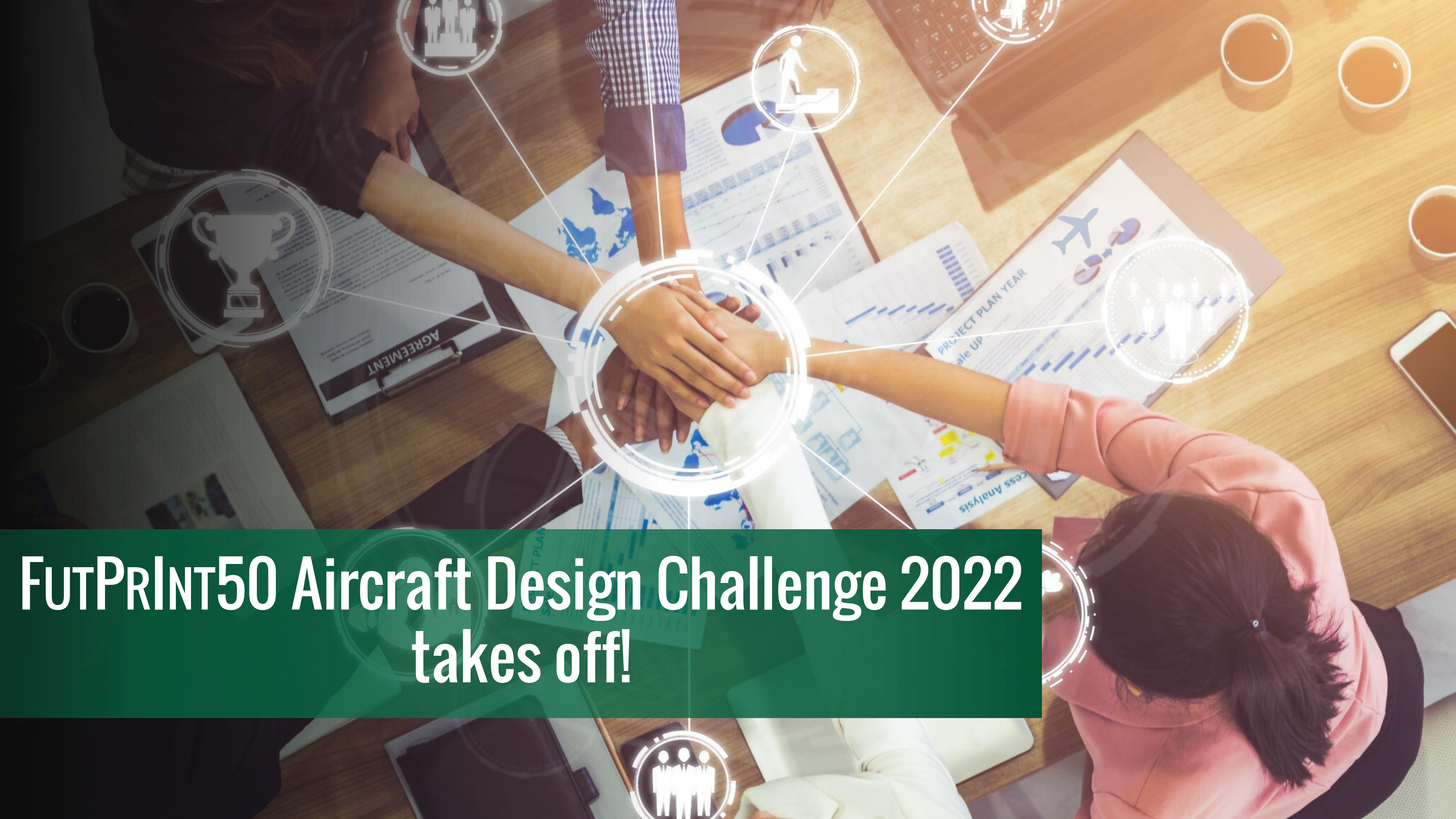
FutPrInt50 Aircraft Design Challenge 2022 takes off!



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Overview

Aviation is a driver of economic prosperity as it connects millions of people and provides a fast way of travelling between different continents. The downside, however, are for example negative environmental aspects. According to various studies, air traffic is currently responsible for around 2% of man-made CO_2 emissions. In addition, the impact of aviation on the environment is not limited to CO_2 but includes other forms of emissions such as NO_x or noise. While emitted greenhouse gases affect the climate and contribute to climate change, noise affects the health and general well-being of residents living near airports. Governments and the aviation sector are making numerous efforts to reduce the negative impacts with the ultimate goal of achieving sustainable air transport.

At the end of 2019, the European Union launched the next step towards a sustainable future - the European Green Deal which aims to ensure that Europe becomes the first "carbon neutral" continent on Earth.

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Similar to Flightpath 2050, the goals of this Green Deal include ambitiously cutting greenhouse gas emissions and enforcing a circular economy. However, these measures were not specific to aviation but were intended to cover all climate-affecting sectors. According to the European Commission's Horizon 2020 vision, an Entry into Service (EIS) for 2035/2040 for a hybrid-electric 50-seat regional aircraft seems challenging but feasible. Powertrain electrification offers many advantages over conventional architectures because electric motors operate with higher efficiencies. In addition, electric motors are almost linearly scalable in terms of power and mass. This could enable the use of novel propulsion concepts such as distributed electric propulsion, as you can see in Figure 1.

Starting with green power, an all-electric aircraft would have no emissions in operation. Currently, the range of such an aircraft is limited due to the low specific energy of today's battery technology. To address this shortcoming, a hybrid-electric concept combines the benefits of both worlds, i.e., the range achieved by conventional fuel and the emission reduction possible by a more efficient electrified powertrain.

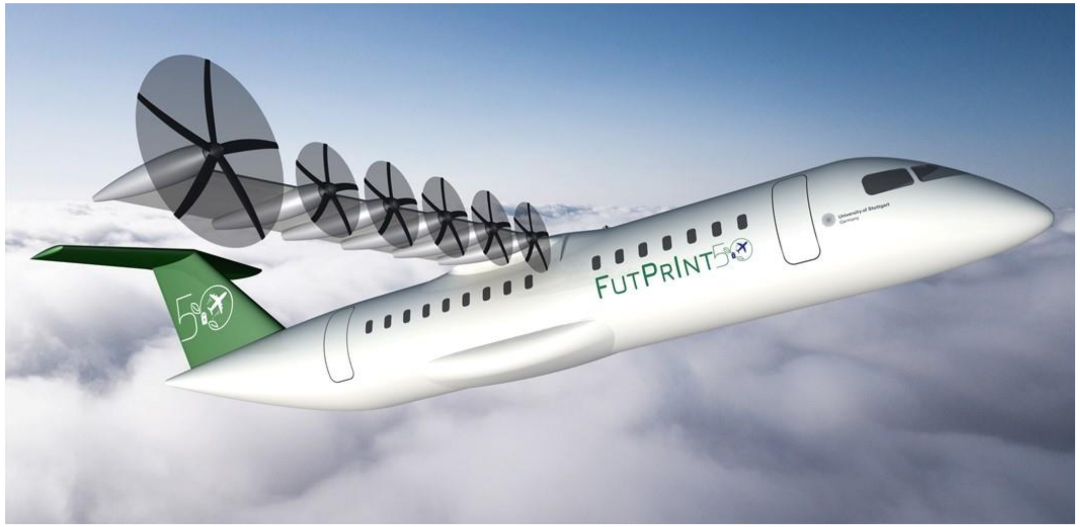

Figure 1: Distributed Propulsion Concept from FUTPRINT50 Project

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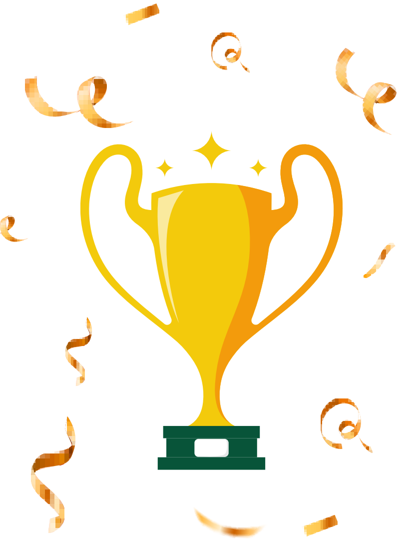
Participation at the challenge

Through your participation in the challenge, you will gain connections to leading researchers, scientific facilities and industry. By presenting your work to key researchers and decision-makers at the EASN Conference 2022 in Barcelona, you will also be able to receive their feedback on the design results you have achieved. This opportunity will enable you to earn optimal entry-level opportunities for your future career in aeronautics. As an introduction to environmentally friendly hybrid-electric aviation, a short course series will be held in which experts from the consortium will give an overview on today's challenges and approaches for future solutions.

The first place prize will include a mentorship by three leading EMBRAER top executives and an open-access journal article whose Article Publishing Charges (APCs) will be covered by FutPrInt50. The mentors and mentees will have the opportunity to raise discussions about their professional development and the future of aviation through dedicated meetings.

Exciting prizes include mentorship by leading EMBRAER top executives & a free open access journal article!



All participants will receive a FutPrInt50 Aircraft Design Challenge 2022 experience certificate.

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Design Challenge Guidelines

In the FUTPRINT50 Design Challenge, students are asked to design a hybrid-electric aircraft according to CS-25 regulations where possible. This extensive task is designed for a group effort for up to five students at maximum. Main task of the design effort is to minimize aircraft emissions to mitigate the environmental impact of flying while aiming at an entry into service in the year 2040 (EIS 2040). A successful aircraft is not solely defined by the performance but by a good balance between market needs or requirements and the actual performance. In this case, you are asked to keep a good balance between energy efficiency, complexity and performance on multiple flight missions.

The following Top-Level Aircraft Requirements (TLAR) have to be met with regard to the market:

TLAR	Value
Number of passengers	50 Passengers
Passenger weight	106 kg per Passenger (incl. luggage) = 5300 kg
Design range	800 km
Design cruise speed	≤ Ma 0.48
Maximum payload	5800 kg
Reserve fuel policy	185 km + 30 min holding
Rate of climb (MTOM, SL, ISA)	≥ 1850 ft/min
Time to climb to FL 170	≤ 13 min
Maximum operating altitude	7620 m (25,000 ft)
Take-off field length	≤ 1000 m
Landing field length	≤ 1000 m
Benchmark for DOCs	Design payload with 400 km mission

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Design Challenge Guidelines

Oftentimes the actual distance flown by the operator is below the maximum capable range with design payload. Therefore, the aircraft direct operating costs (DOC) benchmark is defined as a 400 km mission with design payload. DOCs and the turnaround time shall be optimized for this mission instead of maximum range.

The energy carrier also plays a vital role in this analysis. Airport infrastructure must be adapted to accommodate new types of aircraft concepts. Sustainable Aviation Fuels (SAF) and hydrogen as the primary energy carrier offer promising possibilities for the future. Batteries and (super-)capacitors function as secondary energy sources and allow for additional design freedom. Within the design challenge the primary energy carrier shall be selected based on a qualitative trade-off accounting for operational, ecological and economic aspects before starting your designing efforts. The hybrid-electric architecture can be either serial or parallel, also mixtures between them are possible.

Prime movers and secondary energy source shall be selected supporting the design decisions and trade-offs as well as suiting the foreseen architecture.

Evaluation

A panel of independent reviewers with expertise in the area of the challenge will read and score each entry. The results are divided/distributed in the evaluation as follows:

- Technical report 70 %
- Airline pitch 30 %

- ### Technical Report

The report is limited to 25 pages and is intended to describe the technical implementation, fulfillment of the design requirements (TLARs) as well as the trade-offs leading to design decisions and additional requirements.

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A thorough literature research should be conducted which supports assumptions made during the design process. Dimensions, masses, and key performance parameters of the aircraft should be presented. All tools and methods used to design and analyze the concept should be briefly described. Results shall be validated by using plausibility checks, manual methods, historical data, or other appropriate means.

The feasibility of the final concept, also with regard to the planned EIS, shall be shown by a systematic approach. The following data have to be provided as a minimum for the proposed approach:

- Fact sheet.
- Dimensioned three side view.
- Qualitative reasoning leading to the selection of the primary energy carrier.
- A list of key technologies with corresponding reasoning that they will be available by EIS in 2040.
- A mass breakdown for the following elements:
    - Structural masses of the components
    - Mass of the propulsion unit
    - Payload
    - Energy carrier
    - Operating mass empty (OME), Maximum Zero Fuel Mass (MZFM), Maximum Take-Off Mass (MTOM).
- A table of key performance parameters e.g. take-off and landing distance, rate of climb, cruise speed and altitude, aerodynamic characteristics and propulsion system (e.g. L/D, fuel and/or energy consumption rate, etc.), energy consumption by mission segment, total energy consumption for the mission, etc.

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- ## Presentation

The scenario of the presentation is an airline pitch. You should give an overview on the aircraft design, including performance and benefits of your concept over current aircraft in service. The heart of the presentation will be the business case and why it would be wise for the airline to select your design.

The duration of the presentation is limited to 15 minutes, followed by 10 minutes of questions from the jury.

Assessment of the Design Challenge

The submitted reports will be evaluated by an independent jury based on the following criteria:

- Creativity and innovation.
- Use of scientific literature.
- Method suitability and correctness, quality of design process.
- Readability.
- Reasoning for the airplane configuration and design.
- Comprehensibility of presentation.

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Conditions of Participation

All participants must be full-time master's students at a university, college or university of applied sciences. A group can be up to 5 people. An individual person with his/her supervisor could be registered too, and the FutPrInt50 will assist them to extend their team with other persons who have been registered.

Registration is only possible by a supervisor supporting the students at the local university. You may change or add team members through the registration period as needed. Supervisors may have as many teams as they want, but students may only be on one team.

The final report is also submitted via the supervisor. Participants and supervisor must agree that all submitted documents, illustrations and diagrams may be used for publication on the FutPrInt50 web pages or for other types of public relations, with credit to the copyright holder.

Prior knowledge in aircraft design is strongly recommended, the FutPrInt50 team is not capable of providing substantial support while performing the challenge. As a result, a local supervisor from your institution is mandatory.

The number of participating teams is limited, in case it is exceeded the order of application is considered. The registration through your supervisor is a formless email with the names and email addresses of the participating students.

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Key Dates

- **4 Feb 2022** – Open Call for Participation
- **1 Apr 2022** – Registration Deadline
- **5 Apr 2022** – Kick-Off-Meeting Academy's Official Launch
- **12 Apr 2022** – Launch of Short Course Series 6 courses, 1/week
- **2 Sep 2022** – Technical Report Deadline
- **Oct 2022** – Final Event, 1st Place Winning Team Announcement

Final Event during 12th EASN International Conference for all participating teams & the supervisors for the presentation of their work
Location: hybrid event

For more information and support contact info@futprint50.eu

FUTPRINT50 | www.futprint50.eu

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