

## **EDF-2021-ENERENV-D: Energy efficiency and energy management**

**EDF-2021-ENERENV-D-PES:** Alternative propulsion and energy systems for next generation air combat systems

This call aims at optimising the distribution and management of energy within or between defence systems, e.g. by making use of innovative solutions based on artificial intelligence.

**Proposals are invited against any of the following topics:**

**EDF-2021-ENERENV-D-PES:** Alternative propulsion and energy systems for next generation air combat systems

### **Budget**

The Union is considering a contribution of up to EUR 133 000 000 to support proposals addressing the abovementioned topics and their associated specific challenge, scope, targeted activities and main functional requirements.

**Several actions, addressing different topics, may be funded under this call.**

High value equipment integration in military air platforms contribute drastically to aerial system improvement and innovation. They are key for the European technological sovereignty and strategic autonomy.

Among them sub and supersonic propulsion combined with on-board energy management, within an optimized thrust and power integrated system, will significantly contribute to improve European Air power and to guarantee European aerial superiority.

### **Specific challenge**

The specific challenges of the topic reside in the on-board energy systems coming mainly from the conversion of fuel energy by the engine into propulsion, power, compressed air, etc. With the expected increase of power consumption of new airborne equipment (weapons, detection, communication, etc.), a global management of energy available on board should now be considered, at a system level, optimizing together propulsive and non-propulsive energies of military platforms (from generation to transport, storage and use). The efficiency of energy use could be greatly improved, as well as the ecological footprint of Defence systems.

### **Scope**

To guarantee a full European technological sovereignty of military air platforms, new technology building blocks of next generation of propulsion and energy integrated systems will be evaluated on a dedicated European Propulsion and Energy ground test platform.

Some of these technologies could also be jointly developed and evaluated on the test platform developed within the frame of this project. Depending on the new technology to be developed and evaluated, one or several demonstrators could be used. Such demonstrators could be for instance engines from several types of aerial platforms: from helicopter engines for new materials evaluation, to fighters' engines for new equipment evaluation.

This platform, open to joint technology development activities, would also be an opportunity for Europe to enhance cross border collaboration between large industrial groups, SME and academics.

### **Targeted activities**

The proposals must cover the following activities as referred in article 10.3 of the EDF Regulation, not excluding possible upstream and downstream activities eligible for development actions if deemed useful to reach the objectives:

- Studies, such as feasibility studies to explore the feasibility of new or improved technologies, products, processes, services and solutions.

Studies: For that purpose, a ground test platform, compatible with the evaluation and/or development of at least the following technology building blocks, must be studied and assessed when relevant:

- Advanced fuels (low emission, deoxygenated, etc.).
- Improved energy generation (propulsive and non-propulsive) technologies to meet increasing electrical demand, including power density considerations.
- Improved energy storage technologies (to answer, for example, to the specific needs of airborne directed energy weapons).
- Improved energy distribution technologies, including different network topologies and protection devices (especially for secured communication between local modules and main control system), distributed control system electronics (smart sensors), power electronics (also new semiconductors SiC / GaN) and buffer and interim storage devices (batteries, super capacitors).
- Heat/thermal Management technologies with Integrated Power & Thermal Management (including next generation of heat exchanger).
- Instrumentation (development of the test means necessary for the evaluation of next generation of propulsion and energy integrated systems).
- Improved propulsion component technologies (e.g. bladed rings, nozzle flap, etc.).
- New families of materials technologies compatible with requirements for next generation of engines with improved propulsion and energy management efficiency (high temperature materials, capable of operating temperatures within one of these three ranges: 100-400°C, 400-1000°C, and above 1000 °C).

Some evaluations of technologies (see examples listed above) could be jointly performed through this project to identify the relevant ones for maturity upgrading or to support their manufacturing and application processes.

Those evaluations could lead to the development of one or several propulsion and energy ground demonstrators, depending on the type of technology to be evaluated and related demonstrations executions.

### **Functional requirements**

The proposed solutions should fulfil the following requirements: General

- To enable improving energy efficiency, increasing energy generation (propulsive/non-propulsive) and military air platforms engines performances with complex constraints to reconcile (much higher energy needs/electrical demand of future equipment including armaments and/or sensors, e.g. Laser, DEW<sup>1</sup>, Electronic Attack/Radar systems, etc.) integrated on platforms, future fuels performances and availability (including advanced fuels, etc.).
- To explore from off-the-shelf solutions to alternative power/energy generation capacities or innovations and characterize the potential gains, risks, development and production roadmaps regarding military air platforms engines performances needs and roadmaps.
- To consider improvements of the engine systems, from materials to system architectures through components on different levels (including heat/thermal management, energy generation, distribution and storage).

The demonstration solution should be:

- Compatible with targeted aerial systems technology needs, in order to allow testing which will identify relevant technologies, ranging from off-the-shelf civilian ones (as long as such civil technologies are not submitted to any control and/or export control from non-European third parties), up to exceeding state-of-the-art military ones. The tests will be conducted in a representative environment, involving existing and emerging flight safety, airworthiness constraints and rules when consistent and in the frame of foreseen demonstration ambition.
- Based on a modular architecture enabling an incremental development approach.

The evaluated and/or developed technologies should fulfil the following requirements:

- Provide a gain to be characterized for targeted aerial systems (e.g. improvement of energy performances, ecological and environmental constraints considerations).
- Take into account civilian (pending relevance) and military state-of-the-art to overpass it.
- Be compatible with military environments.
- Be compatible with relevant national, European and global regulations and standards (e.g. REACH<sup>2</sup>).
- Be compatible with sustainable EU manufacturing sectors.

### **Expected impact**

- Facilitate the introduction of new aerial propulsion and energy integrated systems technologies through a reduction of their evaluation time and cost.
- Develop EU autonomous industrial sector and enhance cross boarder collaboration (from large industrial group to SME).
- Contribute to European technological sovereignty and strategic autonomy.
- Contribute to improve European air power and to guarantee European aerial superiority.

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<sup>1</sup> Directed energy weapon

<sup>2</sup> Registration, Evaluation, Authorisation and Restriction of Chemicals is a European Union regulation dating from 18 December 2006