SECTION1 - PROJECT GENERAL INFO

Project Acronym:		**HECATE**	
Project Full Title:		**Hybrid ElectriC regional Aircraft distribution TEchnologies**	
Total Project Cost (-€)		**45.159.602,50 €**	
EC Funding (€):		**34.210.348,00 €**	
Starting date	01/2023	**End date**	12/2025
Project OFFICIAL LOGO			
Project website/ social Media Channel		https://hecate-project.eu/	
Project details from EU Cordis (link):			
Hybrid ElectriC regional Aircraft distribution TEchnologies | HECATE | Project | Fact sheet | HORIZON | CORDIS | European Commission (europa.eu)			

SECTION2 - CONSORTIUM DETAILS

CONSORTIUM INFO			
Beneficiary Name	**Company Type (SME, R&D, IND, UNI)**	**Country**	**Main task in the project**
1-COLLINS AEROSPACE IRELAND, LIMITED	IND	IE	Coordinator. Design of power electronics, electrical distribution and architectures, digitalization, and verification & validation
2-SAFRAN ELECTRICAL & POWER	IND	FR	Design, manufacturing and integration of component and system for "more electrical" aircraft including global electrical system testing
3-LEONARDO - SOCIETA PER AZIONI	IND	IT	Aircraft manufacturer: specify, design, develop, test and certify HER platform
4-AIRBUS DEFENCE AND SPACE SA	IND	ES	Aircraft manufacturer: specify, design, develop, test, and certify HER platform
5-IRT ANTOINE DE SAINT EXUPERY	RTO	FR	Modelling: Weight reduction, thermal and electromagnetic interferences/ compatibility (EMC/EMI) modelling of electrical wiring interconnection systems (EWIS)
6-HS ELEKTRONIK SYSTEME GMBH	IND	DE	Design and manufacturing of electrical power distribution architecture systems, packaging through additive manufacturing, Solid-State Power Controller (SSPC) and Digital Twin (DT) & Predictive Health Monitoring (PHM) related technologies
7-SAFRAN SA	IND	FR	Design, manufacturing and integration of component and system for "more electrical" aircraft including global electrical system testing
8-SAFRAN AEROSYSTEMS	IND	FR	Design, manufacturing and integration of component and system for "more electrical" aircraft including global electrical system testing
9-ADVANCED LABORATORY ON EMBEDDED SYSTEMS SRL	IND	IT	Digitalization of power electronics and electrical distribution modules
10-STICHTING KONINKLIJK NEDERLANDS LUCHT - EN RUIMTEVAARTCENTRUM	RTO	NL	Thermal and electromagnetic interference/ compatibility (EMI/EMC) modelling of electrical wiring interconnection systems (EWIS)
11-FOKKER ELMO BV	IND	NL	Modelling, design and manufacturing of power electrical wiring interconnection systems (EWIS)
12-UNIVERSIDAD POLITECNICA DE MADRID	UNI	ES	Power conversion and optimized magnetic components
13-UNIVERSIDAD CARLOS III DE MADRID	UNI	ES	Ionization phenomena, instrumentation, and high voltage systems

14-AALBORG UNIVERSITET	UNI	DK	Expertise on direct current microgrids, predictive health monitoring and digital twins of power electronics
15-POLITECHNIKA WROCLAWSKA	UNI	PL	Diagnostics and conditions monitoring, electrical machines, and drives
16-UNIVERSIDAD DE GRANADA	UNI	ES	Computational electromagnetics, numerical methods, and finite difference time domain methods
17-GMVIS SKYSOFT SA	IND	PT	Partitioning operating system avionics integrated architecture (IMA) and distributed integrated modular avionics (DIMA), safety critical software development
18-THALES AVIONICS ELECTRICAL SYSTEMS SAS	IND	FR	Electrical conversion for many segments of aviation; inverter, power module, integrated EMI filter, robust communication
18.1-THALES AVS FRANCE SAS	IND	FR	Electric power management onboard aircraft, running on real-time control board targets, involved in the design, programming, and testing of a global supervisory unit (GSU)
19-AEROMECHS SRL	SME	IT	Electric power management onboard aircraft, running on real-time control board targets, involved in the design, programming, and testing of a global supervisory unit (GSU)
20-AERTEC SOLUTIONS SL	IND	ES	Design and development of aerospace and defence systems, bringing expertise on power distribution and monitoring skills
21-DIEHL AEROSPACE GMBH	IND	DE	Global equipment supplier for avionics and cabin system providing expertise on IMA and tools, secondary power distribution, solid-state power controller (SSPC) control
22-AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH	RTO	AT	Electrical energy storage and conversion: model-based design of battery (incl. management and diagnostics), software integration of battery pack and fuel cell system
23-UNIVERSITA DEGLI STUDI DI SALERNO	UNI	IT	Electrical energy storage and conversion: model-based design of fuel cell systems (incl. fault and degradation aware control); co-design of fuel cell system and battery pack sizes (i.e., in terms of nominal power and additional mass)
24-UNIVERSITAT BAYREUTH	UNI	DE	Sustainability assessment, additive manufacturing, topology, thermal and structure simulation
25-TEMAI INGENIEROS SL	SME	ES	Design, certification, and manufacturing of electromechanical and electronics aero equipment for flight control, electrical distribution, refuelling sensing and fuel monitoring
26-FUNDACION TECNALIA RESEARCH & INNOVATION	RTO	ES	Energy conversion solutions for on-board applications. Expertise in model-based software

			development for automotive applications (power converters)
27-FRAUNHOFER GESELLSCHAFT ZUR FORDERUNG DER ANGEWANDTEN FORSCHUNG EV	RTO	DE	Technology demonstration of power electronic for harsh environment based on ceramics embedding and virtual lifetime testing of power electronic for avionic applications
28-UNIVERSITA DEGLI STUDI DELLA CAMPANIA LUIGI VANVITELLI	UNI	IT	Automatic and supervisory control and power electronics, More Electric Aircraft (MEA)
29-TECHNISCHE UNIVERSITAET ILMENAU	UNI	DE	High voltage technology and their applications for the optimization of the components of electrical power engineering (electric arc simulation, arc physics, switchgear research)
30-DRAKA FILECA SAS	SME	FR	Development and production of wires and cables for aeronautics/aerospace applications
31-SAFRAN ELECTRICAL COMPONENTS	IND	FR	Research, development and manufacturing of aircraft components, and landing gear harnesses
32-POLITECHNIKA LODZKA	UNI	PL	Life Cycle Assessment (LCA) and waste scenario including recycling – “closed-loop” recycling
33-UNIVERSITY OF NOTTINGHAM ITALY SOCIETA' CONSORTILE A RESPONSABILITA' LIMITATA	RTO	IT	Electrical systems for aerospace applications
34-GOODRICH CONTROL SYSTEMS PRIVATE UNLIMITED COMPANY	IND	UK	Research, design and modelling of power electronics, electrical distribution and architectures, digitalization, and verification & validation
35-AEROSPACEHV LTD	SME	UK	Specialist support for the design, test and maintenance of high voltage equipment used in the aerospace and automotive sectors
36-THE UNIVERSITY OF NOTTINGHAM	UNI	UK	Design and manufacturing of Power electronics, and support definition electrical systems for aerospace applications and electrical power distribution architectures.
Project Primary Coordinator Contact Name			Ignacio Castro Álvarez
Project Primary Coordinator Contact E-mail			ignacio.castro@collins.com
Project Primary Coordinator Contact Company			Collins Aerospace Ireland

SECTION 3 – AMBITION, INNOVATION, ROADMAP, IMPACT

AMBITION, CONCEPT & APPROACH , CHALLENGES

HECATE is a Clean Aviation project dedicated to the definition of next generation electrical distribution for hybrid electric aircraft under the regional pillar. HECATE has six main objectives:

- *O1. Development of a holistically optimized electrical architecture*
- *O2. Technology brick development to TRL5*
- *O3. Mitigation of HV phenomena and EMI*
- *O4. Development of digital twins*
- *O5. Certification of the electrical distribution*
- *O6. Technology roadmap toward near- and long-term electrical architectures*

These objectives contribute to the development of technologies that enable the path toward long-term roadmaps such as that of Advisory Council for Aeronautics Research in Europe (ACARE). Flightpath 2050 sets specific goals like a 75% reduction of CO2 emissions per passenger kilometre and 90% reduction of Nox.

To meet these ambitious targets for commercial aerospace, in both terms of fuel efficiency and supply demand, a paradigm change is needed. This will be done by shifting towards electric/hybrid-electric propulsion technologies that will significantly reduce the fuel burn. As part of this conjoined effort, HECATE will define, design, and provide with the required technology enablers related to the electrical distribution by means of technology bricks that will act as the building blocks of the architecture. The HECATE project will demonstrate a >500 kW architecture in a copper bird test facility in 2025.

This technology development will enable higher level impact that can be grouped in two major pillars:

- ***Industrial competitiveness and economy impacts**:*
  - *Changes to the aviation ecosystem. (e.g., organisations moving to another supply chain tier position, newcomers embedded into the ecosystem, new and more jobs).*
  - *Changes to the power network work force in terms of skill set and education programmes.*
  - *Increasing the innovation capacity of project partners and wider community.*
  - *Stakeholder engagement from Original Equipment Manufacturers to wider supply chain.*

- ***Environmental and societal impacts**.*
  - *Fostering a sector-wide coherent response strategy to comply with EU policies targeting aviation's goal of net-zero carbon emissions by 2050.*

HECATE mobilizes a large consortium of 36 partners spread over 12 countries and unites EU's industry leaders on power distribution systems working together with key SMRs, RTOs and universities ensuring the knowledge gained in EU is exploited and embedded in future research and education programs within and for the EU. To ensure the path toward exploitation HECATE is in contact with other CA and HE projects and with EASA to ensure a path toward certification for technologies developed within HECATE.

Please fill the table below to report 5-6 "top"(+3 achieved during 2023) important technical" milestones and technologies for COMM purposes

ROADMAP & TIMELINE			
KEY PROJECT MILESTONES			
Milestones NAME	**TIME**	**Description**	**Is there any Hardware /mock-up expected that can be displayed in major events ?**
M1- "Power Converter Specifications Completed"	*06.2023*	***Achieved**- Power Converter specifications and requirements successfully defined, completed and documented, enabling the progress toward product design and development.*	*NO*
M2- "Impact Monitoring Dashboard"	*06.2023*	***Achieved**- A comprehensive dashboard, accounting for all Key technological Performance Indicators towards programme aims is created and successfully updated.*	*NO*
M3 – "Test Bench PDR"	*12.2023*	***Achieved**- Preliminary Design review completed for the specific test bench, where the full electrical architecture will be integrated, accounting for the Interface Control Document of all individual equipment composing the global system.*	*NO*
M4 – "Secondary distribution specifications"	*02.2024*	*Maturation of the Secondary Distribution technology brick, to provide power to the rest of the loads of the aircraft, to a TRL4 level.*	*NO*
M5 – "Primary distribution critical design review completed"	*10.2024*	*Maturation of the Primary Distribution technology brick, to supply power to the electrical propulsion system, to a TRL4 level*	*NO*
M6 – "Power Converters critical design review completed"	*12.2024*	*Maturation of the Power Conversion technology brick, to ensure power is delivered at the required voltage levels within electrical distribution and to the loads, to a TRL4 level.*	*NO*
M7 – "Electrical Sub-Systems Integrated"	*09.2025*	*The integration of all different subsystems at TRL-5 into an approved and validated test bench with a final reporting certifying integration and compliance as per the agreed Interface Control Document of each technology brick.*	*NO*
M8 – "Electrical Architecture Digital Twin validated"	*12.2025*	*Electrical architecture Digital Twin (a digital representation of a physical system that provides real-time evaluation of its physical) fully developed and validated against the results coming from the test report.*	*NO*
M9 – "Electrical Architecture tested"	*12.2025*	*Final testing on a representative test bench (COPPER bird), showcasing a fully integrated electrical distribution system capable of addressing the needs of a Hybrid Electric Regional aircraft.*	*NO*

TRL ROADMAP of KEY TECHNOLOGIES				
Integrated Systems and Sub-systems level	**2023**	**2024**	**2025**	**2026**
Primary Distribution	*TRL3*	*TRL4*	*TRL5*	*Out of HECATE timeline*
Secondary Distribution	*TRL3*	*TRL4*	*TRL5*	*Out of HECATE timeline*
Electrical Architecture fully integrated	*NA- Sub-systems under development*	*NA- Sub-systems under development*	*TRL5*	*Out of HECATE timeline*

CONTRIBUTION TO HIGH LEVEL OBJECTIVES OF THE PROGRAM				
Aircraft concepts	*Please identify the thrust and the A/C concept to which your project contributes to* *HER - USE CASE A;* *HER - USE CASE B* SMR – xxx			
High level objective at system level – (HERA and ACAP at A/C level)	**Yes/No?**	**Quantification at system level (%) (HERA and ACAP at A/C level)**	**Metrics**	**Reference Technology/ Architecture Or Reference Aircraft**
Fuel Reduction	☒	To be studied at Aircraft levelTo be studied at Aircraft level	*	*Electrical architecture.*
Energy efficiency	☒	To be studied at Aircraft levelTo be studied at Aircraft level	*	*Electrical architecture.*
CO_2 Reduction	☒	To be studied at Aircraft levelTo be studied at Aircraft level	*	*Electrical architecture.*
NO_X Reduction	☒	To be studied at Aircraft levelTo be studied at Aircraft level	*	*Electrical architecture.*
Noise Reduction	☐	To be studied at Aircraft levelTo be studied at Aircraft level		
Others - : (Specify Click here to enter text.)	☐	To be studied at Aircraft levelTo be studied at Aircraft level		

*Hecate technologies will act as an enabler to the rest of electric propulsion technologies, so HECATE impact towards environmental KPIs is studied with other CA programs.

SECTION 4 - SUMMARY OF MAIN RESULTS

MAIN RESULTS

HECATE has finalized the top level requirement definition, and it is currently in the design phase of the technology having some of the first PDRs already occurring. The setting and requirement phase defines the means and tools for efficient collaboration between partners and the baseline requirements that will define the electrical architecture and the design of the technology bricks. During this first year, HECATE has achieved the next key milestones:

1. The definition of the top-level requirements.
2. The definition of the electrical distribution architecture,
3. The definition of the requirements for the design of primary distribution, power converters and power management. With a preliminary design review completed for Primary Distribution, and Power Management and Control System.
4. The definition of a validation and verification strategy towards the final validation in a test bench (copper bird) at the end of 2025, with a successful Preliminary Design Review completed for said test bench.
5. An Impact Monitoring process has been defined where certain KPIs and a technology roadmap, towards project objectives and Clean Aviation program aims, is outlined.
6. The definition of interactions with other Clean Aviation programs aiming towards a common platform under the regional pillar.
7. The implementation of tools, mechanisms, and rules for the collaboration of all partners. With both a legal framework defined, and an operational process outlined.

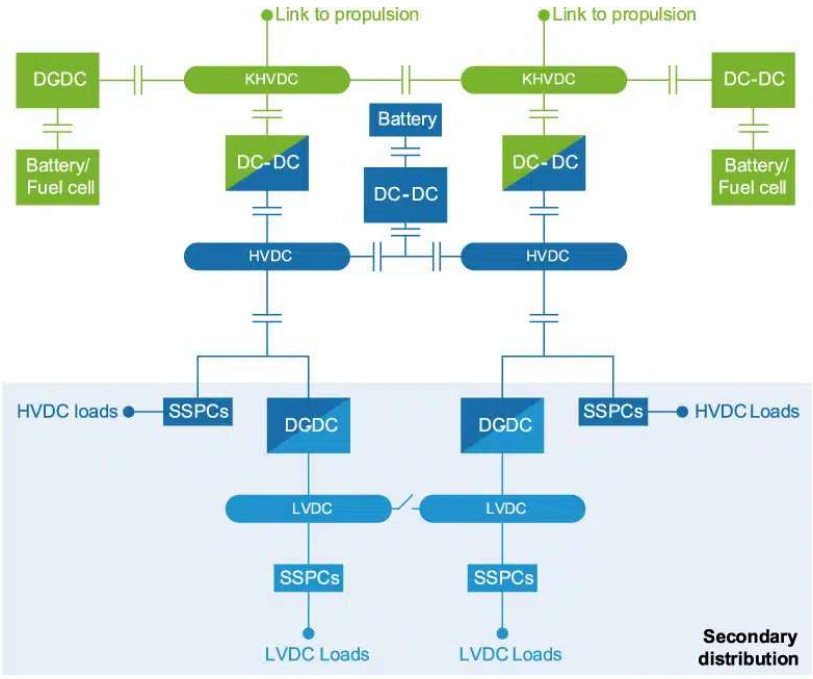

Figure:1: HECATE electrical power system (EPS) architecture

Figure:2: - HECATE KoM

Other public Materials already developed	
Type	**Link**
Videos	HECATE Video: https://www.youtube.com/watch?v=SvzbY27K_0Q
Presentation	https://hecate-project.eu/comkit/
Others	https://hecate-project.eu/