Sustainable Aviation: Opportunities for the Washington State Aerospace Ecosystem

Infrastructure Changes for Sustainable Aviation

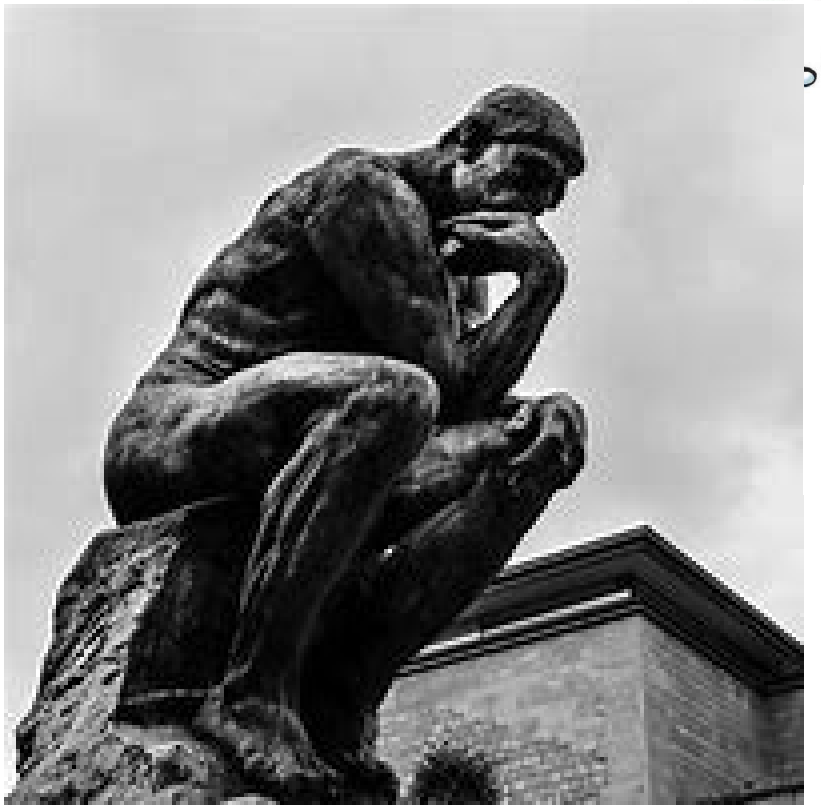
Dr. Subra(Mani)an Vadari

Modern Grid Solutions

Making Smart Grids Business As Usual

Thoughts !!!!

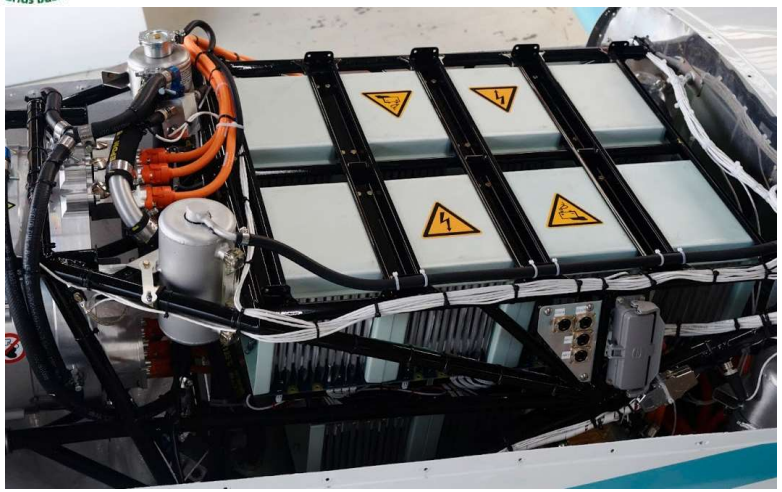
- Discuss the grid challenges & what will need to be changed
- Renewable power source distribution & storage
- That all sectors of the economy decarbonizing simultaneously & there's competition / similarities between



The Future of Aviation - Options

- Sustainable Aviation Fuel
- Electric – Batteries
- Hydrogen
  - Fuel Cell
  - Direct Hydrogen as fuel

The Future of Aviation – Analysis of Options



- Sustainable Aviation Fuel – interim option only as we transition off carbon-based energy sources
- Electric – Batteries. Need more analysis. Issues with
  - Range, Weight, Efficiency – Temperature dependency
- Hydrogen
  - Fuel Cell
  - Direct Hydrogen as fuel

BUT – our ask is not to redesign the aircraft!!!!

Other (much smarter) people are working on that

We have been asked to talk about
Infrastructure Changes for Sustainable Aviation

Let's focus on infrastructure needs

Charging

Energy Density

Energy density is usually defined in terms the number of watt-hours (Wh) you get per kilogram (kg).
Energy density of current lithium-ion battery's energy density might reach 250 Wh per kg
Energy density of jet fuel, or kerosene, is roughly 12,000 Wh per kg.

- Electricity –
  - Supply
  - Delivery
  - Charging infrastructure

SeaTac has 1200-1500 commercial jets flying in and out of the airport every day – this will require a total of (rough calculation) 20-20 GWs of power.

Battery Weight

The weight of a battery stays the same even when it's dead.

- the world's largest passenger plane, the Airbus A380, could only fly 1,000km with batteries versus its standard range of 15,000km. "
- To keep its current range, the plane would need batteries weighing 30 times more than its current fuel intake, meaning it would never get off the ground," he writes.

Range Anxiety

Electrify America is offering "Hyper-Fast" and Ultra-Fast charging stations at 350kW and 150 kW. It will provide about 20 miles of driving range per minute (depending on the EV) and nine miles of driving range per minute, respectively.

For a car!!!!

So-What!!!

Time for this to become real!!!!

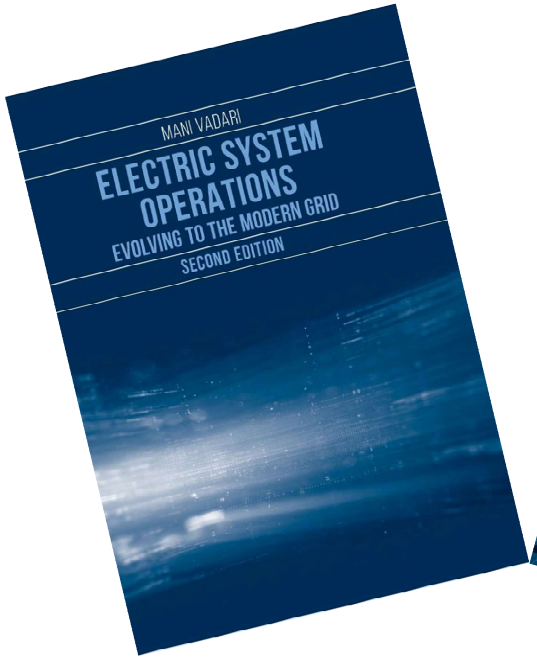
Two other technologies for lowering the emissions of aircraft being considered

- Biofuels propulsion systems (aka SAF – **Sustainable Aviation Fuel**). Biofuels made from organic matter could be used by existing planes and may be greener than kerosene, but as yet the market for it is small and **many biofuels come with their own environmental drawbacks**
- Hydrogen propulsion systems. **Hydrogen, while potentially clean if obtained from a renewable source.** You need something like three times the volume to store hydrogen for an aircraft than you do for kerosene.

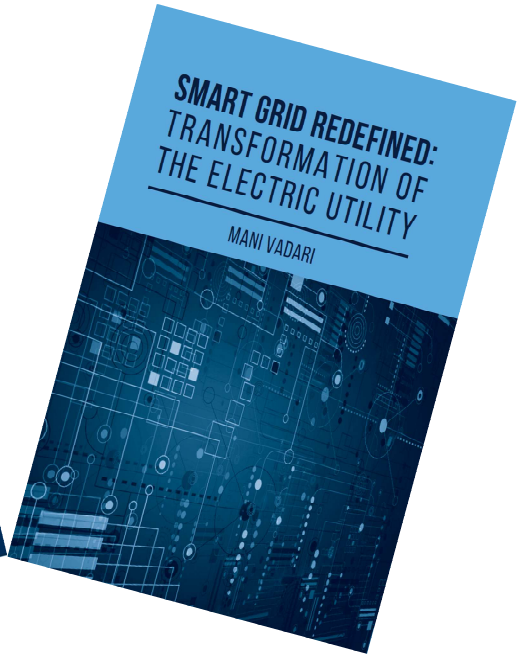
All three of these hopeful technologies – batteries, biofuels and hydrogen – require some major breakthroughs before they can revolutionize aviation.

THANK YOU

Certified Minority Business Enterprise
MBE - WA, CA, NY
US Gov't SBA
NMSDC



Check out the book at www.amazon.com



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Dr. Mani Vadari
mani.vadari@moderngridsolutions.com