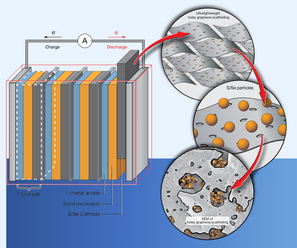



# SABERS

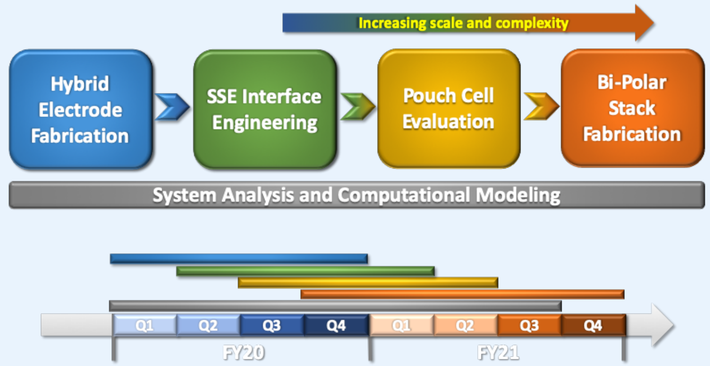
National Aeronautics and Space Administration

## Solid-state Architecture Batteries for Enhanced Rechargeability and Safety

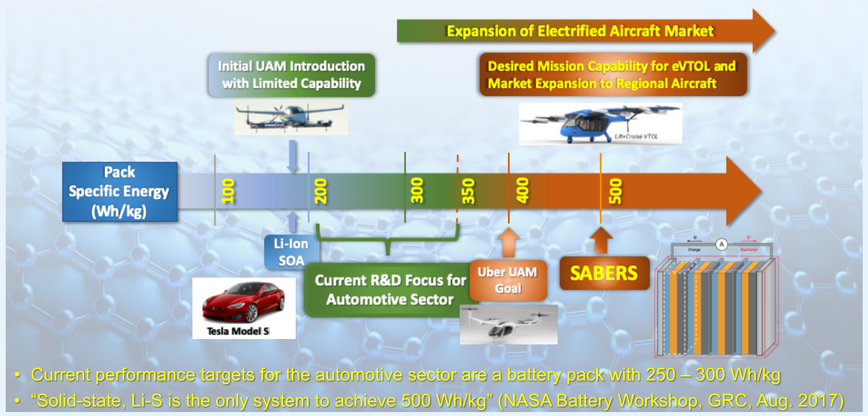
### Overview/Description

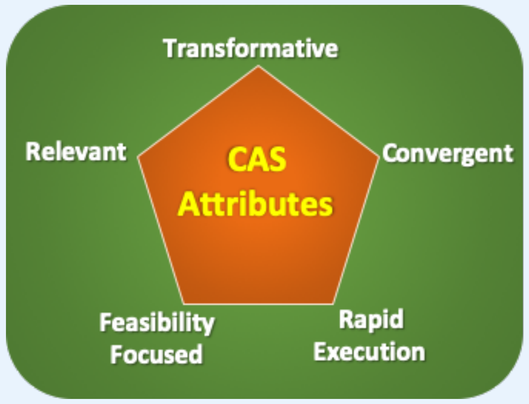
Develop a solid-state bipolar battery stack based on novel Li-S/Se chemistry and a non-flammable solid state electrolyte (SSE) to produce a battery which satisfies the system level needs of urban air mobility (UAM) concepts including: **safety** (non flammable), **energy density**, **discharge rate**, **packaging design**, and **scalability**.

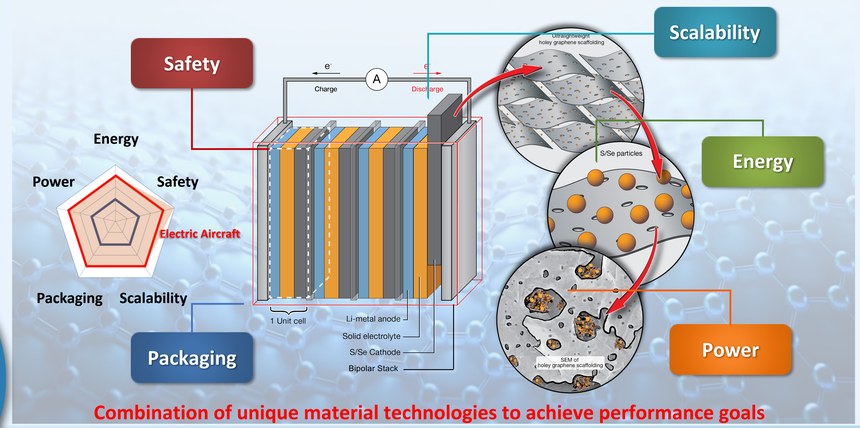
### Feasibility Assessment




"While we continue strengthening our R&D for the traditional aviation market, we must take tangible actions to lead the two important emerging markets: Urban Air Mobility and Electrification of Aircraft." ---Jaiwon Shin (Letter to ARMD; Feb. 25, 2019)





### Partners

- GRC: (1) Agency lead in power and energy with experts in materials, electrochemistry, and batteries; (2) Expertise in systems level analysis of electric aircraft.
- LaRC: (1) Experts in chemistry and materials, (2) Invented holey graphene, a high-performance electrode material that generated significant interest in battery community. Licensed to Carbon Research and Development in 2019.
- ARC: Expertise in systems level analysis of electric aircraft.
- Argonne National Lab (ANL): (1) World leader in fundamental battery chemistry and pioneered S/Se chemistry; (2) offered matching funds for cathode research.
- Pacific Northwest National Lab (PNNL): (1) World leader in solid state electrolyte (SSE) development; (2) discovered and patented sulfide-based SSEs to be tested for SABERS.
- Ionic Materials: (1) Developed polymer-based SSE with superior performance at room temperature; (2) will supply SSE for SABERS and offer training in cell fabrication.
- Aurora: (1) A Boeing Company and a leader in eVTOL development and testing; (2) offered 200 hours of scientific testing of in-kind support in newly built battery test facility.
- EaglePitcher: (1) Leader in battery manufacturing for personal electronics and DoD applications; (2) offered in-kind support to develop and test prototype bi-polar stack.

### Recent Results / Status

- Visited partners at ANL, Ionic Materials, and Aurora; held teleconference with PNNL, initiated formal agreement
- GRC started investigations on synthesis and processing of solid-state electrolyte.
- LaRC started investigations of S/Se cathode chemistry and cathode/solid state electrolyte interface.

### Next Steps

- Kickoff meeting planned on Nov. 19-20, 2019 at GRC.
- Establish critical partnerships with DOE labs and companies.
- Continue investigation on cathode recipe and SSE interface.

### Publications


- Lin, Y.; Jones, K. J.; Greenburg, L. C.; Kim, J.-W.; Hu, L.; Connell, J. W. "Facile, Solvent-Free Preparation of High Density, High Mass Loading Sulfur Cathodes Enabled by Dry-Pressible Holey Graphene Scaffolds." Batteries & Supercaps, 2019, 2 (9), 774-783.


CONVERGENT AERONAUTICS SOLUTIONS


Principal Investigator: Dr. Rocco Viggiano (rocco.p.viggiano@nasa.gov)
Co-Principal Investigator: Dr. James Wu (james.j.wu@nasa.gov), Dr. John Connell (john.w.connell@nasa.gov)