Advanced Aircraft Technologies

Hubert Wong,
Aerodynamics and Configuration Design Engineer – Boeing
Electric Aircraft Opportunities & Challenges
A Boeing Perspective

Hubert Wong
Advanced Concepts | Product Development
Boeing Commercial Airplanes

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Boeing Electric Aircraft Studies
Advanced Concepts – active and realistic approach for over a decade

SUGAR VOLT
Boeing / NASA 2008-2018+

Fuel Cell Demonstrator
BR&T Madrid 2008-2009

ecoDemonstrator Fuel Cell
Boeing / IHI 2012

Hybrid Electric Demonstrator
Cambridge / Boeing 2015

XV-24A Lightning Strike
Aurora 2016-2018

Cargo Air Vehicle (CAV)
Boeing 2017-

Ongoing Internal & Competitive Studies
Boeing 2006-

Pegasus
Aurora 2017-

Wisk
Kitty Hawk / Boeing 2019-
Significant Benefits If Challenges Can Be Overcome

**Opportunities**

- **Environmental**
  - Reduced Noise and Emissions

- **Operational flexibility**
  - Multiple Power Schedules (efficient, quiet, low emission modes)

- **Unique configurations**
  - Distributed Propulsion
  - VTOL/STOL
  - BLI

- **Reduced Cost Potential**
  - Energy & Maintenance

**Challenges**

- **Energy/Power Density**
  - Limited mission capability

- **Safety**
  - High Voltage
  - Thermal management

- **Ground Operations**
  - Battery swap/charging

- **Certification Process**
  - New Technology
  - New Standards
Feasibility and EIS/IOC of useful airliner determined by energy storage capability

Electric and Hybrid Electric (w/energy storage) yield environmental benefits only if sustainable energy used in charging grid

Electric aircraft to date are an order of magnitude smaller and lower power than a regional size airliner

Current development trends result in near-term application for small aircraft and long-term application for parallel hybrid airliners
Boeing understands both the opportunities and challenges of electric and hybrid aircraft

Boeing has history and an ongoing and active program to study the technologies and possible future applications of electrified propulsion

More to come for this promising technology area
Hubert Wong

- Hubert Wong leads the Sustainable Concepts projects within the Boeing Commercial Airplanes Advanced Concepts group. Hubert is responsible for directing studies investigating novel aircraft technologies and configuration concepts that can contribute to reducing aviation’s environmental footprint. He has established electric/hybrid-electric propulsion design methodologies and tools for commercial aircraft at Boeing and has supported the development of low boom supersonic wind tunnel testing methods. Hubert also serves as Part-time faculty in the Aerospace and Mechanical Engineering department at the University of Southern California.
Kevin Lutke

Kevin Lutke is the manager of the configuration synthesis and systems engineering teams in Boeing Commercial Airplanes Advanced Concepts. Kevin and his team focus on protecting Boeing's existing market and expanding into new markets through the application of new technologies to future air transportation systems. His notable projects in BR&T include: Air Launch Assist Space Access and Rapid Eye for DARPA, Revolutionary Configurations for Energy Efficiency and Joint Future Theater Lift for the Air Force Research Labs, and Environmentally Responsible Aviation for NASA. Kevin was also a member of the X-48B and X-48C flight test teams, supporting experimental test flights at Edwards Air Force Base. Kevin's efforts have been formally recognized by the company with the Boeing Silver Eagle Award, the Phantom Works Silver Phantom Award and the Phantom Works Outstanding Achievement Award. Additionally, he has been awarded 23 US patents and has received a meritorious invention award from Boeing.