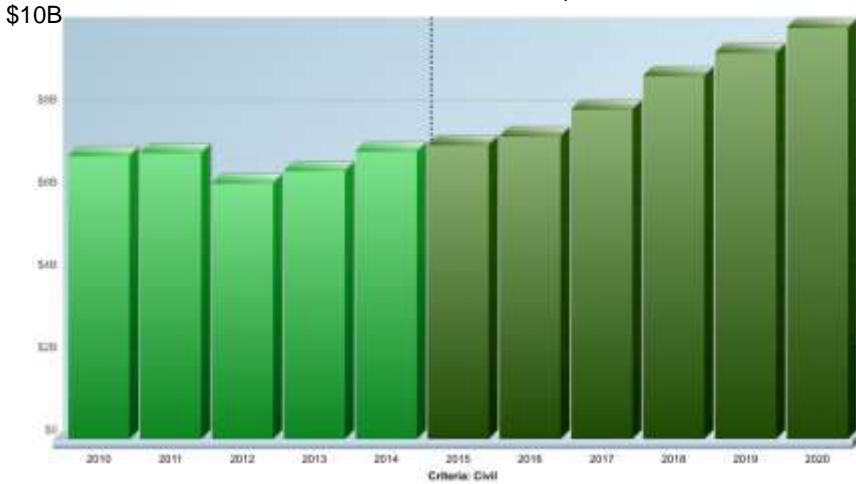
Civil Production Units, 2010-2020



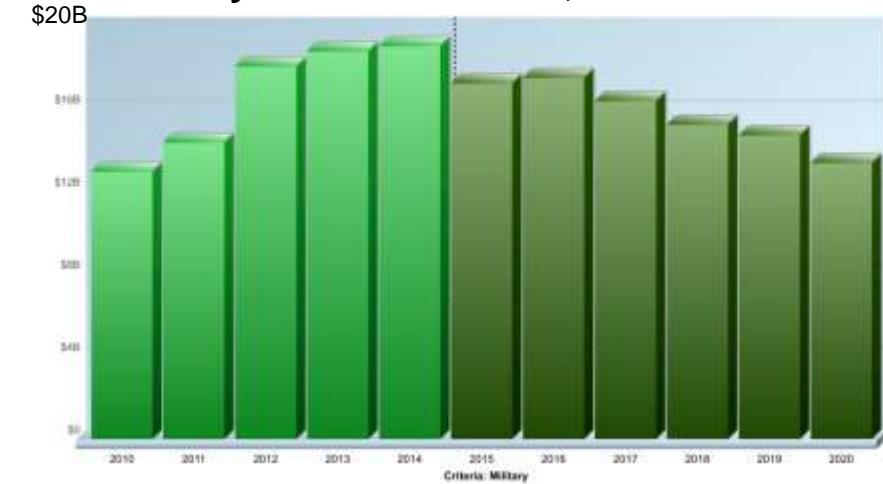
Military Production Units, 2010-2020



Civil Production Value, 2010-2020

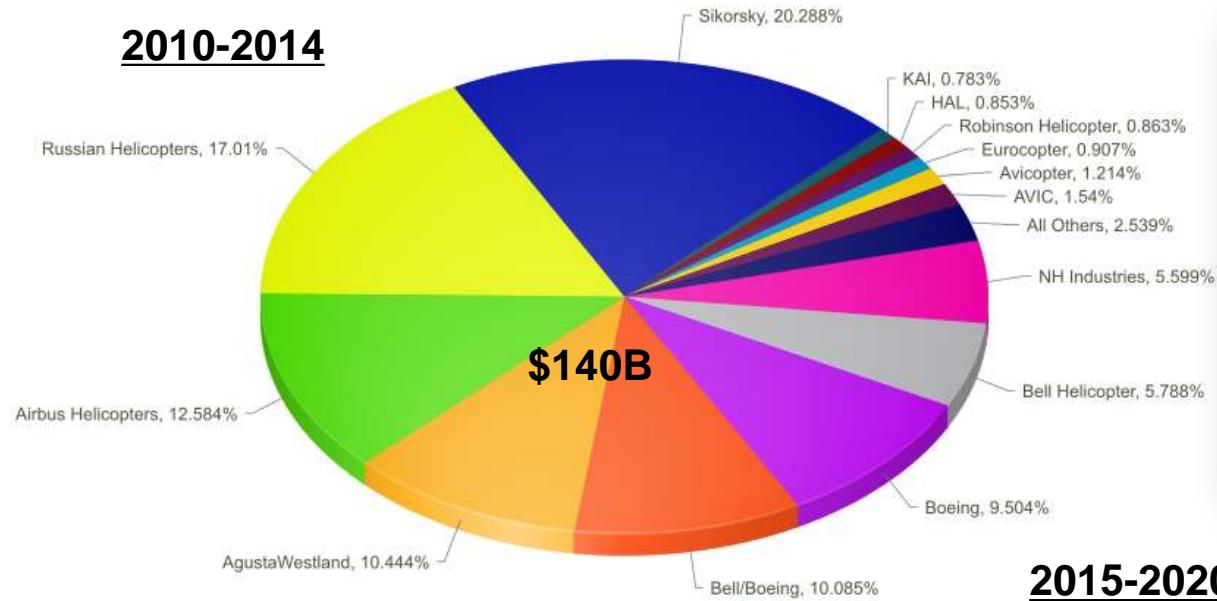


Military Production Value, 2010-2020

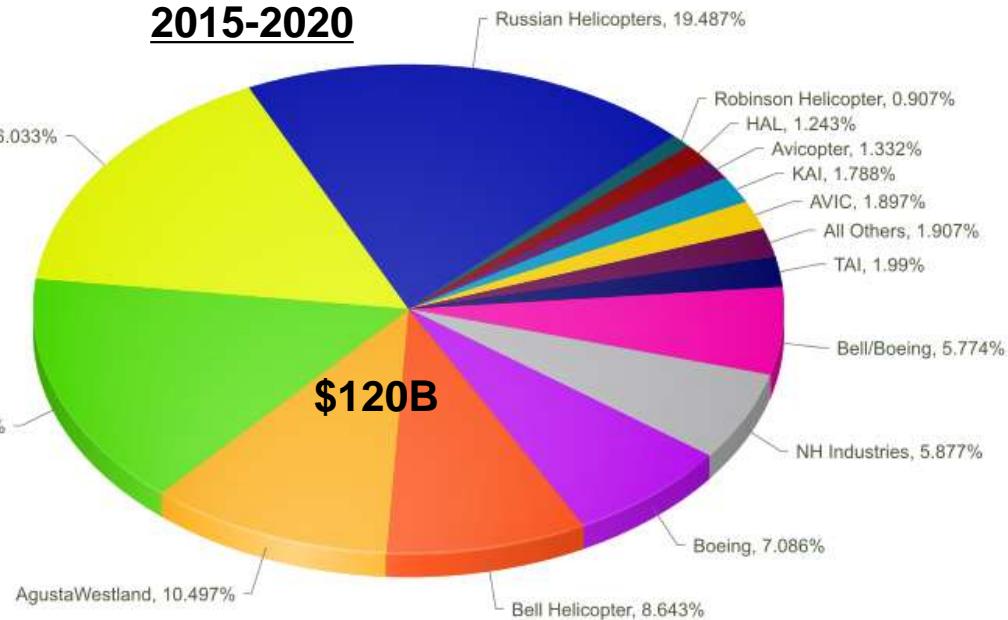


US Losing Market Share

2010-2014



2015-2020



All-New W. European Products



Bell 525 Relentless

- 18,000 lb civil transport
- Announced February 2012
- Service entry early 2017
- ~70 orders
- First Flight July 1
- 3 in flight test by end of 2015



Bell 505 Jet Ranger X

- Announced June 2013
- Named February 2014
- First Flight November 2014
- 3 prototypes flying
- 350+ orders
- 5 seats
- Bell 206L-4 dynamics
- Turbomeca Arrius 2R (504 shp)
- Garmin G1000H glass avionics
- New “green field” factory in Louisiana



Joint Multi-Role (JMR) Preliminary Design Phase



Sikorsky/Boeing SB>1 Defiant



Karem TR-36



Bell V-280 Valor



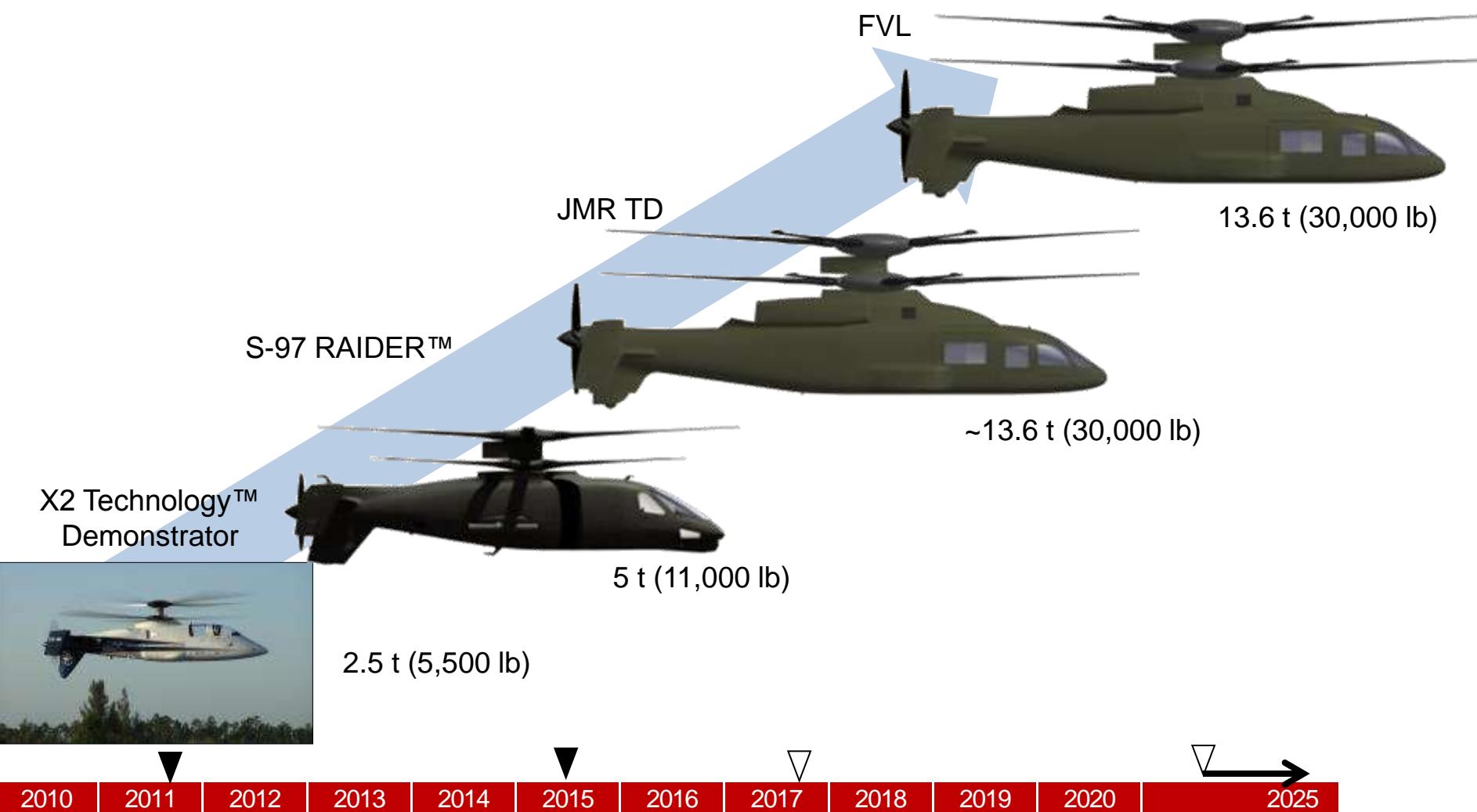
AVX

Bell JMR Demonstrator

- V-280 Valor tiltrotor
- Fuselage assembly began in June
- Composite cabin, cockpit, fuselage built by Spirit AeroSystems
- Delivered September 22
- First flight expected in 2017



Sikorsky High Speed Rotorcraft



Sikorsky S-97 Raider



X6: Super Puma Replacement

Next Airbus Helicopters Product



Airbus Helo Demonstrators

X3 High Speed Helicopter
260 kt



Blue Edge
Passive Noise Cancellation



Blue Pulse
Active Noise Cancellation

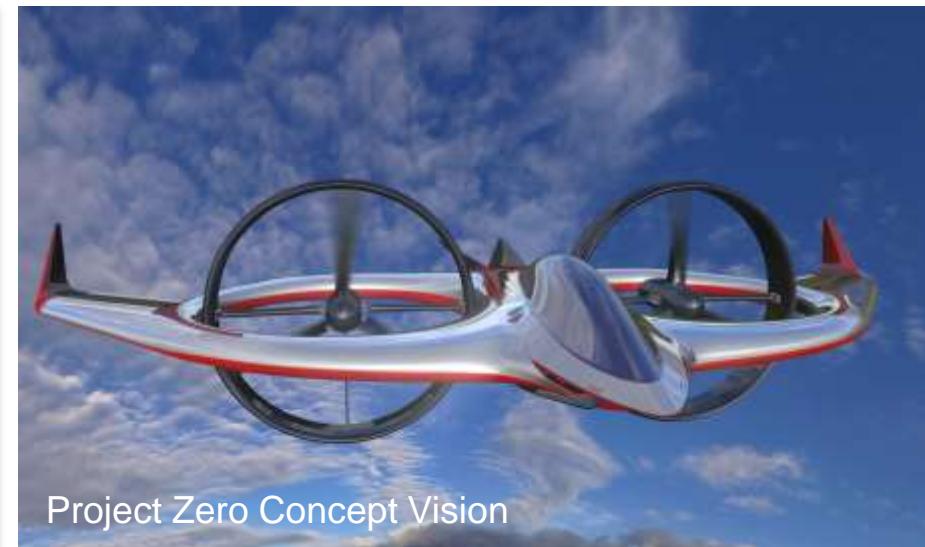


Bluecopter
Eco Demonstrator

AW High-Speed Rotorcraft



BA609 Civil Tiltrotor



Project Zero Concept Vision



Project Zero Full-Scale Demonstrator

Clean Sky 2



Airbus LifeRCraft

Flying Demonstrators in 2020

- Airbus Low Impact Fast & Efficient RotorCraft (LifeRCraft)
- AgustaWestland Next Gen Civil Tiltrotor (NGCTR)



AW NGCTR



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Safety and Noise



Technologies for the Future (1)

- New design tools (e.g. CFD/CSD)
- Advanced configurations
- Variable rotor speed
- Low noise blades
- High performance rotors
- Active/adaptive rotors
- Swashplateless hub
- FBW/FBL flight controls



Technologies for the Future (2)

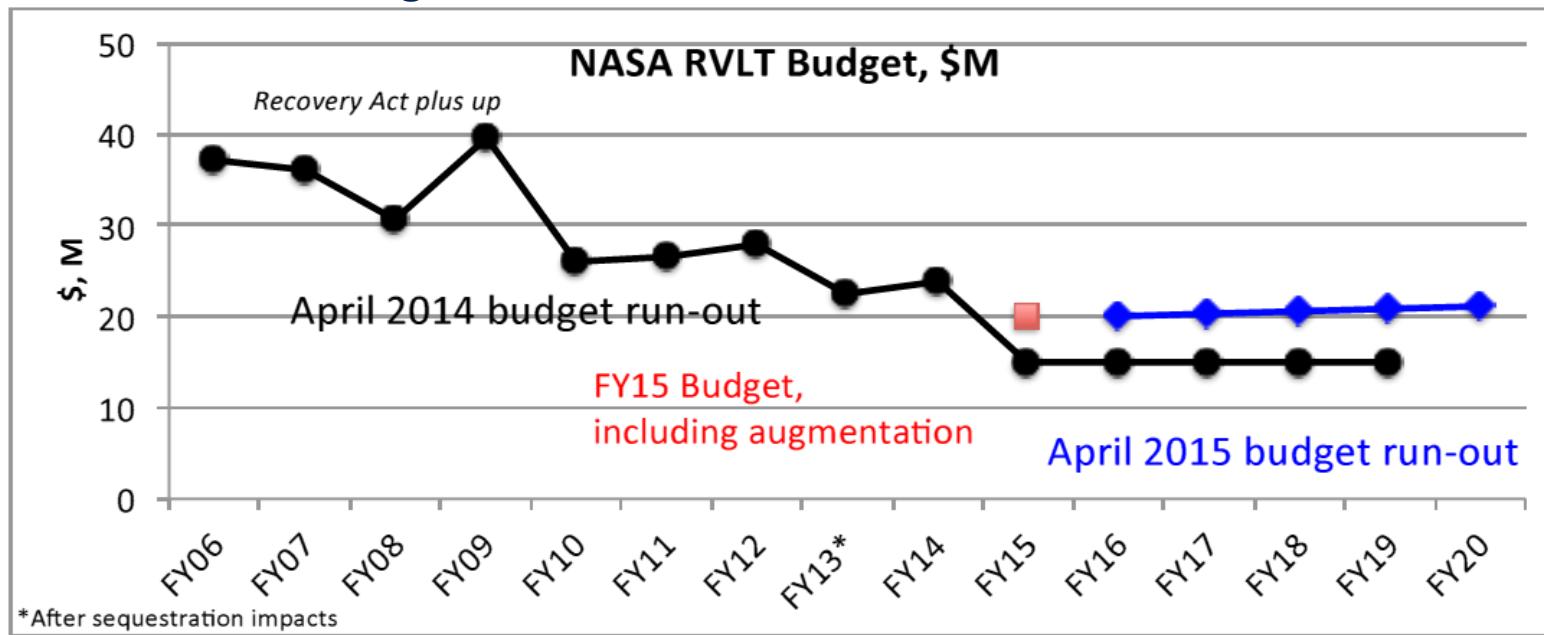
- New manufacturing methods
 - Lean, Automation, RF ID Tracking
- Advanced composites
 - Unitized Composite Structures
 - Automated Fiber Placement
- Advanced engines
 - high P/W, low sfc, low emissions
- Advanced transmissions
 - high efficiency/low weight
- Biofuels/reduced carbon footprint



Many fertile areas being explored for potential

Aeronautics Vision

- “Vision without action is a daydream. Action without vision is a nightmare.”
 - Japanese Proverb
- “Vision without funding is a hallucination”
 - Major Mike Witteried, USAFR, Joint Staff (1995)
- “Leadership is just as important as funding, and funding is just as important as leadership.”
 - Mike Hirschberg



Recommendations for NASA

- Continue to support Blue Chip personnel and facilitates
- 2x increase in RVLT funding – back to historical levels
 - A well-thought out plan that is well-supported by industry and academia, and synergy with other government agencies where sensible
- Continue to increase the funding for Transformative concepts and look for synergies and cross-fertilization of tools, technologies and resources
- Work with the VTOL community to enable to future of vertical flight

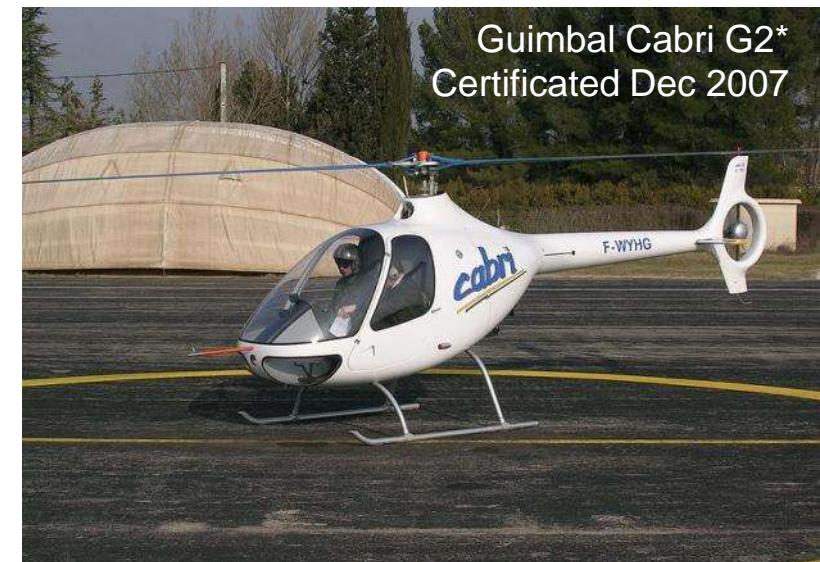


Questions?



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New Light Civil Rotorcraft



* Piston powered

Chinese Rotorcraft

- China operates few civil helicopters, some police/paramilitary
- Recent purchase of Enstrom
- Military purchased or produced Russian or European models
- Cooperative developments with Eurocopter for civil and military
- Indigenous developments



Eurocopter EC175 (2012) / Avicopter Z-15/AC352



Avicopter/Harbin Z-19: 5t Attack (2010)



Avicopter/Changhe Z-10: 7t Attack (2003)

Russian Helicopters

- World's largest helicopter producer (by value)
- Combines Kamov, Mil, Kazan, etc.
- Modernizing aircraft for civil and military customers



Indian Rotorcraft

- Hindustan Aeronautics Limited (HAL) licensed-production of Eurocopter designs began in 1960s
 - Developed indigenous variants (e.g. high altitude)
- HAL developed Dhruv Advanced Light Helicopter (ALH) – also civil and export
- HAL developed derivative Light Combat Helicopter (LCH)
- Tata Joint Ventures with AgustaWestland and Sikorsky for production



Japanese Rotorcraft

- Primarily US produced or licensed helicopters for military
 - Fuji-Bell UH-1 Huey
 - Kawasaki-MD OH-6 Cayuse
- Kawasaki Heavy Industries (KHI) joint development with MBB/Eurocopter of BK117
- Kawasaki OH-1 Ninja Light Observation Helicopter (LOH)
- Kawasaki UH-X utility helicopter for Japan Ground Self Defence Forces
 - Development started March 2013
 - First flight 2018



BK117



OH-1



UH-X

Korean Rotorcraft

- Primarily US and European produced helicopters
- Indigenous development of Korea Aerospace Industries (KAI) Surion Korean Utility Helicopter (KUH)
 - Assisted by Eurocopter
- Full-scale production of 24 for the Army began in 2012
 - 40 Surions for Korean Marine Corps planned by 2023
- New co-development
 - Light Civil Helicopter (LCH): 2020
 - Light Armed Helicopter (LAH)



Turkish Rotorcraft

- Turkish Aerospace Industries (TAI)
- Licensed production of S-70 Black Hawk and key supplier
- TAI-AW developed T129 ATAK
- 5-6t Indigenous civil / Utility Helicopter



TUHP INDUSTRIALIZATION ESTABLISHES A PERMANENT FACTORY IN TURKEY

