
TZUNUM
FASTER FLIGHT FOR EVERYONE

Strong EE-Aero team developing electric air technologies

Electric

AEROXCHANGE
Aviation Supply Chain Solutions

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Once-in-a-generation upgrade of aircraft propulsion

Where old rules will no longer apply

Third great age of aviation

- Vast impact, as significant as the jet age
- 15-20 year transformation of aviation

Led by smaller manufacturers

"staircase" to airliners

- Staged scale-up to long-haul airliners
  - Recreational and trainers
  - VTOL and ODM
  - Rotorcraft and Commuters

Transformation starts now

scale-out in 2020s

- Key technologies largely in place
- 15-20 years ahead of airliners

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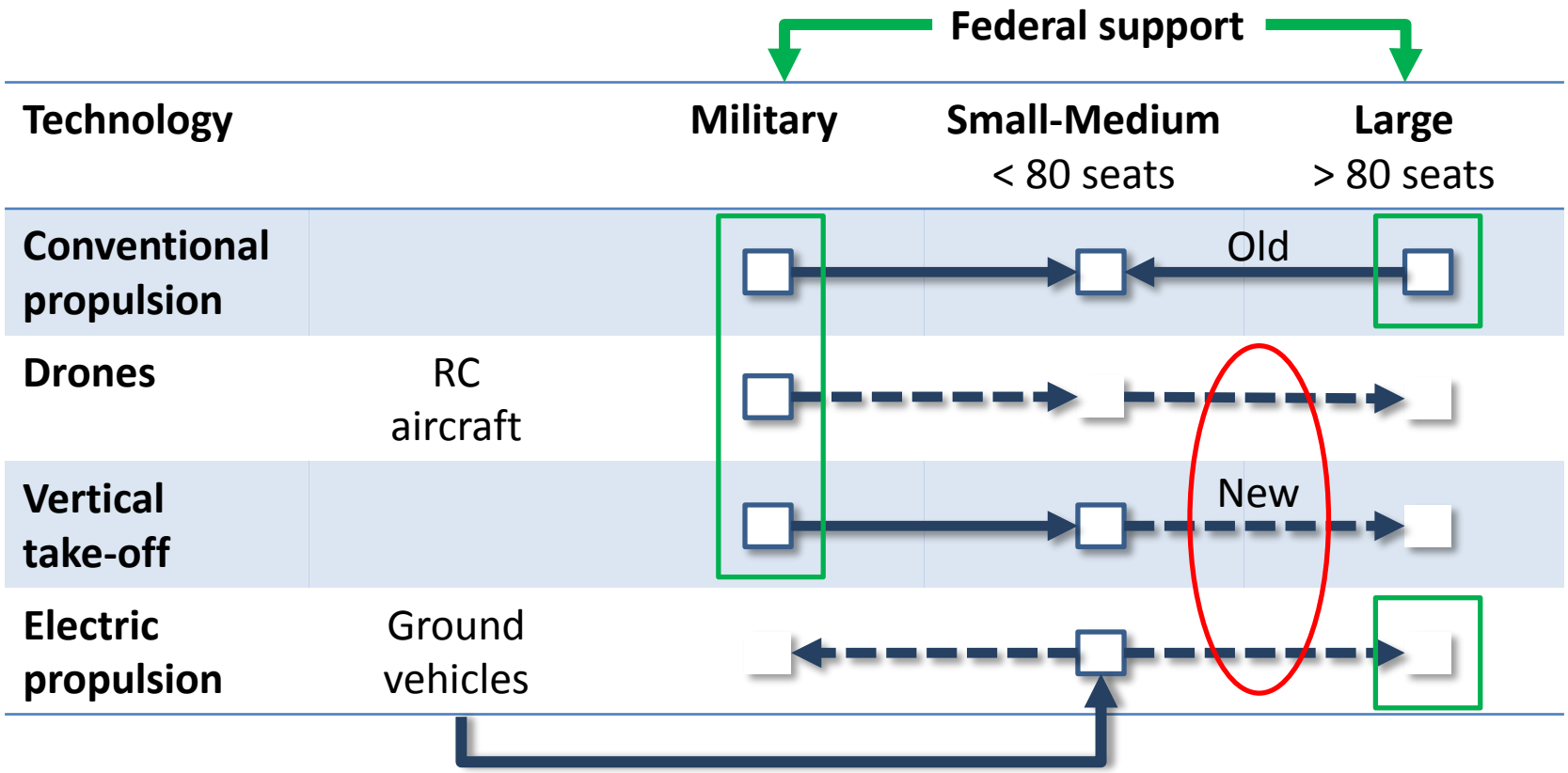
Reversed flow of technology leaves US vulnerable



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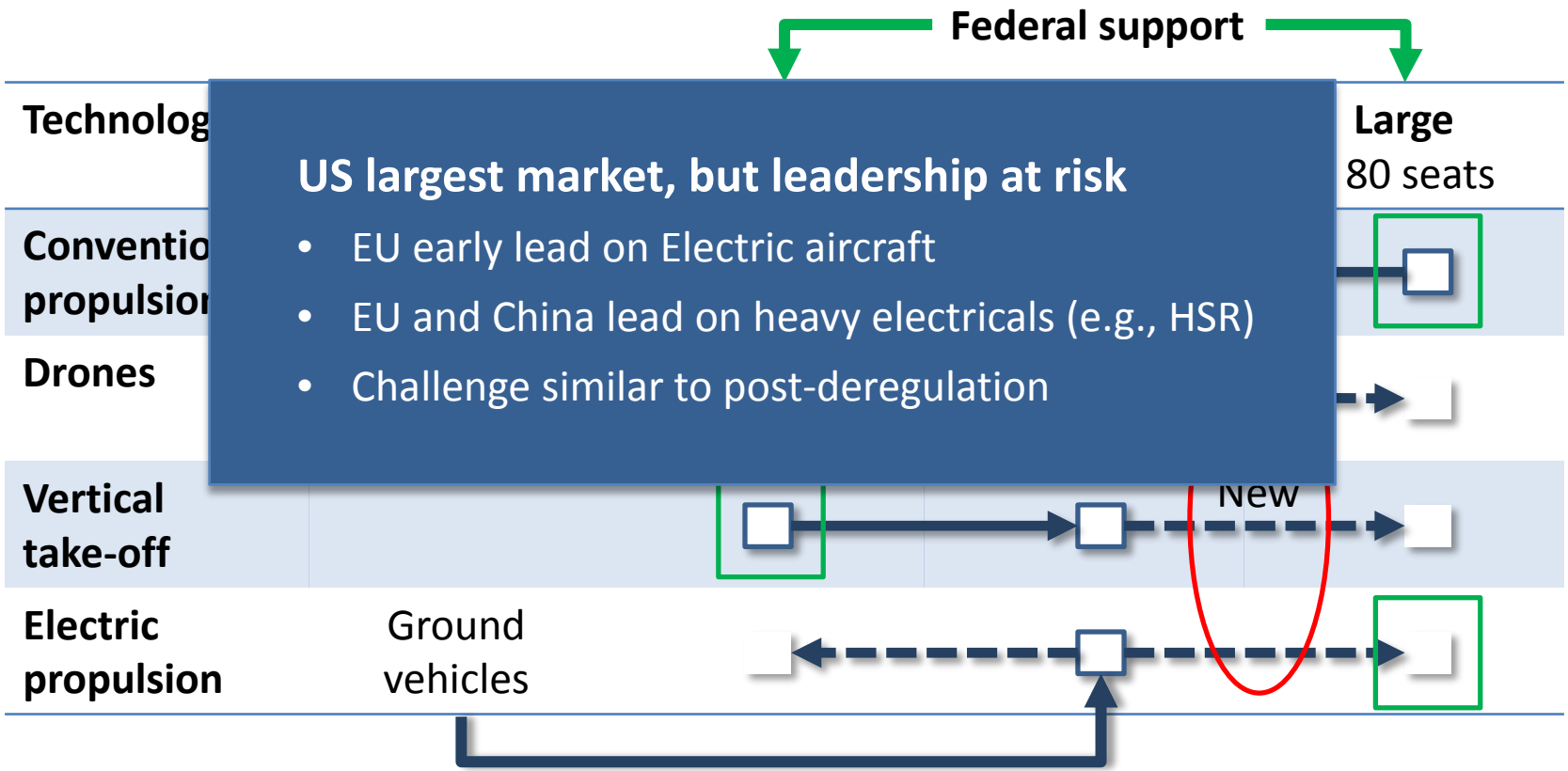

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Action needed in four areas to accelerate US progress

Focus on innovation staircase

- Over emphasis on majors and N+3 needs
- Shift roadmap to focus on progressive flight platforms 2020-2040 leading to airliners

Balance government support

- $B in Federal and State support to EV closed to aviation
- Extend support from ground to all vehicles (DOE, DOT)
- Balance innovative platforms vs airliners (e.g., CLEEN)

Clear certification pathways

- Conclude Part 23 re-write; develop EV standards
- Fund research e.g. aviation battery safety, paschen limits

Establish infrastructure roadmap

- No clear path to define and develop airport infrastructure for electric aircraft, e.g., swap, recharge
- Define process and accountabilities for infrastructure

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Path to Certification: ASTM working groups

- **FAA regulations to industry consensus standard basis per Congressional mandate**
- **Standards developed by working groups of industry, FAA, and EASA**
- **Final standards become regulations when "accepted" by FAA and EASA**

Part 23 re-write nearly complete

- ASTM F44 Working group
- Unifies FAA part 23, and EASA CS-23
- First release of "new part 23" in 2016
- Part 23 covers installation
- Very little new content for electric
- Once accepted, adding electric propulsion content much easier

EV standards in progress

- ASTM F39.05 launch September 2014
- Responsible for all electric propulsion* and related systems, incl. hybrid
- Global: Good FAA support, limited EASA
- Progress determined by participation
- Tzunum coordinating work to establish a battery safety standard

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*Design, alteration, and Certification of Electric propulsion systems

Developing standards for aviation battery packs

Requirements

- Covers all aspects of battery install-ation, operation, recharge, swap
- Provide level of safety to equivalent to current systems
- Accommodate aircraft 1 to 19 passengers
- Be “technology agnostic”
- Minimize specific guidance

Approach

- Build on existing standards
  - SAE and ISO ground EV
  - DO-311a from RTCA
  - LSA and EASA CS-22 special conditions
- Engage SMEs on BMS, battery testing
- Define tests and metrics which reward safer technologies
- Complete draft for Spring working session; finalize in 2017

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Leadership of the age of electric aviation at play