



SIEMENS

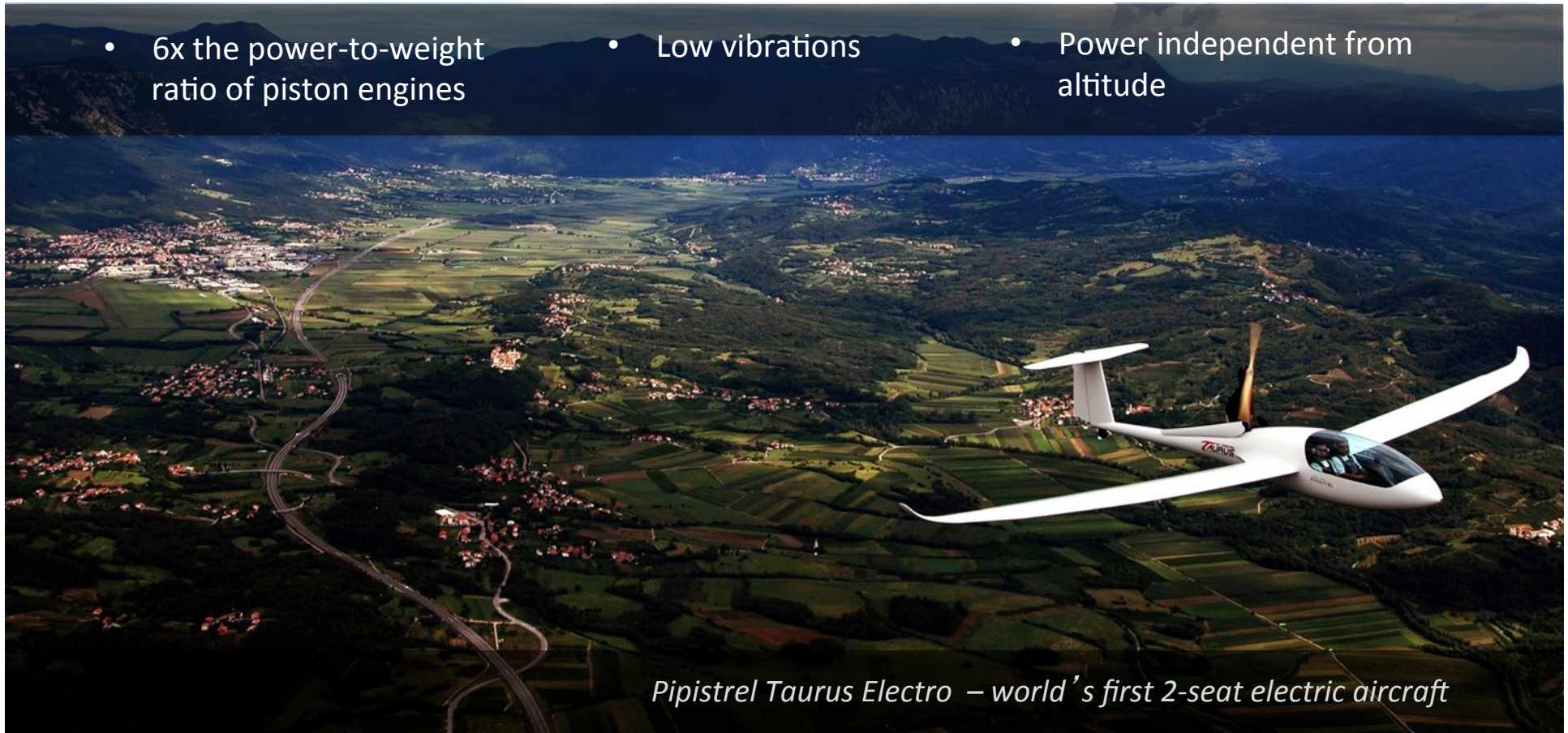


## An introduction to the project

Igor Perkon, Pipistrel

## Electric aircraft advantages

- 6x the power-to-weight ratio of piston engines
- Low vibrations
- Power independent from altitude



*Pipistrel Taurus Electro – world's first 2-seat electric aircraft*



## Electric aircraft advantages

- Almost no maintenance
- Zero vehicle emission
- High energy efficiency



*Pipistrel Taurus G4 – world's first 4-seat electric aircraft*

## Electric aircraft advantages

- Power and efficiency don't degrade at smaller sizes
- Extremely quiet
- 10x lower energy costs



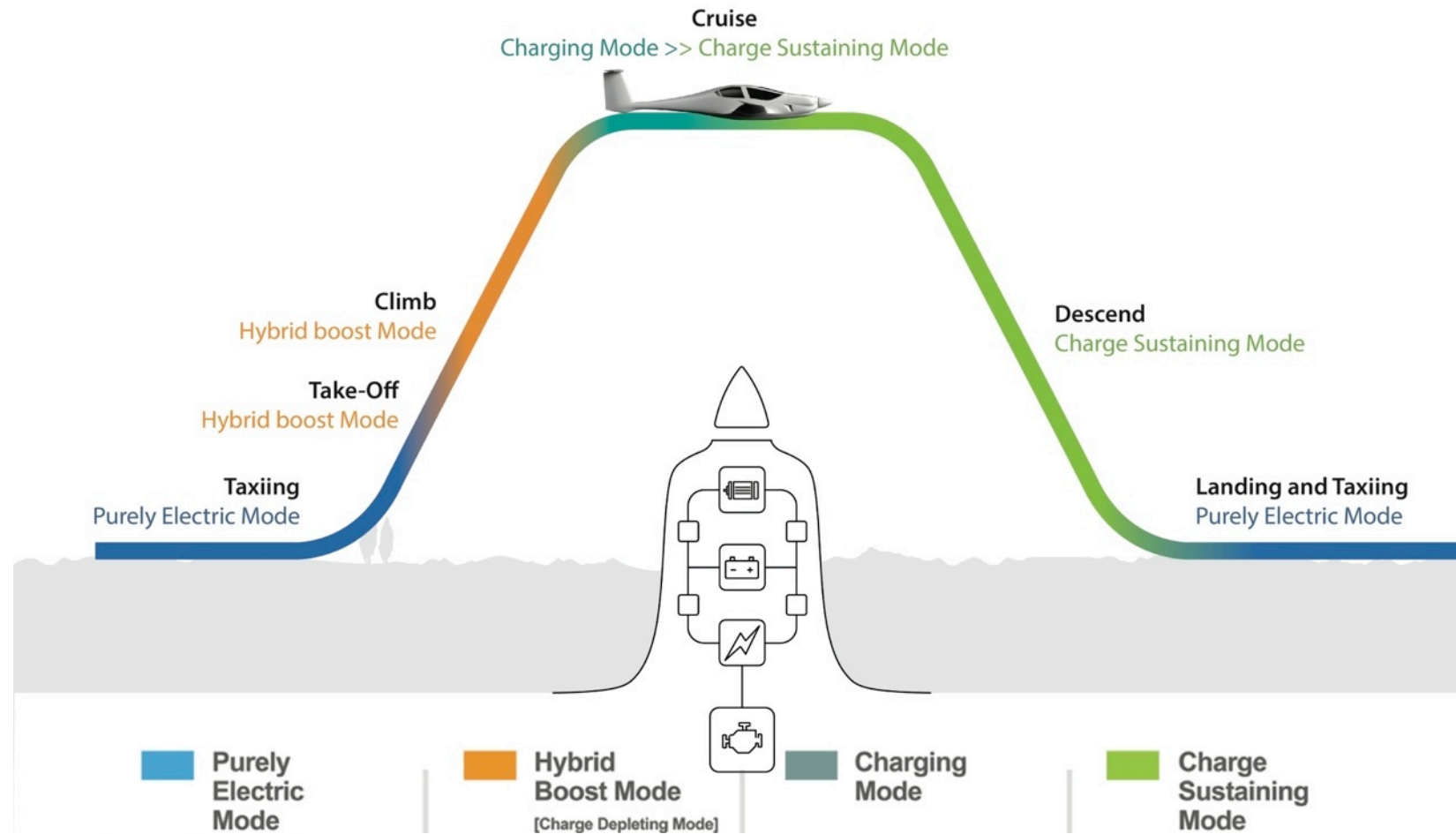
*Pipistrel Alpha Electro – the electric trainer with 1 hour range + 30' reserve*



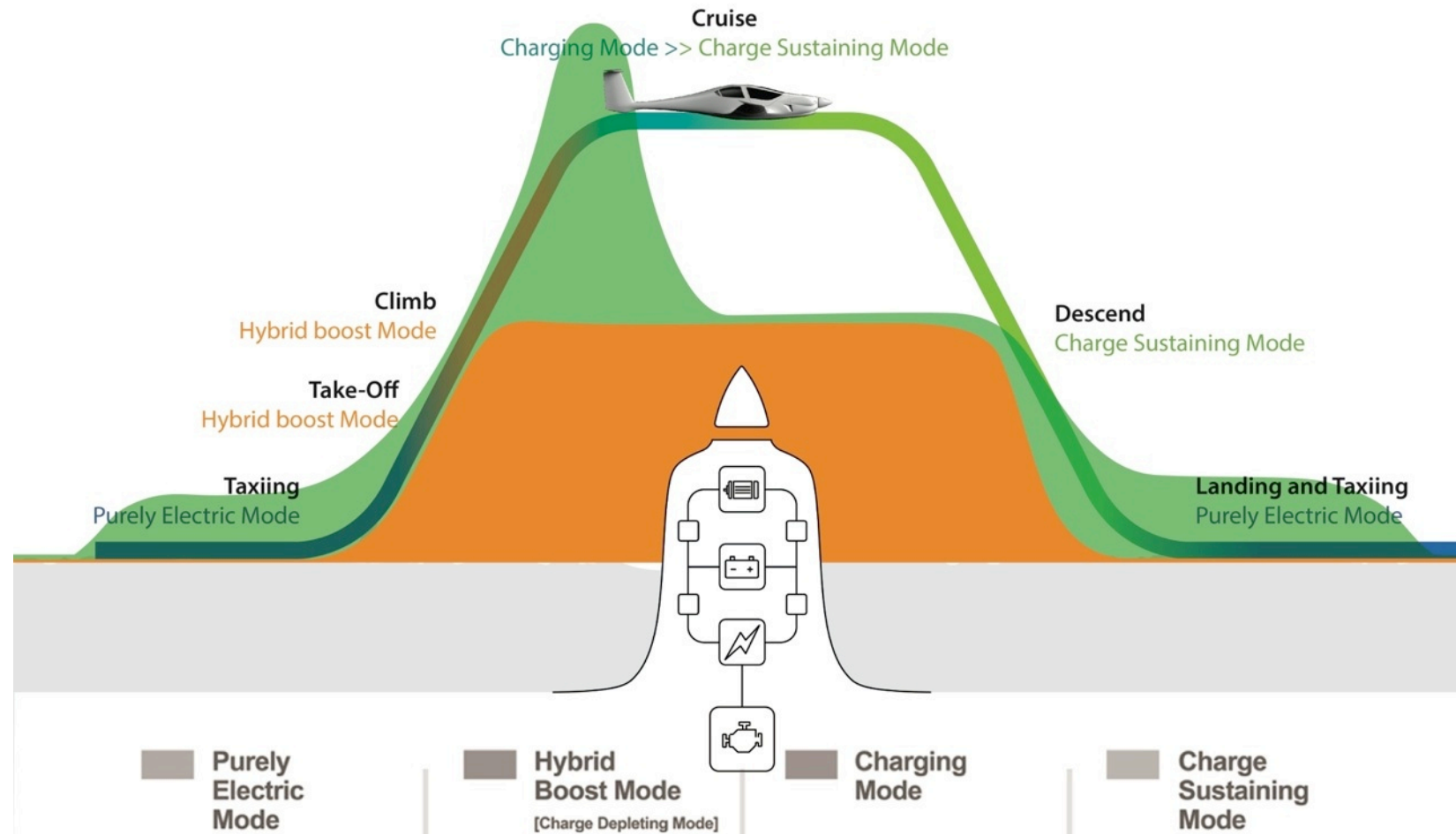
## Motivation: more range for electric aircraft



# Hybrid-powered mission profile



# Hybrid flight and power generation



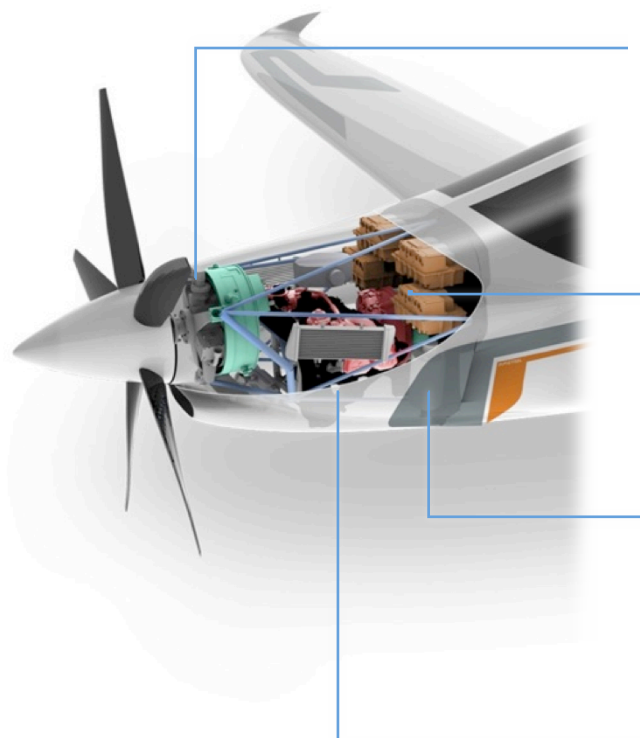
## Hybrid architectures: serial vs parallel

Serial Hybrid (HYPSTAIR)	Parallel Hybrid
<ul style="list-style-type: none"><li>+ Two independent energy sources</li><li>- Electric generator</li><li>- At least two inverters</li></ul>	<ul style="list-style-type: none"><li>- Closely coupled</li><li>+ No electric generator</li><li>+ One inverter</li></ul>
<ul style="list-style-type: none"><li>+ Cruise RPM is not linked to the ICE</li><li>+ Optimum propeller efficiency from take-off to cruise</li><li>+ Low noise (pure electric take-off), low cruise RPM</li><li>+ Suitable for new aircraft configurations (e.g. distributed propulsion)</li></ul>	<ul style="list-style-type: none"><li>- Cruise RPM linked to the ICE</li><li>- Oversized propeller for cruise</li><li>- No big difference to classic engine</li><li>- Classic configurations only</li></ul>



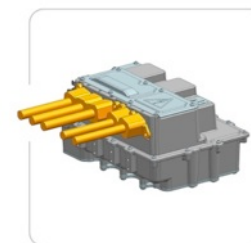
# HYPSTAIR Serial hybrid drive components

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200 KW MTOP  
electric motor

4 inverters for a  
fail-safe design



100 KW generator for charging  
batteries/powering the motor

Turbonormalized ICE  
as Range Extender



## HYPSTAIR Installation platform concept

HMI integration with modified dashboard and controls

Fuselage with few modifications required for hybrid powertrain

Low rpm propeller design

Motor / generator mount with same attachment points as ICE engine

Modified wing structure for battery system integration

## Test platform on a CS23 1315kg MTOW ac fuselage



Firewall-forward installation  
compatible with the piston engine  
powered version

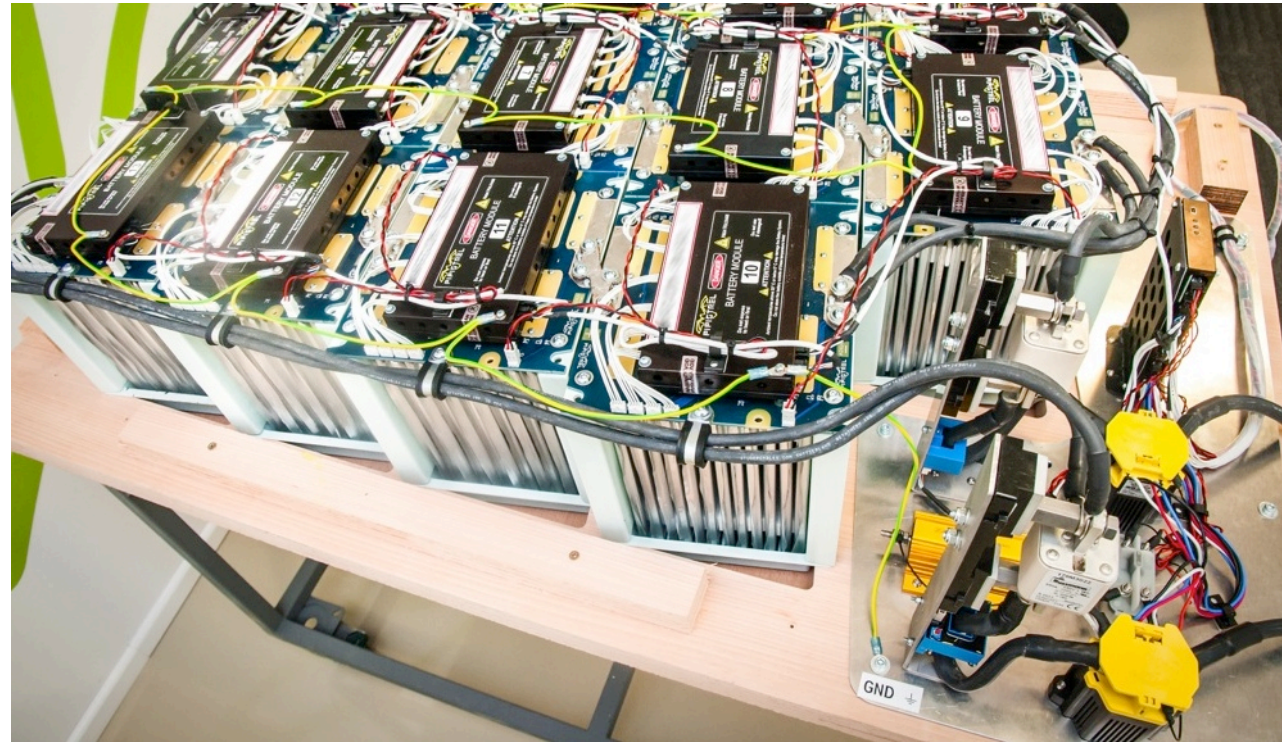




## High-power battery system

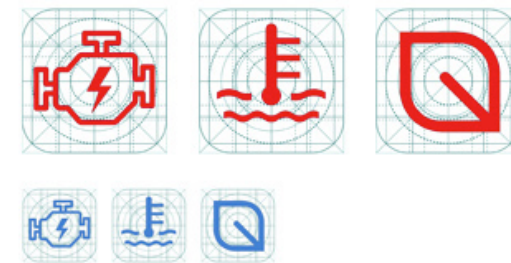
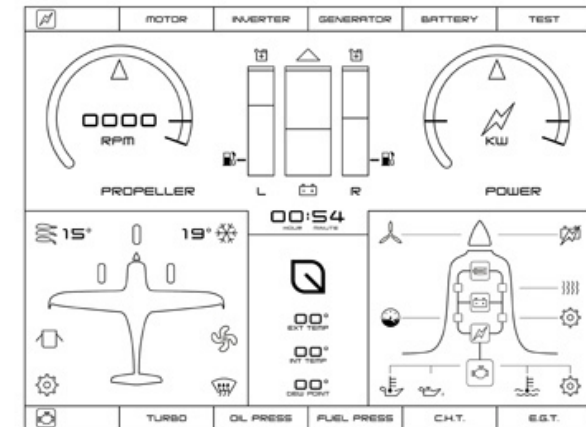


Approx. 110 kg,  
approx. 13 kWh  
usable capacity.  
Capable of 200  
kW continuous  
discharge,  
aircooled, with  
proprietary  
active BMS.





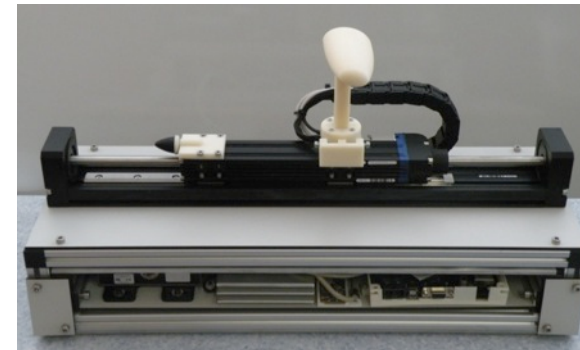
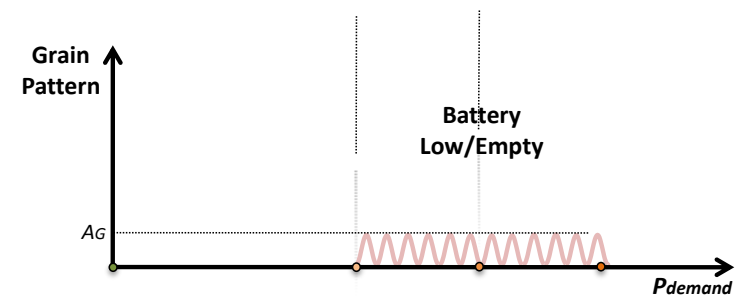
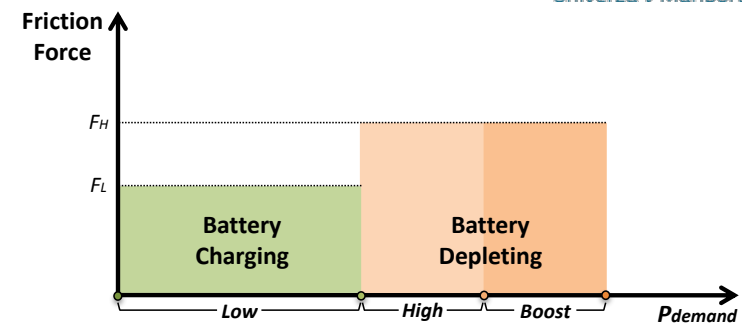
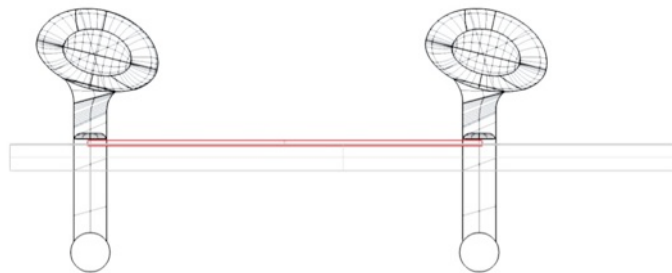
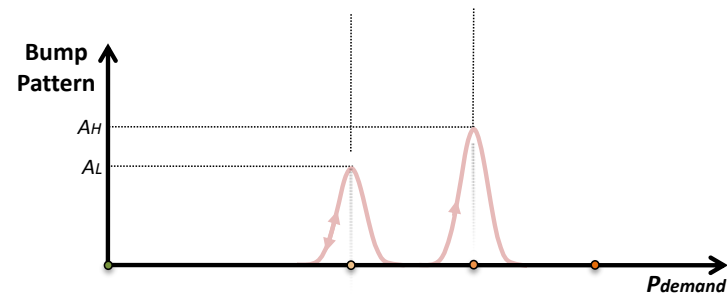
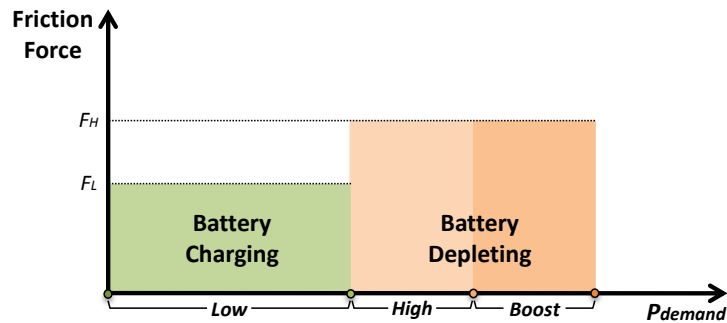
# Human Machine Interface for hybrid aircraft



Font for Hypstair HMI

QWERTYUIOPASDFGHJKLZXCVBNM  
1234567890

# Haptic control for power

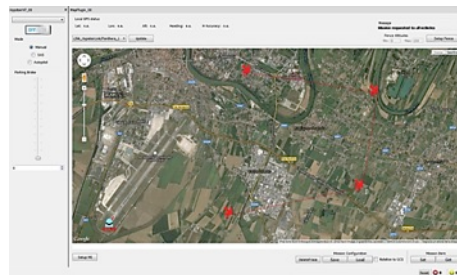




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# Energy mission planning: hybrid simulator

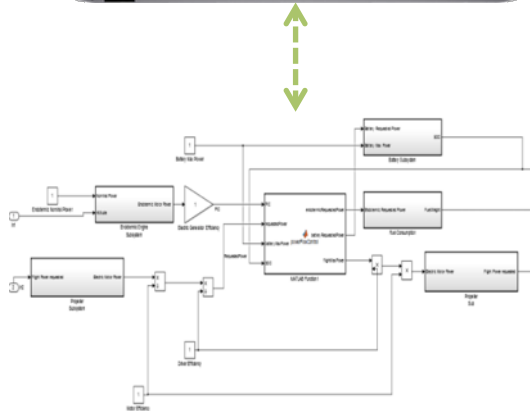
*Pilot Input:  
Joystick*



*Pilot Input: Mission Planner*



*Aircraft simulator*



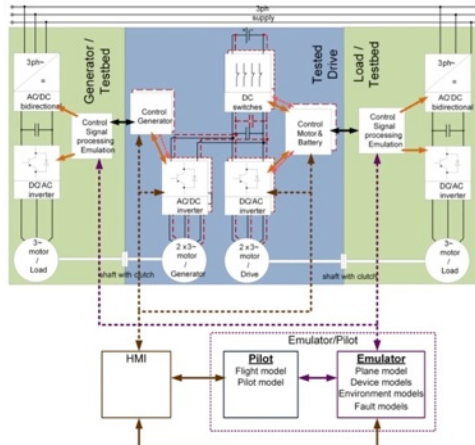
*Performance model*



*Human-Machine Interface*

## Powertrain testing has started!

Hypstair targets to reach TRL 4 level







More details in the contributions to follow..