Needs Description

Introduction

The Armed Forces have a complex and increasing need for energy in field operations, with many different devices having their own power supply solutions. The Norwegian Defence Research Establishment (FFI) would like to encourage the market to propose and demonstrate a minimum viable product (MVP) that reduces the need to manage many different power supply solutions. In addition to functionality, important aspects are security, robustness, and environmental requirements. FFI and the Armed Forces emphasise these in all their procurements.

The initiator of this competition is ICE worx, which is FFI's centre for innovation, concepts, and experimentation. ICE worx' task is to contribute to effective development work in and for the Armed Forces.

Which problem do we wish to solve?

Various systems and equipment in the Armed Forces typically use their own power supply solutions. These may involve different batteries, chargers, cables, plugs, and power adapters. This is a challenge because the Armed Forces has to bring a great deal of different accessories to supply their field equipment with power. This means that the equipment takes up more space and weight. Moreover, it wears out and needs to be managed etc.

Another challenge stems from the Armed Forces' need to use several different systems and equipment. These often communicate poorly with each other. Thus, it may not be possible to achieve a complete overview of total energy data, such as energy consumption and available capacity. Furthermore, the various equipment can be hard to control remotely, and the different equipment can be difficult to monitor efficiently in a single system.

A third challenge is related to the environment and sustainability, specifically that without flexible coordination, there is a certain risk of operating systems less efficiently. Bringing more equipment is also environmentally disadvantageous in terms of logistics, as the physical footprint is larger.

What are we looking for?

The overall goal of this competition is to produce a functioning prototype of a unit that can solve the challenges mentioned above. Such a prototype can help demonstrate whether the Armed Forces can achieve:

- a flexible energy system in the field that can connect various components
- an efficient energy system with low energy loss and long operational lifetime
- a streamlined setup that reduces the number of components in use and need of management
- a remote-controlled system that contributes to control, operational optimisation, and increased performance

If the unit proves to be promising, there could also be opportunities for further collaboration on product development and resources to develop a final product. We believe there should be a marked potential for a product like this, both domestically and abroad.

What are we envisioning?

Initially, we need a unit that can handle small to medium-sized equipment powered by direct current (DC) at various voltage levels from 0 to 50 V. With a DC interface, we believe that it should be possible to design a unit that allows different equipment to be powered by a single type of energy supply.

The unit should be able to receive energy from different power sources used in the field, such as batteries or battery packs, AC connection, generator (AC/DC), solar cells, wind power, etc. By connecting different equipment to the same power supply, the Armed Forces can reduce the number of components in the setup. Moreover, it would be an advantage if the proposed solution is capable of charging batteries that are commonly used in the Armed Forces (e.g., BB2590/U), or preferably a selection of batteries. However, solutions that do not charge batteries will be considered. We also want to be able to record the unit's battery capacity and use this data for energy management and optimisation.

Furthermore, we want the unit to have a data interface for remote operation and a strategy or use concept for this interface. We want to be able to remotely control and program the outputs, for example by allowing certain outputs to be used to prioritise loads and by enabling some outputs to activate other outputs, etc. Moreover, the system should be able to measure and send data such as battery status, energy consumption, and temperature to the data interface. The system should ideally communicate with a selection of batteries if this does not result in unreasonable disadvantages in terms of size, weight, or power consumption.

Performance, features, and key data we consider relevant for the solution:

- The unit's communication protocol and interface for remote control and monitoring have not been decided, and we are open to suggestions. However, the solution should be designed to ensure information security in a military context.
- A communication protocol for batteries and energy systems has not been decided, and we are open to suggestions. Typically, SMBus, SBData, and CAN bus would match the interface of widely used equipment.
- The inputs should have a voltage range from 5 to 50 V DC in addition to AC connection via an appropriate connector (e.g., Schuko). The unit should have inputs that can receive energy from various energy systems and producers, such as USB-C (Power Delivery (PD) / Programmable Power Supply (PPS)). The physical interfaces of the inputs should be suitable for military purposes.

- The outputs should deliver direct current (DC). It should be possible to regulate the voltage of the outputs, and they should be able to supply loads from 3 to 50 V. The physical interfaces of the outputs should be suitable for military purposes.
- The unit should measure power consumption and other relevant electrical quantities, as well as temperature. The unit should be able to charge batteries.
- The unit must be touchproof.
- The unit should be as energy efficient as possible.
- The unit should be portable and as small and lightweight as possible.
- The unit should have flexible connection interfaces so that it can be used with a wide range of products from different manufacturers.

FFI is initially interested in a solution with multiple inputs and outputs that can handle power input and output between 50 W and 300 W. However, we would also be interested in a proposed solution that can be scaled up or down to meet other needs. The number of inputs has not been decided, but the unit must be compatible with expected of battery systems and small energy producers such as solar cells, small wind turbines, fuel cells, generators, etc. The number of outputs has likewise not been decided, but for a prototype, 5–10 outputs will be sufficient to test the concept.

Conceptual sketch that visualises how we think the solution might work:

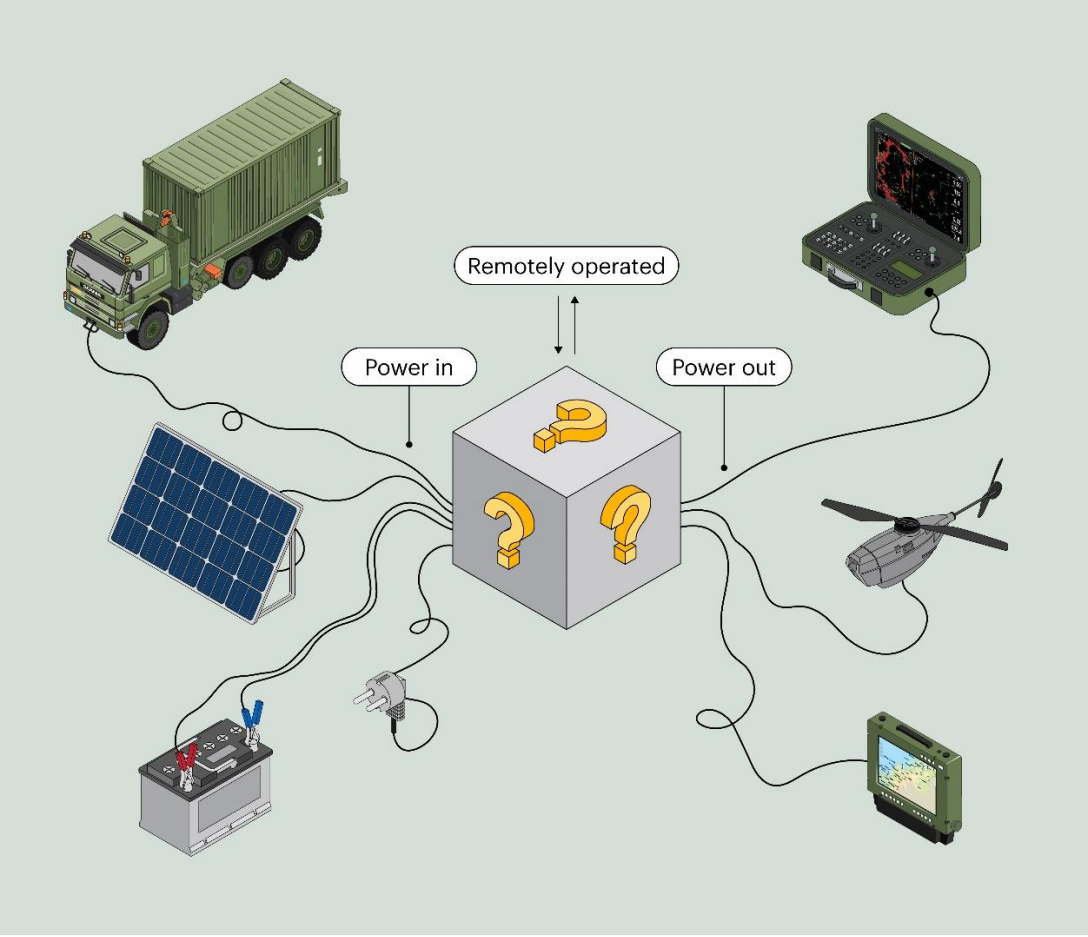

Figure: Conceptual sketch for a solution that can handle various energy sources coming in and distribute the energy to equipment with different power requirements and with different connectors. If the solution can receive and send data as well, it would be possible to remotely control the solution and receive information about the status and condition of the unit and connected equipment.

The needs matrix

The needs matrix is a summary and concretisation of the description above. The solutions that best meet the most needs listed below will be invited to continue in the competition.

No.	Category	Description of need	Preformance/function
N01	Connection/Inputs	The solution should be able to connect to various energy systems, power producers, voltages, and interfaces.	• Touchproof and flexible solutions for connection to DC and AC • Adjustable DC inputs with voltage levels from 5 to 50 V, or higher as long as the unit remains touchproof
N02	Supply/Outputs	The solution should be able to supply a range of equipment with different voltages and outputs.	• Touchproof DC outputs • Voltage from 3 to 50 V, or higher as long as the unit remains touchproof • At least 5 outputs
N03	Battery Charging	The solution should be able to charge batteries.	• The unit should be able to charge military batteries such as BB2590/U and others. • The unit should preferably be able to charge Li-Ion, lead-acid, NiMh batteries, etc. • Charging function should not significantly impair other features.
N04	Data Exchange	The solution should have an interface that allows remote control of functionality and access to status and condition information from a distance.	The solution should have a data interface for remote control of functions and monitoring of relevant status and energy data. The unit is meant to be connected to a system for sending and receiving data.
N05	Signature	Low thermal signature, low acoustic noise, weak electromagnetic and electrical fields, etc.	The lowest possible signature is positively emphasised.
N06	Sustainability	The solution should be ecologically sustainable in terms of material use, reuse, and climate emissions.	The final solution must meet the climate and environmental requirements of public procurement.
N07	Efficiency	The equipment should have low energy loss and high efficiency.	The equipment should have low energy loss in order to optimise operational lifetime and energy consumption.
N08	Climate and external impact	Suitable for military use in the field, in different climate zones, especially in Arctic regions.	• The final solution should withstand strong mechanical, climatic, and atmospheric loads and stress. • The final solution should be easily operable in the field and under various weather and light conditions, especially in the Arctic, as well as in tropical zones and deserts.
N09	Safety and security	The unit must be designed to ensure: • personnel safety during intended use • data and information security	• Safety covers, for example, touch proof, safe design (enclosure rating, no sharp edges, etc.), no harmful electrical fields, etc. • The final solution must comply with the Norwegian Defence' demands for information security