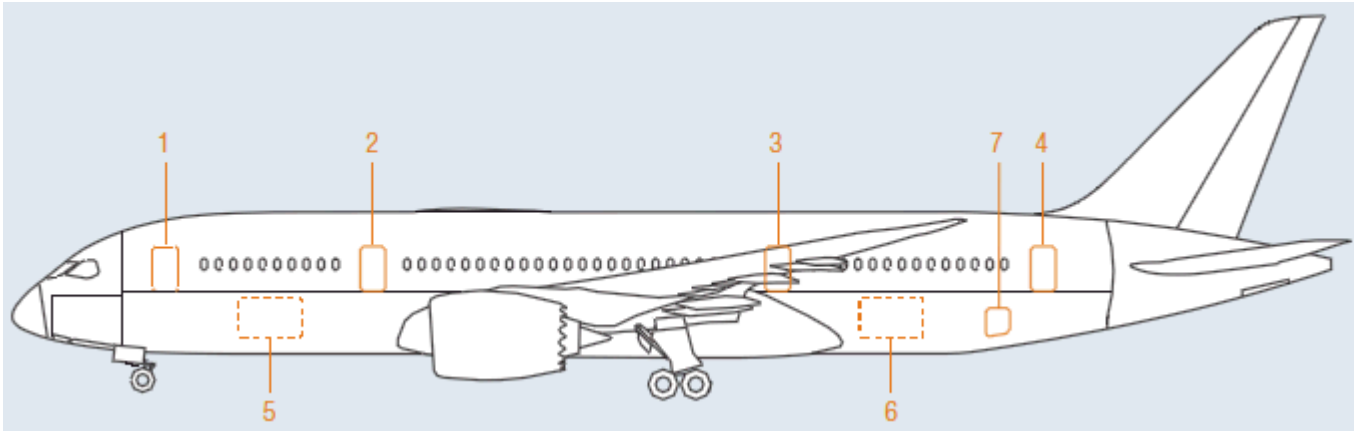
SAND2010-6185P

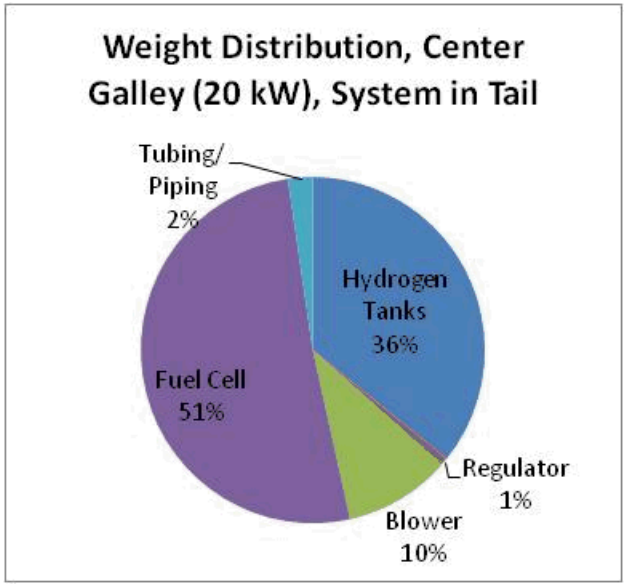
PEM Fuel Cells for Commercial Aircraft

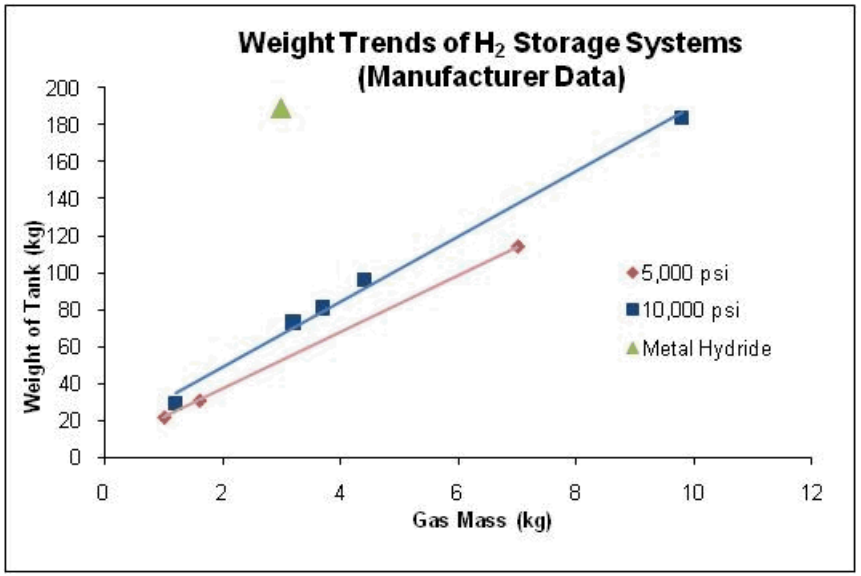
- Department of Energy sponsored analysis and modeling “scoping” study
  - 3 months, $450k
- Non-proprietary, airframe-independent yet realistic for near-term .
- Chose a “787 derivative” platform as representative of the industry’s trend toward the more electric airplane.
  - Boeing has been supportive from the airplane design point of view; has active interest in this topic.



Task 1: Engineering Analysis

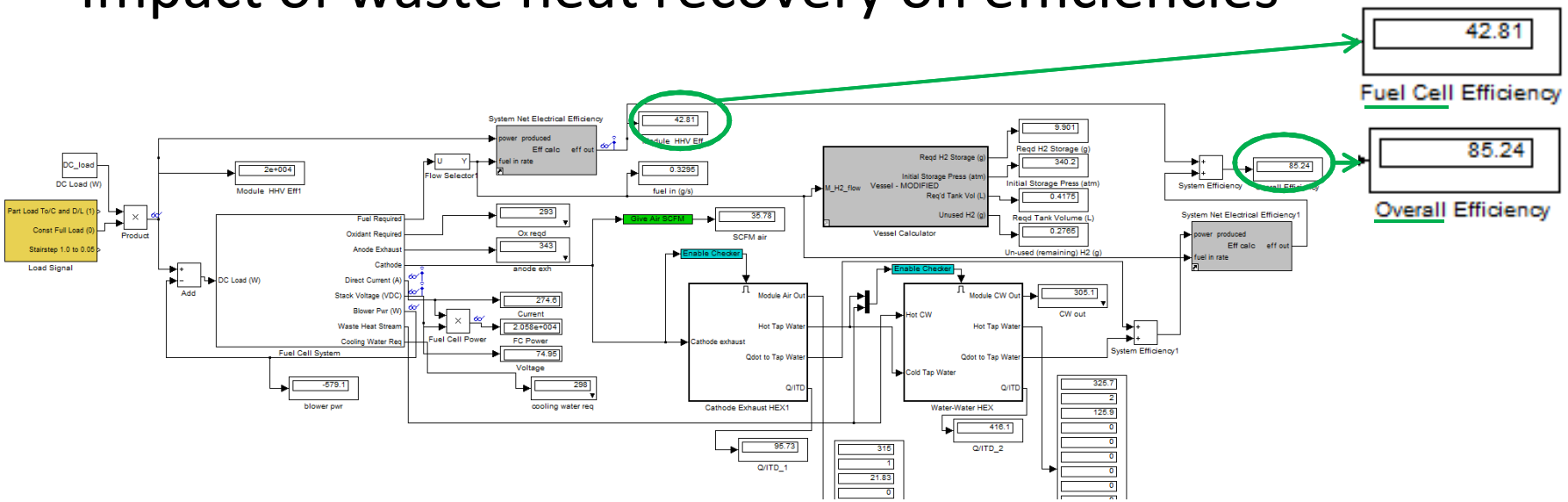
- Weight impacts
- System design
- Interface with airplane





Task 2: Thermodynamic Analysis

- Impact of waste heat recovery on efficiencies



- Impact of system on airplane performance

Breguet Range Equation

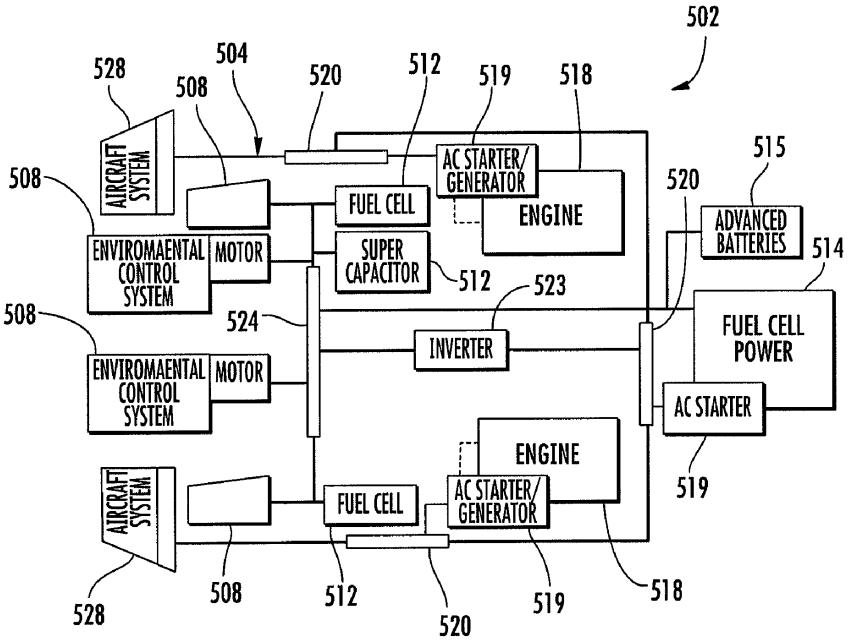
$$R = \frac{aM}{c_T}\frac{C_L}{C_D}\ln\frac{W_1}{W_2}$$

Additional Fuel Requirement

$$\Delta W_f = \Delta W_2(e^C - 1)$$

Task 3: Electrical Grid Analysis

- Electrical interface method of FC system with airplane loads and generators
- Emphasis on dynamics



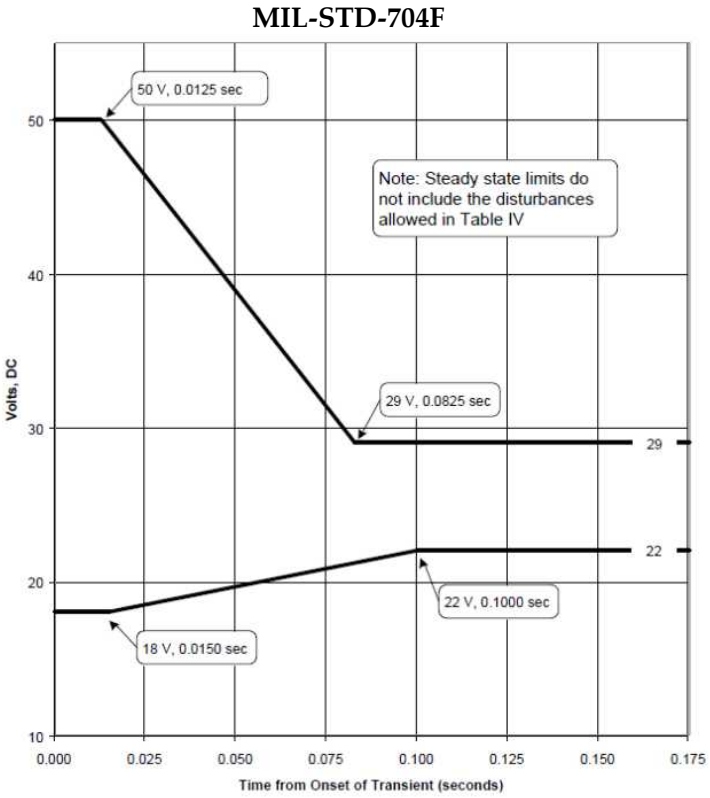


Figure 2. Envelope of Normal Voltage Transients for 28 Vdc System

Win-Win Situation

- DOE and airplane manufacturers around the world benefit from the findings.
- Sandia utilizes its expertise in airplane fuel cells, energy systems, and electrical grid design while growing its knowledge of the airframe side.
- Developed capability can be readily applied to other aviation-related energy needs.