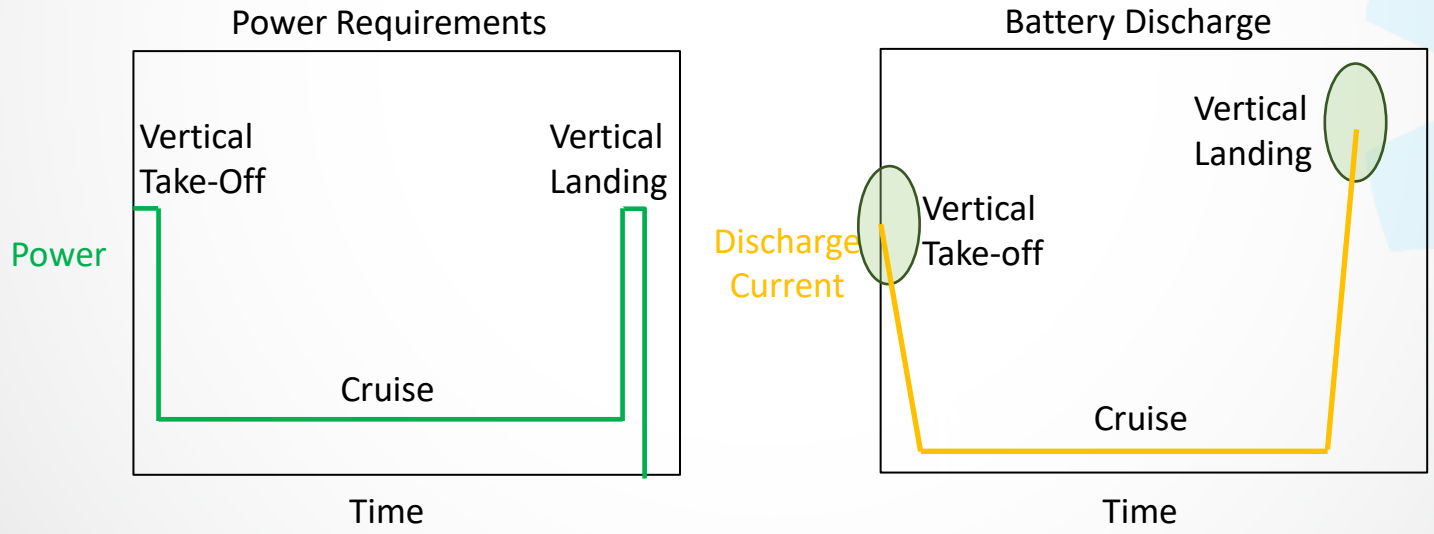
Advanced Air Mobility (AAM)

"The AAM market is estimated to reach US$115 billion annually by 2035, employing more than 280,000 high-paying jobs."[1]

1. Deloitte Insights, Advanced air mobility, Can the United States afford to lose the race?, pp 2.

AAM Vehicle Battery Use

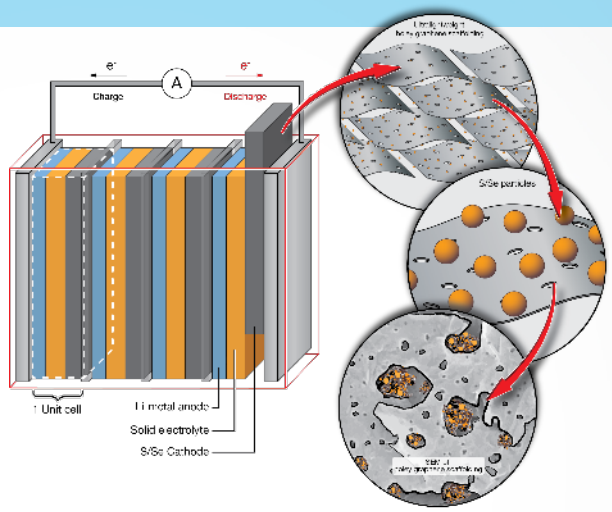
- Planned operations and vehicle designs are limited by the power and the capacity of batteries
- Takeoff, landing, and reserves consume ~40% of available energy
- Electric Vertical Take-Off and Landing (eVTOL) takeoffs and landings require high power (~8 times horizontal flight), adding safety risk and additional aircraft mass
- Low energy or emergency landing (especially under extreme weather) uses even more energy and are a potential threat to safe AAM operations

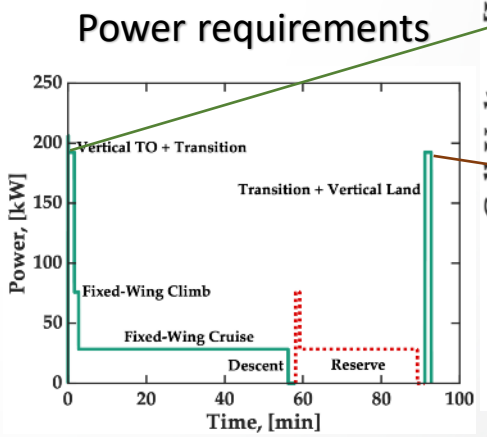


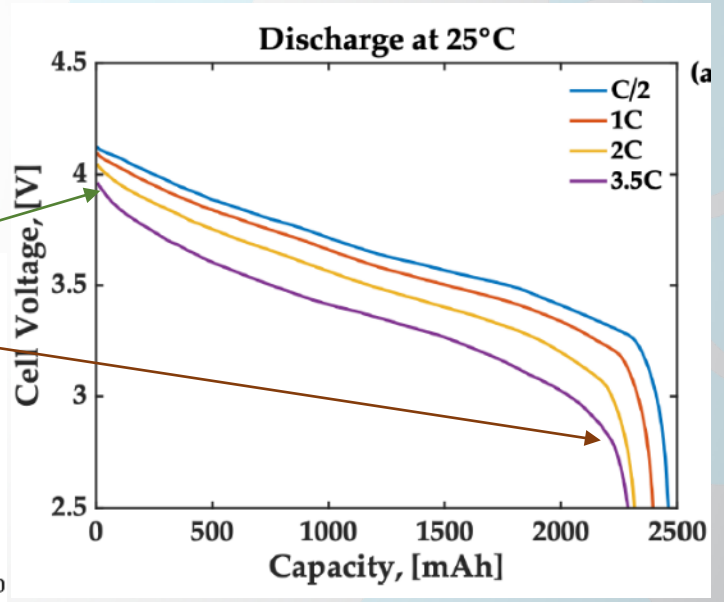
W. L. Fredericks, et al., Performance Metrics Required of Next-Generation Batteries to Electrify Vertical Takeoff and Landing (VTOL) Aircraft (2018)

Battery Limitations for AAM

- **Insufficient Specific Energy**
  - Jet A: 12 kW-h/kg
  - Best Li-ion Battery: ~700 W-h/kg (lab)
  - Li-S (solid-state) Battery: ~500 W-h/kg (lab)
  - Best Li-ion Aviation Battery: ~400 W-h/kg
- **Battery Damage during high discharge operations**
  - Reduced battery lifecycle
- **Higher energy depletion rates occur during low charge states**
  - Potential safety issue during low power landings





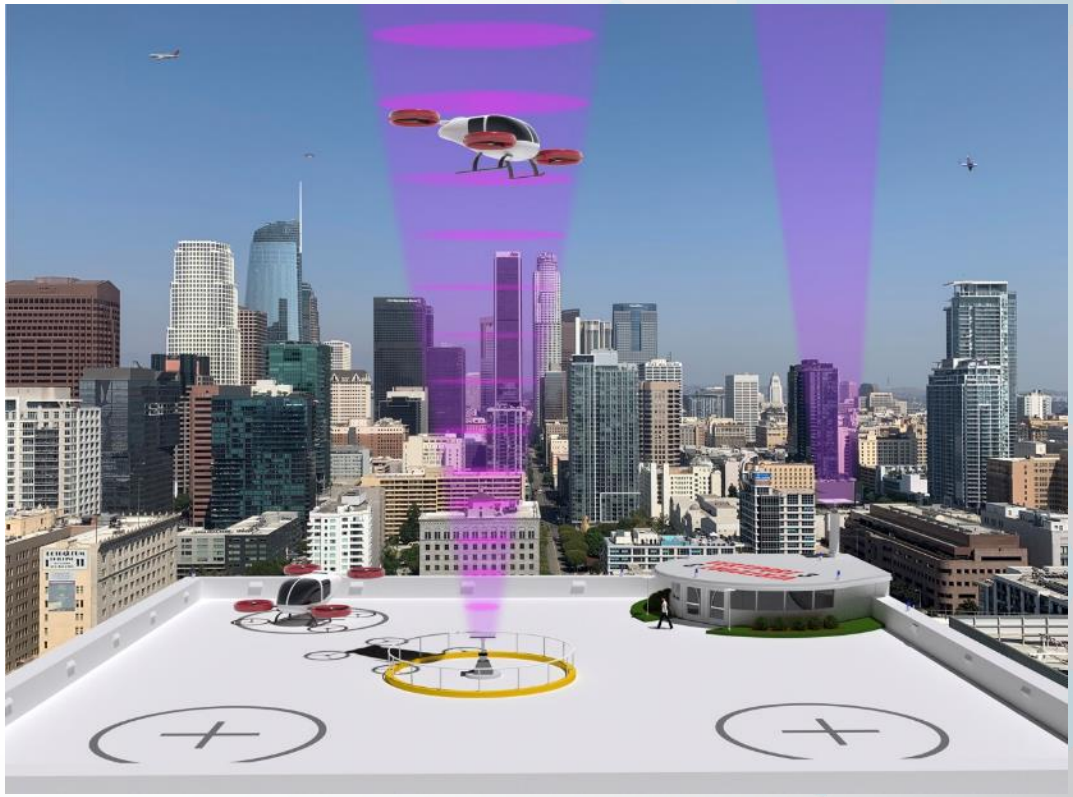


W. L. Fredericks, et al., Performance Metrics Required of Next-Generation Batteries to Electrify Vertical Takeoff and Landing (VTOL) Aircraft (2018)

Opportunity for Power Beaming

Inflight Charging

- Enabling the capability to add external energy to AAM vehicles
- Vertiports could provide a powered assist to AAM vehicles for takeoff, landing, and holding
- Add multifunctionality to existing vertiport infrastructure
- Provide a backup system to power AAM vehicles during emergencies
- Leveraging vertiports or other buildings to power eVTOLs (enroute charging)



Business Case

- **IF** power beaming is found compatible with passenger carrying AAM vehicles, an opportunity is present for inflight charging.
- *Assumes batteries will not advance sufficiently to mitigate current limitation
- Other power beaming options include inflight charging of cargo delivery drones

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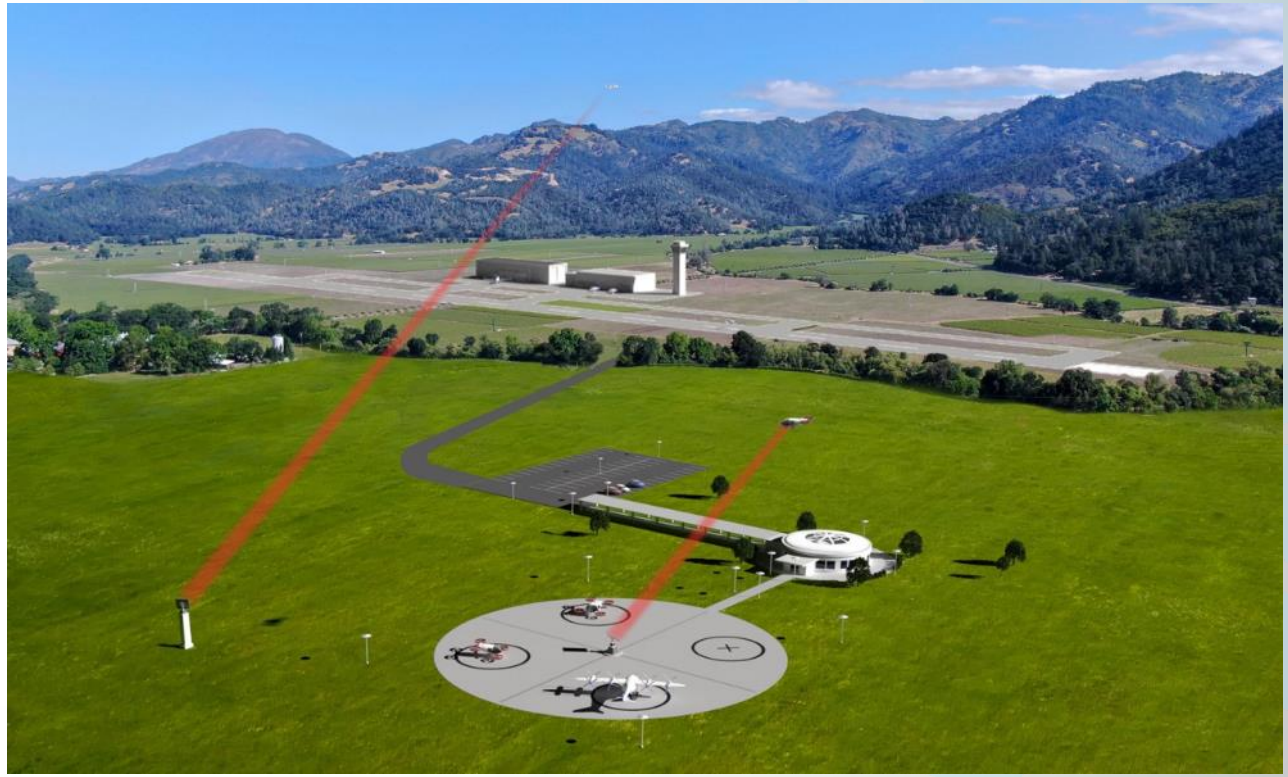
- Leverage power beaming technology to tap into $115B AAM market
- Develop technologies that support inflight charging and power augmentation systems at vertiports or enroute.
  - Extend battery lifecycle
  - Reduce on-ground charging times
  - Improve flight safety
  - Extend operational range and duration



Government Funding Opportunities

1. **NASA Small Business Innovation Research (SBIR) Program** (https://sbir.nasa.gov/)
   - Early-stage funding for research & development (R&D)
   - Up to $1 million during your first three years, plus up to nearly $3 million or more through our Post Phase II opportunities
   - NASA takes zero equity, and you are in control of your intellectual property
   - The experience of working with NASA experts on your technology
   - The opportunity to join us on one of our many ambitious missions

2. **NASA Project Funding**
   - Convergent Aeronautics Solutions (CAS) – Beaming Energy for Air Mobility (BEAM) research

3. **NASA Innovative Advanced Concepts (NIAC)** (https://www.nasa.gov/niac-funded-studies/)
   - The NASA Innovative Advanced Concepts (NIAC) Program nurtures visionary ideas that could transform future NASA missions with the creation of breakthroughs – radically better or entirely new aerospace concepts – while engaging America's innovators and entrepreneurs as partners in the journey.
   - NIAC projects study innovative, technically credible, advanced concepts that could one day "Change the Possible" in aerospace.