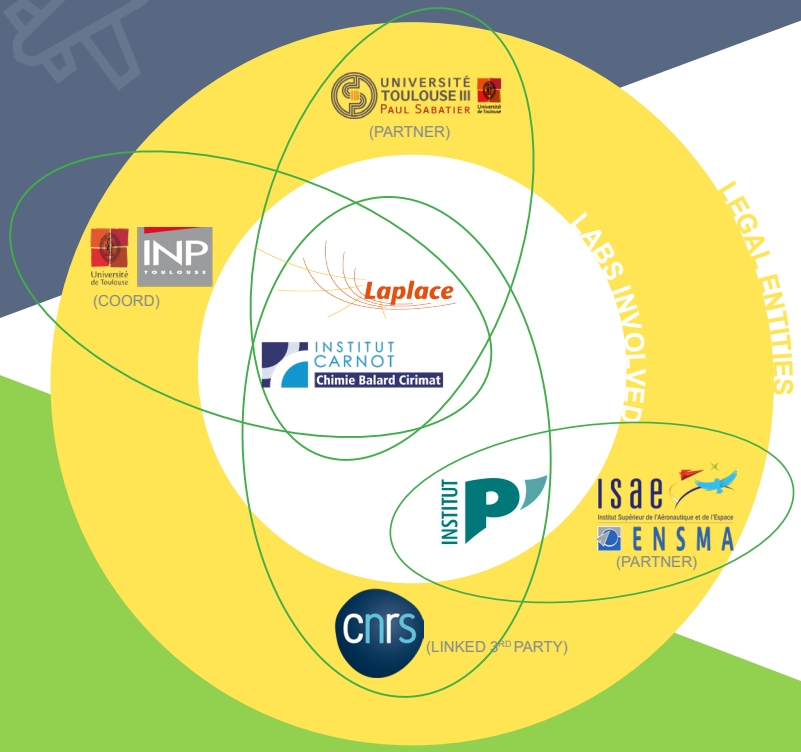

HASTECS

HYBRID AIRCRAFT: ACADEMIC RESEARCH ON THERMAL & ELECTRICAL COMPONENTS AND SYSTEMS

CONTACT

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HASTECS is a European (H2020, Cleansly II) 5 year project launched in Sept 2016. It is related to the technological design of a hybrid electric power train for future (beyond 2030) aircrafts. Coordinated by Toulouse INP, it involves 3 research labs (LAPLACE, Pprime, CIRIMAT) with 6 PHD Thesis plus 2 post doc, for a global budget of 1.5 M€.

MAIN CHALLENGES

- High specific power electric motors: towards and beyond 10kW/kg for 2035!
- Highly integrated power electronics: towards and beyond 25kW/kg for 2035!
- High efficient motor and power electronic cooling solutions: the thermal challenge!
- Facing partial discharges in electric motors and power electronics for ultra HVDC bus
- Future trends of new technologies for batteries and fuel cells
- System integration of the overall hybrid power chain

This project has received funding from the Clean Sky 2 Joint Undertaking under the European Union's Horizon 2020 research and innovation programme, under grant agreement N° 715483.

SYNOPSYS

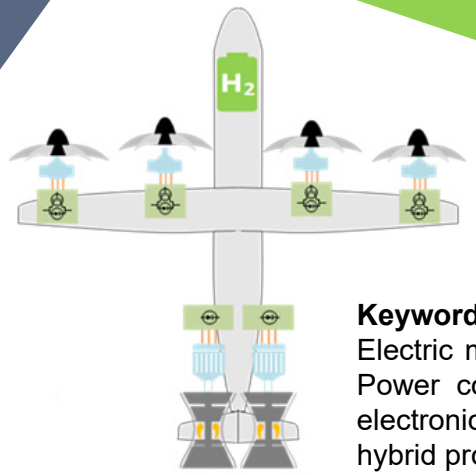
The HASTECS project aims at supporting the **demonstration of future less pollutant aircrafts** by means of **new concepts, models and tools development** that can help the designers in assessing main benefits of **architectures and power management of hybrid electric propulsion**.

We especially target the regional aircraft segment in the case of a series hybrid architecture. The proposed consortium involves all competences to face the huge complexity of this process. All academic researchers gather their expertise to optimize the overall hybrid power chain, starting with **electric and thermal components up to system integration** by taking into account main environmental constraints. Assessments are integrated at the system level and include design and analysis of main components of the hybrid power chain: electric machines and related cooling, cables, power electronics and related thermal management.

This system integration takes into account the main **environmental constraints, especially partial discharges** due to new **high power and ultra-high voltage standards**.

Thanks to this ''electro-thermal vision'' and to the overall optimization of the hybrid electric power chain, the HASTECS project proposes to reach aggressive targets with a strong increase of specific powers for the main components; two successive targets are focused for 2025 and 2035 horizons. We especially target to double the specific power (including cooling) of **electric machines from 5kW/kg for 2025 to 10kW/kg for 2035** while **specific powers of converters** are to be increased from **15kW/kg for 2025 to 25kW/kg for 2035:** the expected gap between 2025 and 2035 in terms of specific powers, when installing 4 inverter–motor drives of 1.5MW, would lead to a weight reduction of 1.8 tons, which would offer a significant fuel burn reduction estimated at 3.5% for a short range (~300nm) regional flight.

Additional fuel burn reduction has to be obtained thanks to several technological steps, as on **"auxiliary sources"** (batteries, fuel cells, etc) and by optimizing the overall system sizing integrating the power management.



Keywords:
Electric machines / Machine Cooling / Partial discharges / High voltage Power converters / Thermal management / Heat exchanger / Power electronics cooling / Fuel cells Batteries / System integration / Electric hybrid propulsion / Power management / Overall system optimization