The Journey to Net Zero

Electrification, Hydrogen, and Data Science

UNIVERSITY OF MIAMI
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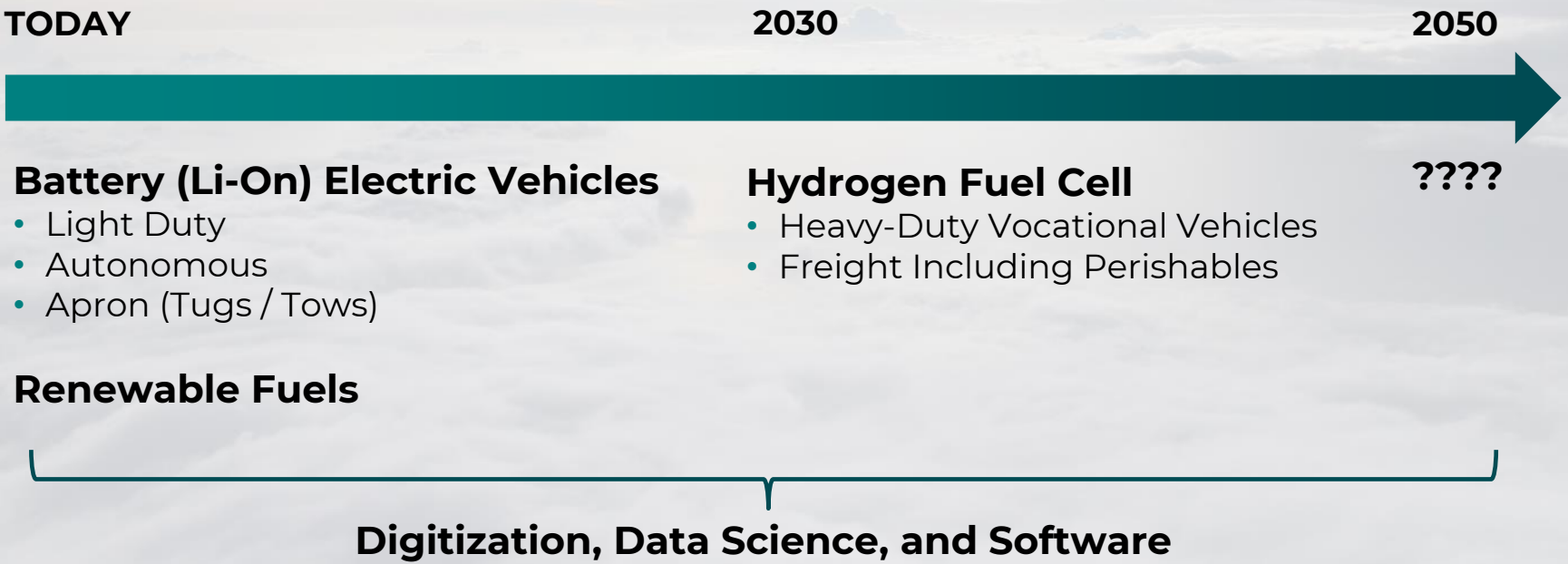
SWIFT
SEPT 25-28 2023 WINNIPEG

Aviation Events Group

Technology Deployment Timelines

(Commercial Deployment at Scale)

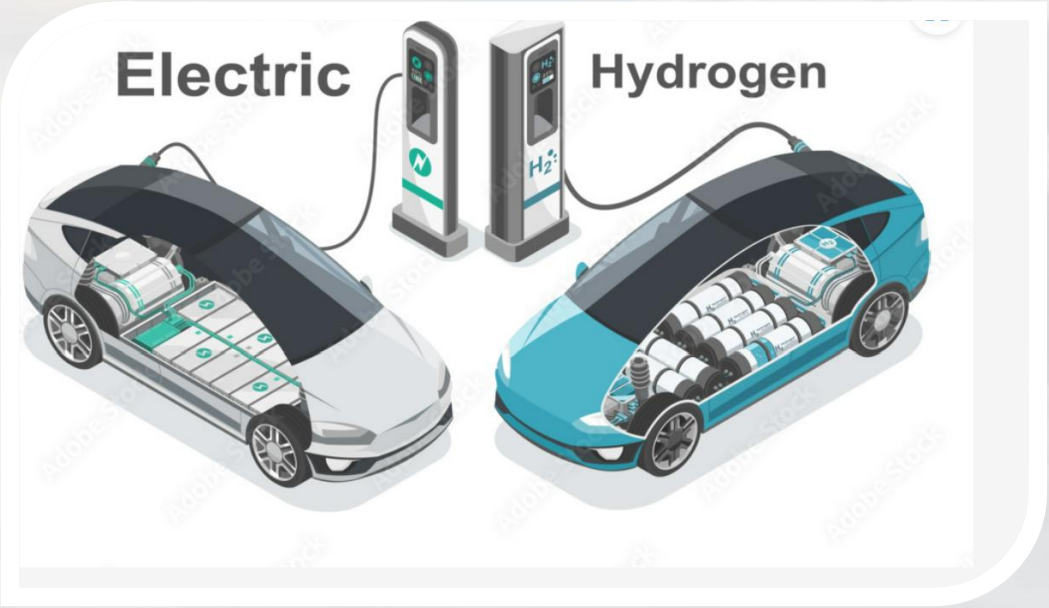


The Great Debate

The winner *today* is . . . **BOTH**

Battery Electric
- Light Duty
- Short Haul Freight
- Tugs / Tows

Hydrogen Fuel Cell
- Heavy-Duty Vocational Vehicle
- Long Haul Freight
- Continuous operation under load



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Example Illustration

400 HP ~ 300 kW Powered Unit in Snow Event

12-HOUR SNOW EVENT

	Time (hrs)	Load %	Power (kW)		Energy (kW/h)
Start Up	0.5	0.0	0.0		0.0
Stand By at "Home"	1.0	0.0	0.0		0.0
Movement to / from Air Traffic Area	0.5	25.0	75.0		37.5
Stand by Air Traffic Area	1.0	0.0	0.0		0.0
Manouvering During Operation	1.0	50.0	150.0		150.0
Operation Air Traffic Area High Power	3.0	90.0	270.0		810.0
Operation Air Traffic Area Medium Power	5.0	45.0	135.0		675.0

1672.5

Battery Electric Requirements

1700 kWh Energy Required

- Charge Time ~ 1 hour 40 minutes* with a 1MW DC Fast Charger at end of 12-hour shift

or

- 4 charges of 26 minutes each with 1MW charger every 3 hours

*Charge times are rough approximations due to loses from chargers and cabling.

Hydrogen Fuel Cell Electric

- 1 kg of Hydrogen ~ 33 kWh of Energy
- 52 Kg of Hydrogen required for 1700 kWh of Energy
- Fast Flow Fuelling ~ 4 kg/min*
- Hydrogen Refill for 1700 kWh less than 25 min

*NREL/DOE, **Honda**, Air Liquid June 2022

Other Alternatives

- **Bio Fuels**—In Use Today

- **Hydrogen Combustion**—In development with long term durability questions being assessed.

Digitization, Data Science, Software

A Largely Untapped Opportunity for Airfield Sustainability Initiatives

Digital Twins

- **Planning** (Snow Plans, Routing)
- **Training Simulators**
- **Evaluation on New Tech on Airfield** (Energy Use Simulations)

Data Science, Machine Learning, and Operational AI

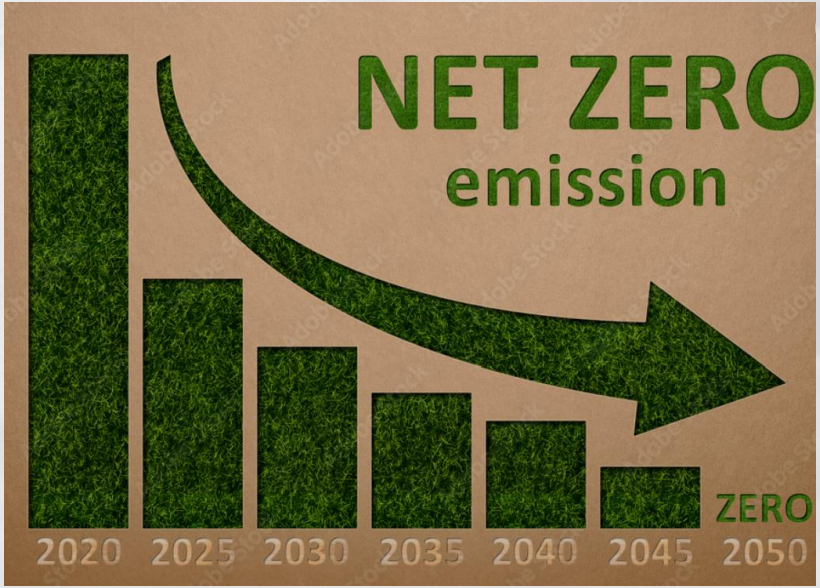
Operational Analysis and Insights
- Identification of good and bad trends in energy consumption

Computer Vision and Sensor Fusion
- Multi-tasking, error reduction, enabling multi-purposing of vehicles

Autonomous Operation and Operational Intelligence
- Real-time decision-making support
- Redundancy and hold time reduction
- Integration of multiple data sources (weather, traffic volume…)

The Journey Will Require:

- Multi-Disciplinary Skills
- Multiple Technologies
- Digitization and Software



Thank you SWIFT 2023

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