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CLEAN AVIATION

Green Mobility: Aircraft Electrification Challenges

Dr. Daniel Izquierdo-Gil
30th October, 2024
Pamplona

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EUROPEAN PARTNERSHIP

European Green Deal and achieve climate neutrality in aviation by 2050.

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Do you know the CO_2 emission rates in transport sectors?

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13,5%

EU Transport CO_2 Emission Rates

72 %

14,5 %

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Electrification roadmap in Airbus

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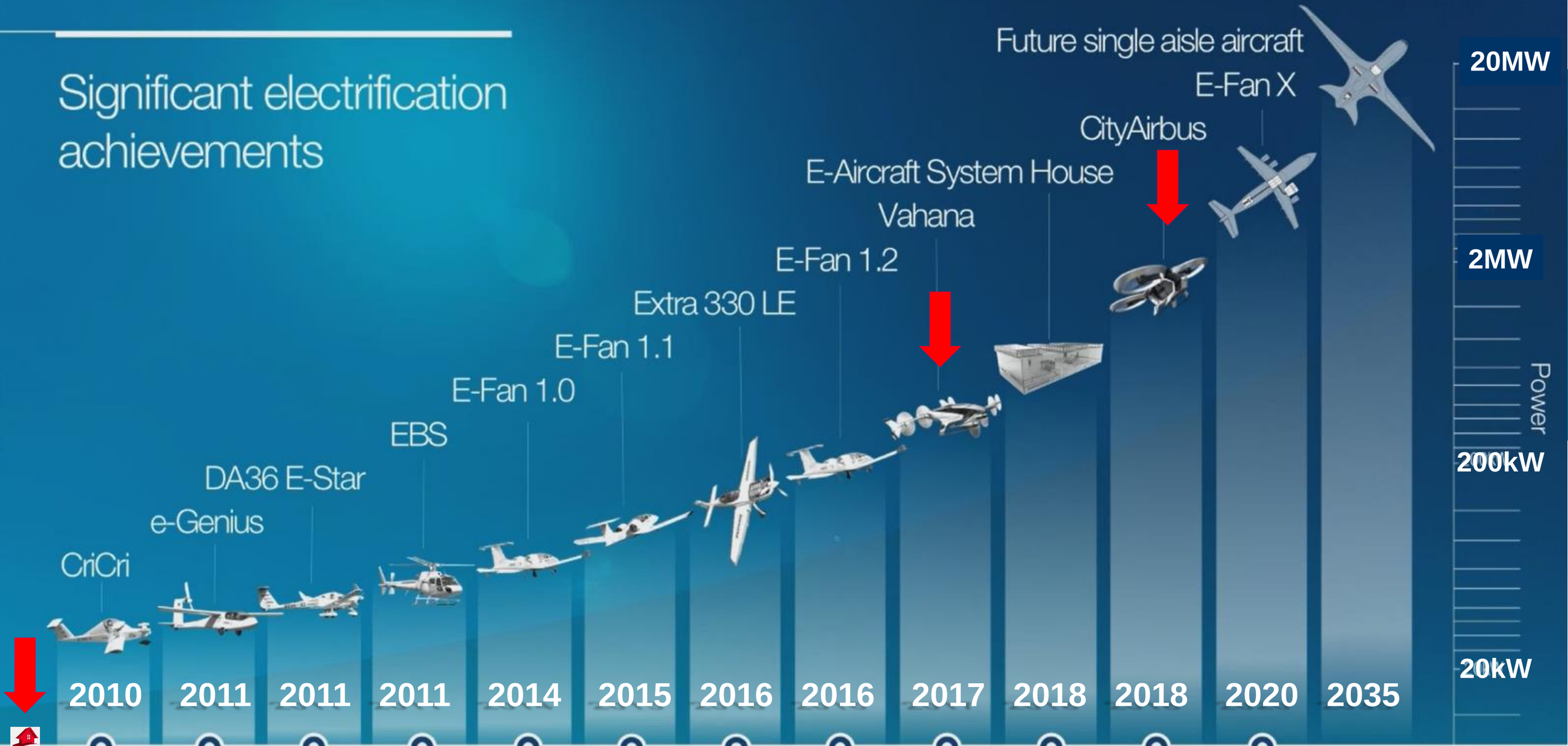
Significant electrification achievements
CriCri
e-Genius
DA36 E-Star
EBS
E-Fan 1.0
E-Fan 1.1
Extra 330 LE
E-Fan 1.2
E-Aircraft System House
Vahana
CityAirbus
E-Fan X
Future single aisle aircraft
2010
2011
2011
2011
2014
2015
2016
2016
2017
2018
2018
2020
2035
20MW
2MW
200kW
20kW
Power

URBAN AIR MOBILITY

0,5-2 MW

HYBRID REGIONAL AIRCRAFT

<3 MW

FUTURE SINGLE AISLE AIRCRAFT

<20 MW

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How to distribute the electrical power?

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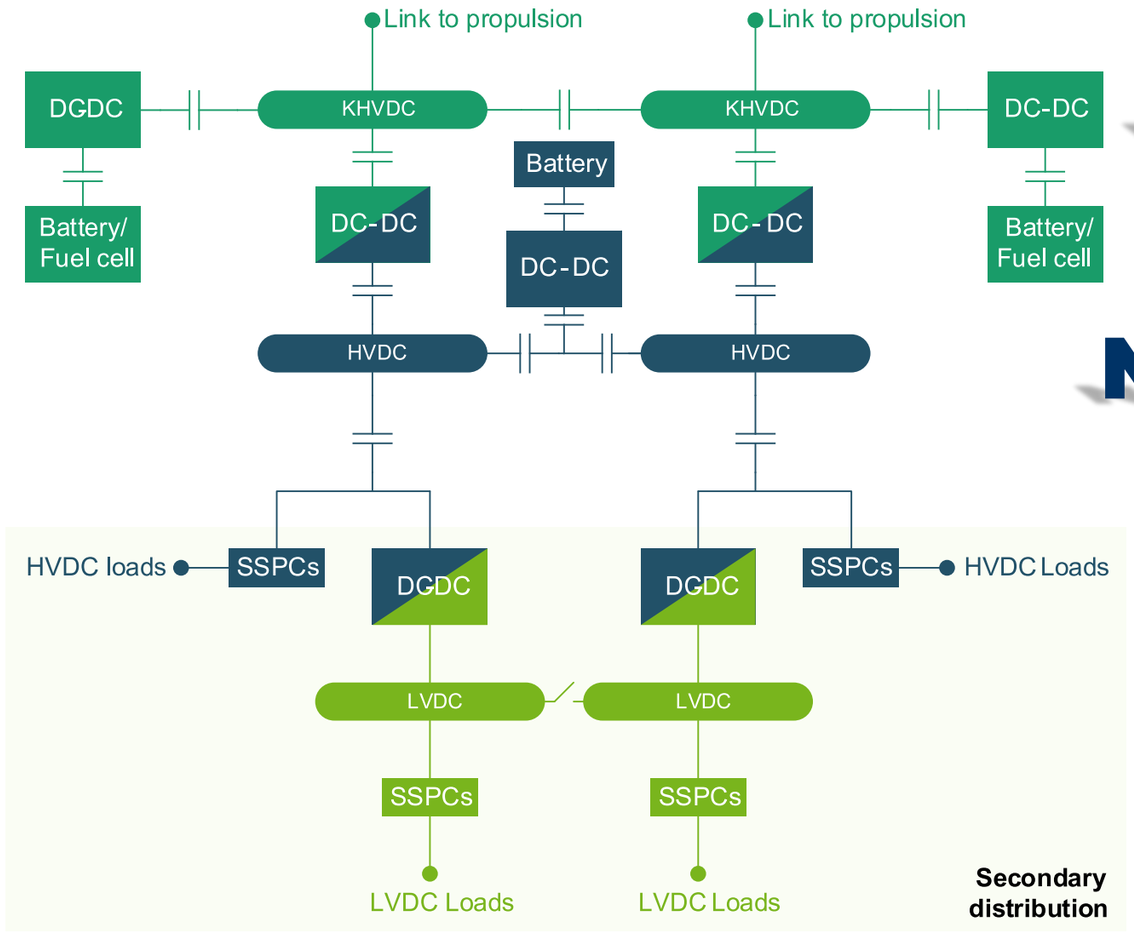
HECATE Electrical Distribution Network



Propulsive

Non Propulsive

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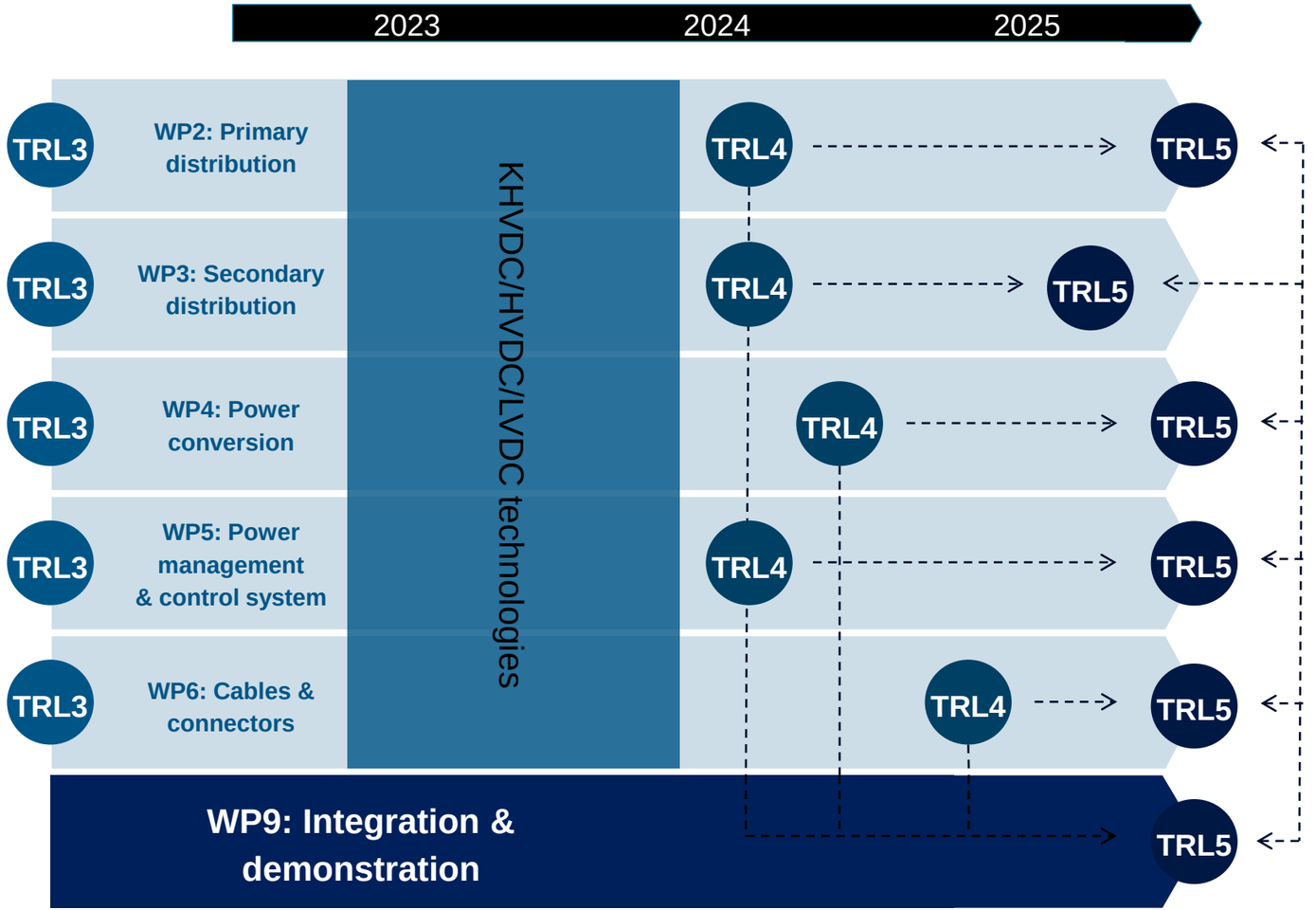
HECATE Key Technologies



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HECATE-Video

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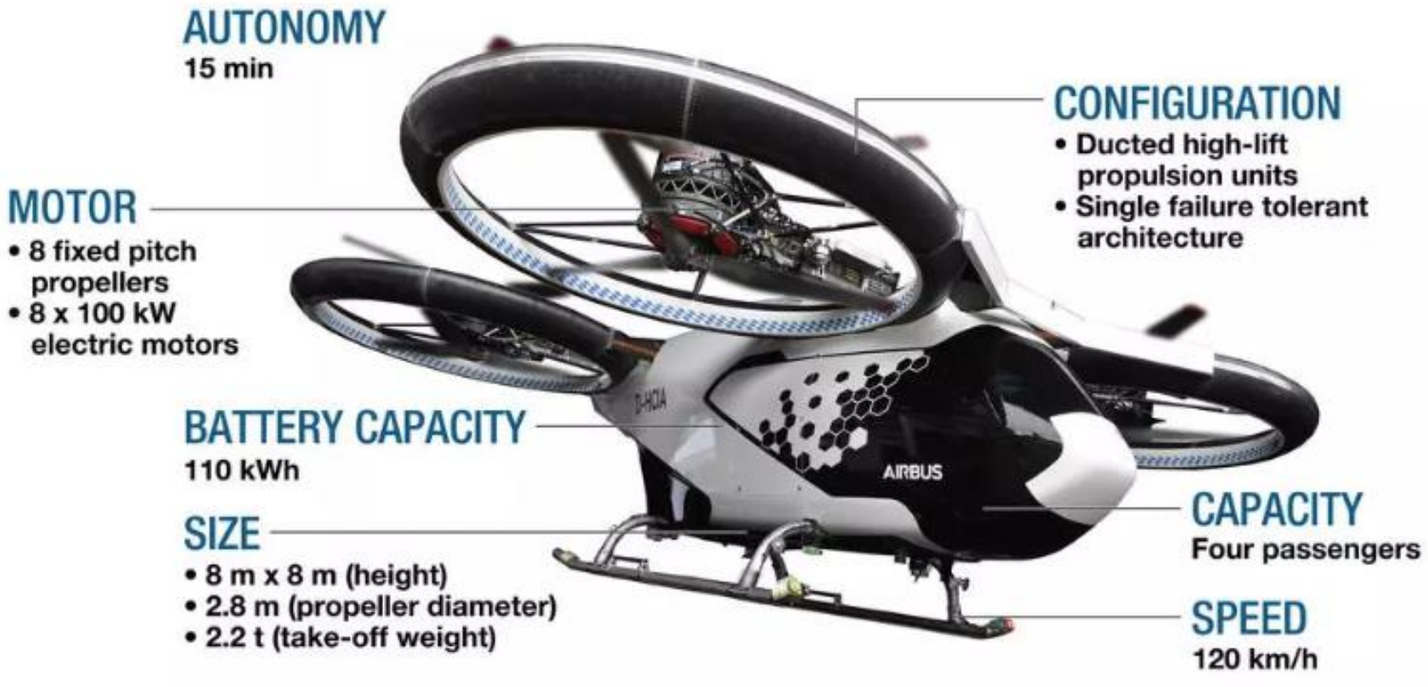
How to generate the electrical power?

All-electric, four-seat, multicopter vehicle demonstrator



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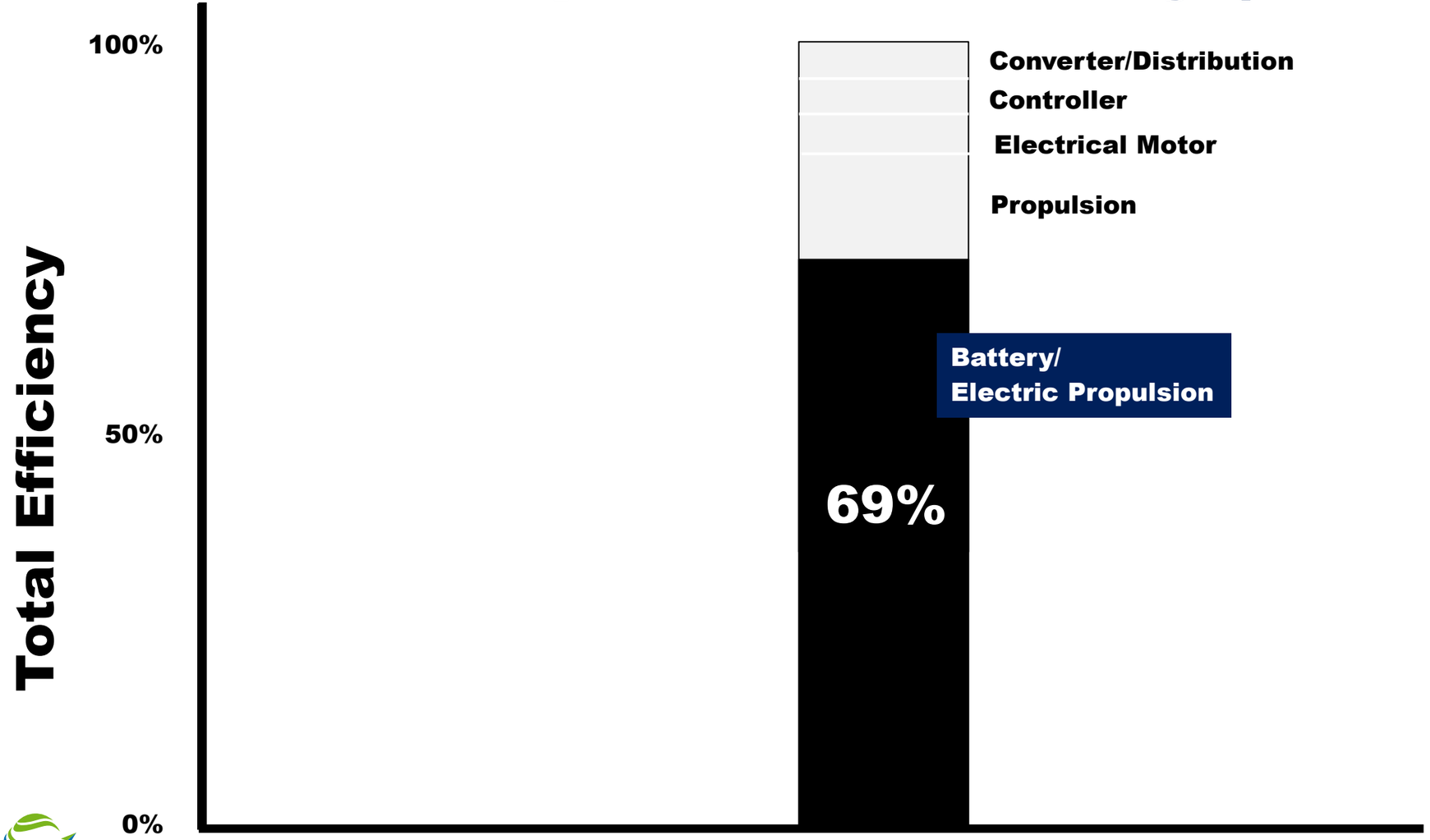
Electric Propulsion Efficiency (Battery)



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Electric Propulsion (Fuel Cell)

ZERO-E Six Pod based on Fuel cell

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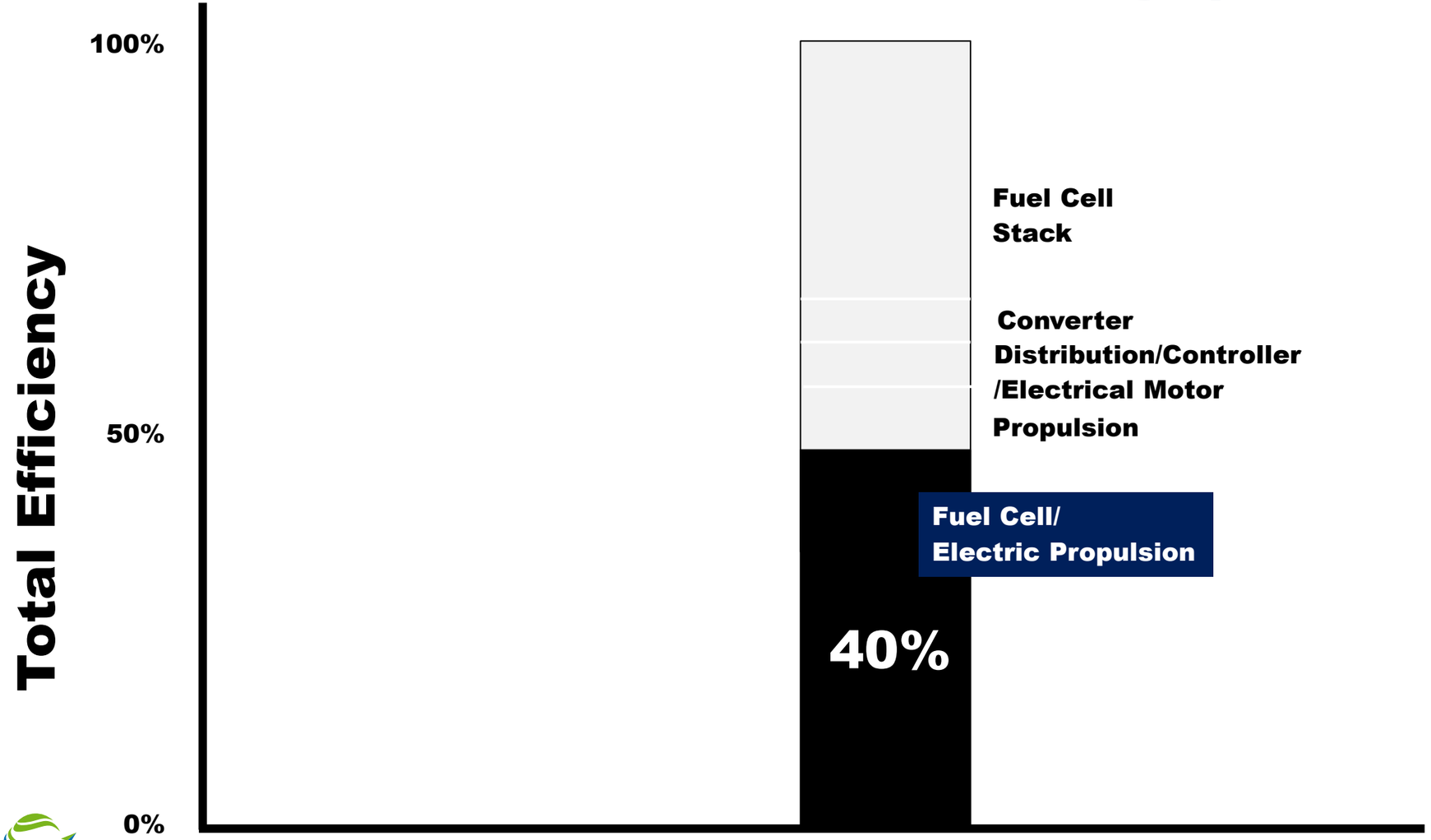
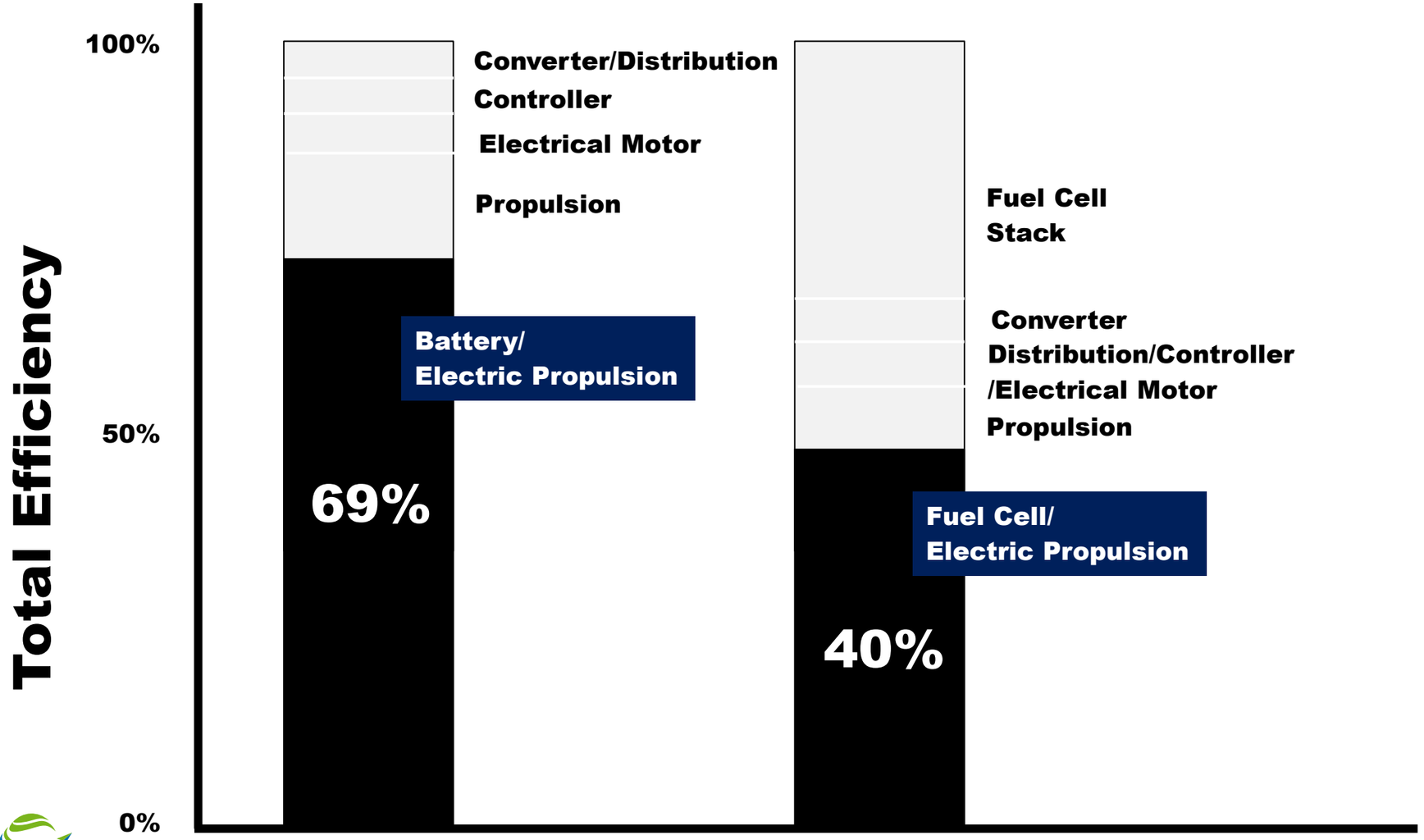
Electric Propulsion Efficiency (Fuel Cell)



Efficiencies Comparative



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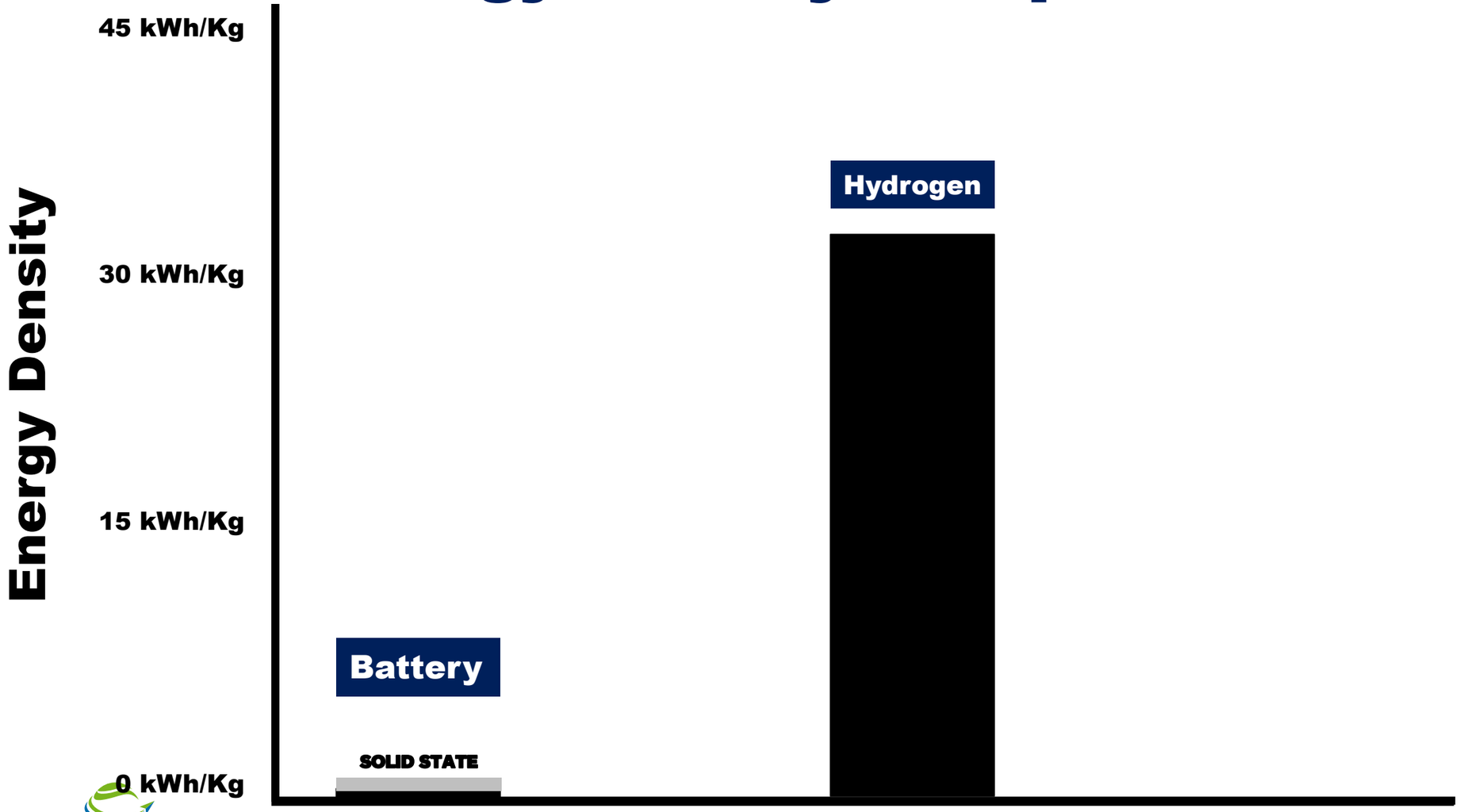
Energy Density Comparative



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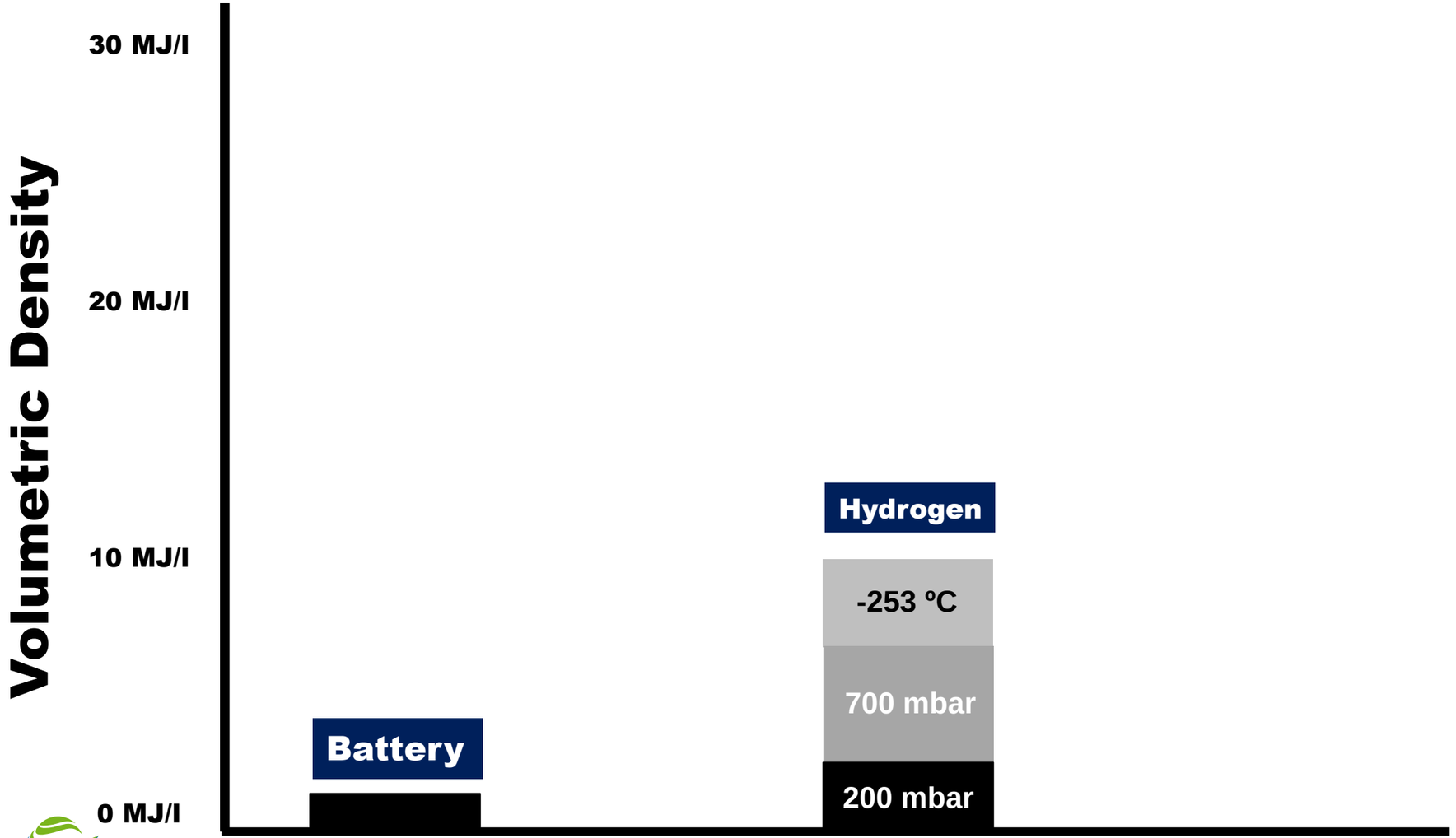
Volumetric Density Comparative



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New Challenges on board

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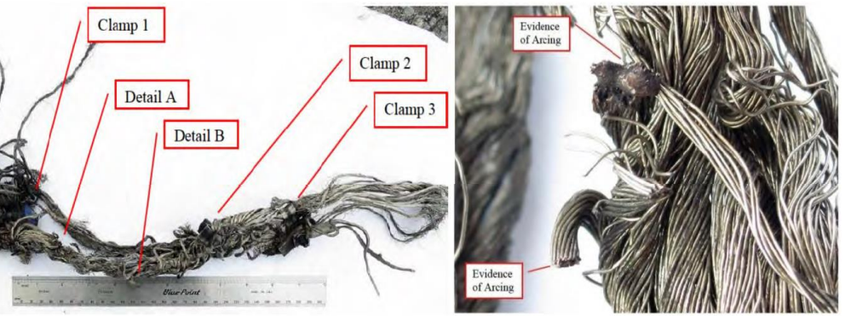
Wiring and connectors materials

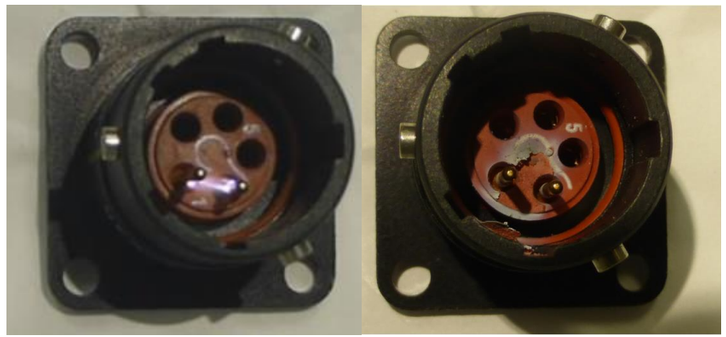
Wire/Cables and connectors must have:

- Insulating materials stable for the entire life of the vehicle
- Harness/connector material must not degrade
- Additional space will be necesary to route the power lines

F-22 crash due to an electrical arcing
PA Release No. 060613



LECTROMEC ©



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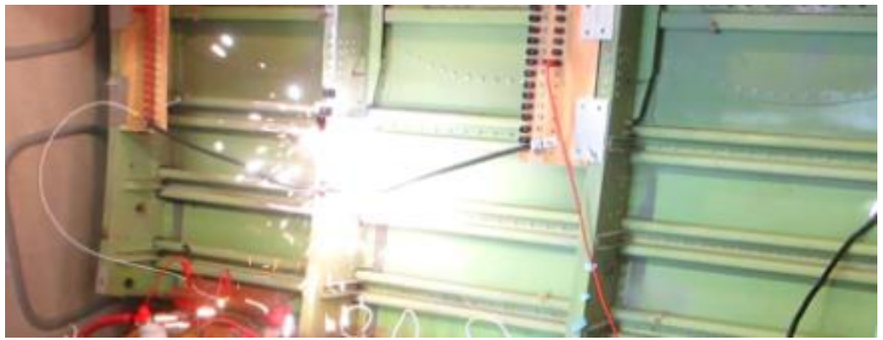

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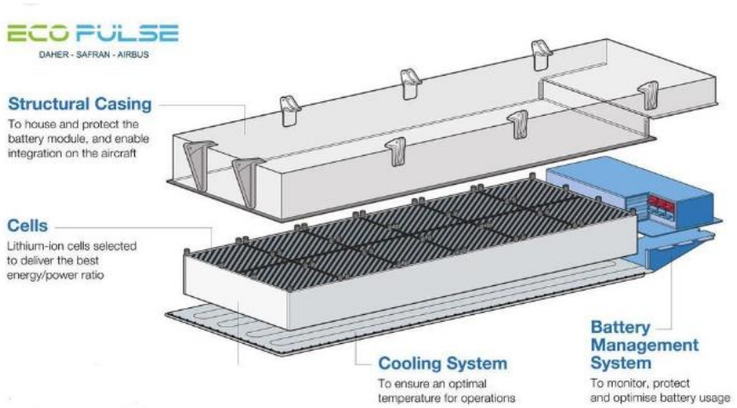
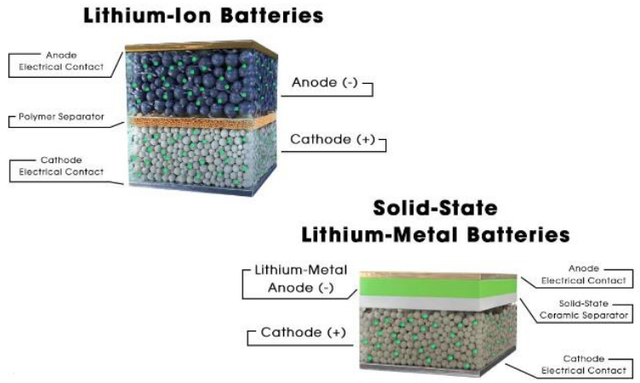
Battery Topic materials

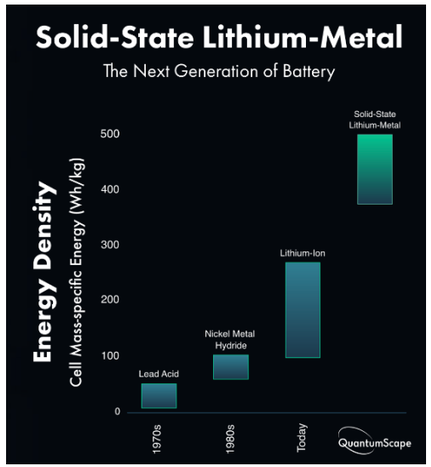
Battery system must take into account:

- Structural Batteries
- Battery based on Solid State Technology (Solid Electrolyte)



ECO Pulse demonstrator battery





QuantumScape ©

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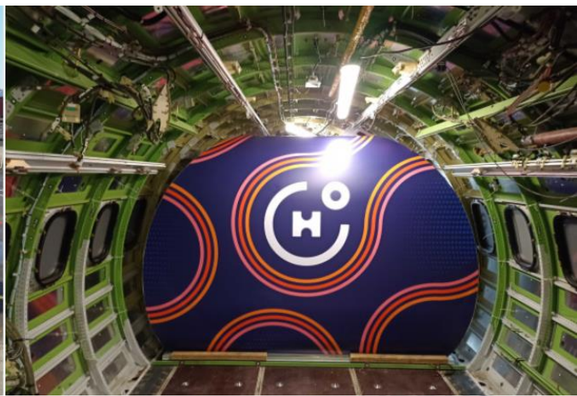
Hydrogen and Fuel Cell

Potential Hydrogen & FC System must have:

- H_2 Detection and Protection barriers (Safety)
- Volumetric Density Improvement -> Low temperature?
- Thermal Management for Fuel cell System and H_2



UNIVERSAL HYDROGEN ©

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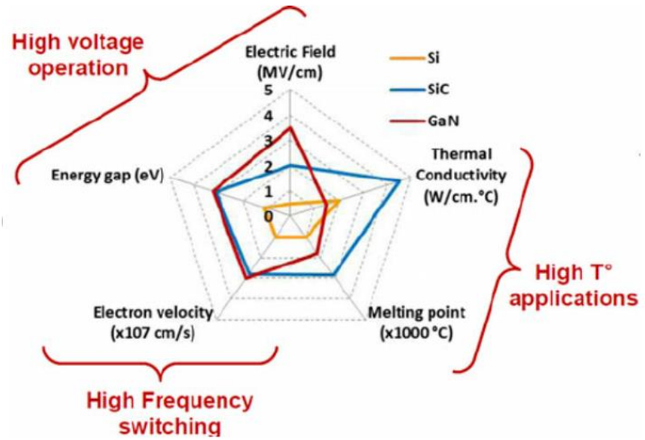
Semiconductors materials

Power electronics must take into account:

- Improvement of the power and weight efficiency of power semiconductors
- Wide bandgap (WBG) semiconductors such as silicon-carbide (SiC) and gallium-nitride (GaN), packages and modules adapted to aerospace applications



A Survey of Wide Bandgap Power Semiconductor Devices
Article, May 2014, Author Jose Millan et all

Electrification is key driver for VTOL

Advantages

- ❑ Reduce CO_2 emissions
- ❑ Improve system efficiency
- ❑ Increase Functionality
- ❑ Improve Life Cycle Cost

Drawbacks

- ❑ Battery Energy Density
- ❑ Hydrogen Safety
- ❑ Thermal Management
- ❑ Certification process

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Summary

- New **environmental and city mobility restrictions will push Hybrid Regional Aircraft and eVTOL Solutions**.
- **Challenges in the Electrification field** have to be addressed, in order to manage new power levels of VTOL and Hybrid Regional Aircraft
- **Future Hybrid Regional Aircraft** Electrical Networks have strong synergies and links with the **eVTOL and automotive industries**
- New **technologies and materials** will be needed to have a commercial product (Battery, Power Electronics, Cables, …).

Any Question?
Thank you

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