Finally, in June (a busy month), the SolarImpulse was unveiled. This solar-powered airplane is meant to fly around the world powered only by the sun.

The CAFE Electric AC Symposium III

I was fortunate enough to attend the third CAFE Electric Aircraft Symposium, held at the Hiller Aviation Museum in San Carlos, California, on April 24, 2009. The estimated 150 attendees heard 15 presentations during the full and interesting day. Talks started with climate science and then focused on battery, controller and motor technology, ending with presentations about various aircraft designs, both real and imagined. Unfortunately, no electric airplanes were brought to the event.

The Yuneec E430 from China appeared last June. It's LSA eligible, and may fly for 2.5 hours on a charge.

There seemed to be general agreement among the speakers that the key to a successful electric airplane is increased battery energy density. Energy density is a measure of the amount of energy that can be stored divided by the weight. Generally units like watt-hours per pound or kilogram of weight are used. Where lead-acid batteries have a density of about 30 watt-hour/kg and NiCads have 40 watt-hour/kg, lithium ion batteries have 120 to 185 watt-hour/kg, and the capacity is increasing at 8% to 10% per year. Where current batteries seem sufficient only for motorgliders or light, single-place aircraft making short flights, increased battery energy density encouraged many at the symposium to dream of more complex aircraft. This led to my earlier predictions.

One of the most refined electric airplanes discussed was the Antares 20E, a motorglider that has impressive performance, a very high price tag and an interesting motor turned inside out. The center portion of the motor is hollow for air cooling and fixed to the aircraft, while the rotor acts as a case with the propeller blades mounted directly to it—an "out-runner" configuration.

Two speakers working on similar motorglider designs are Greg Cole of Windward Performance and a team at the University of Stuttgart. Both presented details about their efforts. At the end of the day most participants left with ideas about what it will take to make a practical electric aircraft.

Aviation Green Prize

The high point for many of the attendees was the announcement of the Aviation Green Prize (officially the 2011 CAFE Aviation Green Prize Challenge), which is a $1.65 million prize cosponsored by the CAFE Foundation and NASA (only U.S. citizens are eligible) and allows for any type of aircraft, but those in the audience were all thinking electric or hybrid. The goal is to develop an aircraft before July 2011 that can cover 200 s.m. at more than 100 mph with better than 100 miles per equivalent gallon of gasoline.

Fuel type	BTU per gallon	Density lb/gal	Energy ratio to 87 octane
87, 89, 91 unleaded autogas	115,000	6.09	1.0
Biodiesel B20	127,250	pending	1.1065
Avgas 100LL	120,000	6.02	1.0435
Petro-diesel	129,500	7.09	1.1261
Hydrogen, liquid	34,644 (51,532/lb)	0.567	0.3013
Electricity: mi/kWh	N/A	N/A	33.703 kWh per gallon

The 2011 Challenge is meant to encourage the development of new technologies for small aircraft that are potentially applicable to unmanned aerial vehicles (UAVs), air-taxi operations, homeland security surveillance and personal transportation. New technologies that may be competitive include, but are not exclusively limited to, electric airplanes. The score for each aircraft is a function of miles per hour, number of passengers carried, and MPGe (the equivalent miles per gallon relative to 87 octane regular unleaded auto gasoline).

The equation to calculate the score is: Passenger MPGe = number of passengers (pilots, passengers or seats with equivalent ballast) multiplied by the calculated vehicle miles per gallon equivalent for the fuel and/or electricity referenced to the average energy content of 1 gallon of gasoline. For example, if there are two passengers and the airplane gets 100 MPGe, then Passenger MPGe = 200. Further, if the plane averages 100 mph over the course, then the total score is 50.

To see what this means for an electric airplane or some other technology, consider Table 1, which contains data from the CAFE web site. Say you flew an electric airplane that had 66 kWh of energy stored in batteries. In terms of 87-octane gasoline, this is about 2 gallons (66/33.703) and the MPGe is 100 as in the previous example. To get a feel for 66 kWh of energy, consider that your car battery can store about 1.0 kWh. However, there are battery packs that can provide this amount of energy for a more reasonable size and weight.

Other rules are summarized here. (For full details refer to the Aviation Green Prize web site listed in Resources.)

Passengers: Upright seats with adequate volume for a 6-foot-tall, 200-pound adult.

Efficiency: ≥ 200 Passenger MPG energy equivalency.

Speed: ≥ 100 mph average over the racecourse.

Range: 200 miles with FAR mandated reserves (30 minutes).

Minimum speed: ≤ 52 mph in level flight without stall.