Fuel cells offer a promising technology for clean, efficient power generation important to both High Altitude Long Endurance (HALE) remotely piloted aircraft, and future envisioned environmentally friendly commercial transports. Both consumable fuel and regenerative fuel based fuel cells are of interest. The former type is applicable to both HALE and commercial transports, while the latter type is of interest for a solar-electric powered HALE capable of multi-month missions. The consumable fuel based fuel cell will likely use atmospheric air for the cathode gas, while the regenerative systems will likely use pure oxygen stored and regenerated on-board. For both applications, the focus of this subtopic is on hydrogen fuel based systems including liquid for consumable fuel systems and gaseous for regenerative fuel cell systems.

To realize these aircraft applications will require one or even two orders of magnitude improvement in unit power and power density (volume and weight) for the power generation system, and specifically the fuel cell stack, as compared to ground based systems. In addition, the systems are required to operate at altitude, including high altitudes (≥ 60,000 ft) for the HALE applications, and provide service life and reliability significantly greater than ground-based systems. Thus, NASA is seeking "break-through" technologies necessary for aircraft instead of evolutionary improvement to current state-of-the-art.

Technologies of specific interest include:

- Innovative fuel cell power systems demonstrating high specific power and high efficiency using consumed liquid hydrogen fuel with scalability to 100's of kW and capable of high altitude operations;
- PEM stack demonstrating ≥ 2 kW/kg and ≥ 50% efficiency (LHV) with scalability to 100's of kW;
- SOFC stack demonstrating ≥ 1 kW/kg and ≥ 50% efficiency (LHV) with scalability to 100's of kW; and
- Innovative regenerative fuel cell energy storage systems and critical components (e.g., unitized fuel cell and electrolyzer stack, PEM or SOFC based systems, etc) demonstrating ≥ 600 watt-hr/kg and high round trip efficiency.