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

EDF-2021-ENERENV-D-EEMC: Energy independent and efficient systems for military camps

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-R-EEMC: Energy independent and efficient systems for military camps;

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.

Despite a constant improvement of their energy efficiency, a growing energy consumption of weapon systems and of their logistic footprint has been observed. This is mainly due to the number of the vehicles, the huge requirements in mobility of force, the on-board electronic system, the soldier connected devices and equipment and more globally, the digitalisation of the battlefield. This increase in energy consumption should be achieved by means of new production such as renewable energies, hybrid powertrains or energy production, batteries and fuel cells. However, these new forms of consumption pose a challenge for their integration in weapon systems, for their technological development and for their logistics operational management. These multiple changes will lead to structural evolution regarding operational energy.

Nowadays, Forces mainly depend on fossil fuels to achieve their mission. This is even truer during operations. However, the question of the security of supply in future years faces two challenges:

- Strategic issues linked to the access to resources;
- The climate emergency context, which requires the implementation of energy transition measures.

Part of the answer will come from the exploration and development of disruptive and new energy sources (synthetic fuels, hybridization, hydrogen, etc.), as well as the study of solutions allowing better management of resources and optimization of needs.

From an operational point of view, an autonomous military camp will integrate a wide energy source approach, with several different technological bricks (fuel cells, batteries, synthetic fuels small refinery, hybrid electric generator, deployable solar panel, etc.). From an industrial point of view, the collaboration between the partner Nations and the implementation of industrial standards would allow the creation of a European market for sustainable energy systems in defence applications and a better interoperability between allies engaged on the same theatre of operation.

The energy transition is an operational asset making it possible to be more efficient, aim at a better autonomy and strengthening the resilience of forces. It could also bring tactical benefits like the reduction of noise, thermal and electromagnetic signature.

Specific challenge

The specific challenges of the topic reside in:

- The need to reduce fossil fuel dependency in military deployable camps (support and mobility) without any drop of operational performances.
- The need to have a sustainable energy defence model with technical as well as operational standards agreed by European Nations (for overseas deployable field camp: energy requirement, different energies and tools needed or authorized to fulfil the mission).
- The need to optimize the involvement of Nations by considering all the studies, works and research carried out or ongoing within the framework of defence.
- The need to study the feasibility of different technologies to answer to the identified needs of the Member States ensuring the interoperability of systems and by taking into consideration opportunities such as autonomy or resilience, but also the constraints such as cybersecurity.
- Particularly the need to study projects involving hydrogen.
- The need to study all the issues of disruptive energies logistics: delivery, storage, distribution involving large quantities (particularly concerning hydrogen logistic).
- The adaptation for military requirements of already existing civilian equipment, as they will be used in specific climatic and operational conditions.
- The development of an operational simulation and planning system.

Scope

The proposal must address:

- Benchmarking of the current industrial existing solutions and identifying the possible needs and constraints for adapting civilian products to the military operational conditions.
- Benchmarking of the past and ongoing defence studies, research, and multinational military working groups' results, which represents a substantial work base.
- Identification of the needs of the European Armies especially in an interoperable context for all types of energies including electrical network.
- Study and implementation of technological solutions in order to allow the forces to reduce fossil fuel dependency in military deployable camps by integrating the logistics and financial aspect, and collateral benefits (for example, hydrogen fuel cells will produce water that could be used by human in extreme condition and in sensitive environments).
- Study of the capacity to produce, transport, store, distribute and use hydrogen or hydrogen based synthetic fuels in military context and to power supply in fields operations.

- Study on risk assessment (vulnerability, detections of such systems, how easy are to be replaced, possible collateral damage in case of destruction).
- Study Artificial Intelligence (AI) for the camp's energy management system that hinder cyberattacks.

This action is a first step and the outputs could be used to set-up in a second stage a full-scale operational demonstrator of a deployable camp fulfilling interoperability between inter-allied armies and NATO, with a modular and easily deployable energy system and adaptable energy mix.

Targeted activities

The proposal 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.

The proposal must pay particular attention to the other R&D and dual-use on-going initiatives at Union level to avoid unnecessary duplication. The project should be as short as possible (typically two years) for allowing soon the building of the full-scaled operational demonstrator.

Studies:

- Feasibility studies including an inventory and a state of the art of the finished or on-going projects and demonstrations of different technologies and emerging technologies in the military sector to reduce dependence on fossil fuels.
- Architecture/topology study of the electrical power network taking into account the needs and the constraints of camps:
  - Camp power grid optimal architecture from economic, environmental and technological point of view.
  - Guarantee resilience, ensuring an adequate level of cyber protection, monitoring and incident management.
  - AI based optimal planning and control of camp power grid, AI based self-organizing power supply solution (i.e. microgrids) formed by mobile energy storages, distributed generators and electric vehicles.
  - Modular approach aimed at managing and monitoring the microgrid, in terms of load balancing, blackout prevention and control, microgrid components fault detection and prediction, and sustainable maintenance strategy.
- Study of a global energy military ecosystem including production, logistic and final uses (for example, in operational condition of a complete hydrogen chain, which includes production or transportation and filling center, containers dedicated to hydrogen logistics and generator of electricity from hydrogen).
- Study of the reliability and security of these systems (hydrogen/synthetic fuels, smart grid, microgrids, self-healing power systems, etc.) in order to validate the feasibility of deploying these types of solutions in operations areas (emergency energy use and auxiliary or primary power unit).

Work on standardization:

- Establishment of European standards and specifications, which could be part of an EU standardization of deployable field camp.

An assessment of the procurement methodology:

- Assessment of the procurement methodology to buy the systems by the MS taking in to account the economic scale effect.

A planning tool:

- Studies for a tool to predict and simulate energy production / consumption for longer period of time and determinate the most efficient solutions (if possible implementing advanced algorithms of machine learning, artificial intelligence, etc.) through the virtualisation of the energy consumption and production.

Training and Documentation:

- The use of new technologies in the context of military application, must also consider how the armed force will adapt to it. This will require a training and documentation well adapted to the specificity of the armed force.

<u>Functional requirements</u>

The proposed work should fulfil the following requirements:

- A study and a proposed energy architecture with lower fossil fuel dependency for a deployable camp, that means an operational military infrastructure (close to the threats), modular and the most autonomous possible in energy.
- An energy-system of a deployed camp should target the use of an energy mix, including a growing share of renewable energy while becoming also an operational military advantage:
    - By increasing the Energy autonomy of the camp:
        - With the use of renewable sources (wind, solar, geothermal, biomass, etc.).
        - If a power station is created, it should be able to be started and stopped by command.
        - By producing and storing its own electricity or sustainable fuel (e.g. Batteries, Hydrogen).
        - By ensuring energy efficiency and adaptability with a (DC or AC current) smart electricity grid and energy management system.
        - By implementing cogeneration of power and heat wherever is possible.
        - Require a minimum of maintenance and simplify the supply chain of spare parts.
        - Use cost-efficient solutions.
    - By increasing the operational capacity of the camp:
        - Reducing the noise and detection/signature compared to the usual electricity generating units.

- Reducing the local pollution due to usual thermal engines by taking into consideration environmental and safety rules.
- Reducing the logistical convoys in fossil fuels.
- Be protected against military risks such as gunshots, blast, shrapnel and the risk of fire and lightning strike.
- Be protected against natural emergencies phenomenon, such as biological, meteorological and geological.
- Keep the possibility to use fossil fuel if needed with conventional diesel generators.
- Be interoperable between allied armies and NATO offering possibility of energy-system data exchanges.
- The technical bricks, systems and sub-systems should be interchangeable either if they come from the same or different suppliers.
- The study should identify a basic energy-system module, in term of power supply, for every deployed camp macro-function (Combat Service, Combat Service Support, HQ, lodging, etc.).

- By easily and rapidly transportable (even air-transportable) and deployable solutions:
  - Without involving a lot of labour force.
  - In different geographic and climatic regions from Artic to Tropical regions.
  - In different conflict situations.
  - Under natural disaster conditions.
  - Housed in container of 20 ISO feet.
  - Easily deployable and removable.

In order to achieve these requirements, the study should include:

- Inventories and identification (benchmark) of the needs of the European Member States taking into account:
  - The different existing concepts of deployment for overseas operations.
  - The energy needs according different hypothesis of engagement.
  - The different technologies, civilian and military, which are developed nowadays to respond to the need of energy self–sufficiency uninterrupted and that could be used for the military forces (including the vital and non-vital systems for the camp).

- Regarding Energy storage, Hydrogen/hydrogen based synthetic fuels are a promising solution. However, in contrast of batteries the possibility and the utility of Hydrogen use (production, transport and logistic, storage and use) in the military context and field operations still need to be confirmed. Proposals should tackle this uncertainty by studying the feasibility of deploying this type of solutions in operational areas particularly in terms of transportation and storage, specifying the hydrogen phases that can be used (such as compressed gas or liquid).
- Define an architecture of a modular, lower fossil fuel dependency energy system for a deployable camp. Digital twins, machine learning, and AI could help to define the most efficient architecture and assembled technologies.
- Propose tests and validations methods of the possible technology bricks and their integration in a sub-system or system, according to the military requirement.

- All implemented systems will have to comply with cyber-defence and cyber-security requirements.

Expected impacts

- Develop cooperation between private enterprises including SME, research institutes and universities in the area of operational energy for defence.
- Adapt civilian sustainable energy technology to military requirements and develop European standards.
- Improve armed forces autonomy, resilience, interoperability and capabilities in operations regarding the growing needs of energy.
- Decrease the total costs of ownership of deployed capacities.
- Enhance the competitiveness and innovation capacity of the EU defence industry in the area of new energies.
- Complete the global European strategy for renewable and sustainable energy, hence tackling the climate change.